City of Canton, Ohio

Purchasing Department
218 Cleveland Ave. SW, 4th floor
Canton, Ohio 44702

Sludge Processing Modifications, Contract 27

Item/Project

Water Reclamation Facility

Responsible Department

Thursday, June 28, 2018 at 2:00 PM local time

Bids Due On or Before

Bid Proposal Submitted By:

Company Name

Street Address

City **State** **Zip**

Contact Person **Phone No.** **Email Address**

LEGAL NOTICE:
Ordinances 69/2017 and 3/2018
The City of Canton, Ohio Director of Public Service will accept sealed bids on or before 2:00 PM local time on **Thursday, June 28, 2018** for the purpose of securing bids for the:

Sludge Processing Modifications, Contract 27

The City will disqualify any bid not received on or before 2:00 PM local time on Thursday, June 28, 2018. Shortly after the deadline for the submission of bids, bids received on time will be publically opened and read aloud. The 6th Conference Room of Canton City Hall located at 218 Cleveland Ave. SW, Canton, OH 44702 is the location for the Bid Opening.

Submit all bids to the City of Canton Purchasing Department, 218 Cleveland Avenue SW, Fourth Floor, Canton, Ohio 44702 according to the specifications and bid documents at the City of Canton Purchasing Department's website at https://cantonohio.gov/purchasing.

Each bid must contain the full name of every person or company participating in the bid.

A certified check, cashier's check or surety bond, in accordance with Section 153.54 of the Ohio Revised Code, must accompany the bid. This check or bond must be made payable to the City of Canton. Draw this check or bond from a solvent bank or bonding company satisfactory to the Director of Public Service as a guarantee the contract and its performance are properly secured if the bid is accepted. Said certified check or cashier's check shall be for ten percent (10%) of the total amount bid. Where a bid bond is used, it shall be in an amount of one hundred percent (100%) of the total amount of the bid. The City of Canton will only accept original checks and bid bonds. Therefore if any company and/or bidder submits a copy of its security, the City will disqualify the bid. Bidders submitting a certified or cashier's check will be required to provide a surety bond in the amount of one hundred percent (100%) of the contract sum for faithful performance. The Director of Public Service reserves the right to waive any technical defects in any bid bond submitted so long as the bond is in substantial compliance with state law. Should any bid not be awarded or be rejected, such check or bond will be returned to the bidder or bidders after the execution of the contract.

Any bidder may withdraw his bid, by written request, at any time prior to the hour set for the bid opening by following the instructions in the Invitation to Bid.

The Board of Control reserves the right to reject any or all bids and to accept the bid(s) deemed most beneficial to the City of Canton.

The successful bidder must comply with all State of Ohio Prevailing Wage Rates.

All companies must submit their Federal ID Number.

A Project Labor Agreement (PLA) is required for this project.

The estimated construction cost is **$5,592,000.00** for this project.

The bidder is responsible for monitoring the City's website for any official addenda.

Please contact Director of Public Service Andrew Roth at andrew.roth@cantonohio.gov if you have any questions regarding this bid.

By order of the Canton Director of Public Service: John M. Highman, Jr.
Published in the Repository: June 6, 2018 and June 13, 2018

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Section I: Instructions to Bidders

A. Submitting Bids

1. Bids are to be returned to:
   The City of Canton Purchasing Department
   218 Cleveland Avenue SW, 4th floor
   Canton, OH 44702

2. Bids should be enclosed in an opaque sealed envelope, box, or other suitable container, marked with the following:
   a. Project title.
   b. Office where bid is to be submitted.
   c. The name and address of the bidder.
   d. The date and time of the bid opening.

3. The following items should be submitted with a bid in order for it to be considered. **Failure to submit one of these items may result in a disqualification of the bid.**

   City of Canton Requirements
   a. Bid Title Page
   b. Signature Page
   c. Proposal Pages
   d. Bid Form 1 – Minority Business Enterprise Utilization Commitment
   e. Bid Form 2 – Bidder and Contractor Employment Practices Report
   f. Bid Form 3 – Authority of Signatory
   g. Bid Form 4 – Bid Guarantee
   h. Bid Form 5 – Bidder Information
   i. Bid Form 6 – Project References
   j. Bid Form 7 – Non-Collusion Affidavit
   k. Bid Form 8 – Questionnaire in Determining Lowest and Best Bid
   l. Bid Form 9 – Insurance Affidavit and Certificates
   m. Project Labor Agreement Letter of Assent

4. Bids will not be accepted after 2:00 PM on **Thursday, June 28, 2018**. The party submitting a bid is solely responsible for the delivery of the bid to the specified location prior to the deadline for the receipt of bids. The Purchasing Department time stamp clock is the official time used for the deadline of the submission of bids.

5. Bidders may withdraw their bids between the time they are submitted and opened if so desired. This must be done via written request submitted to the City of Canton Purchasing Department.

6. The bids shall be opened and publicly read shortly after the deadline for their submission.

C. Pre-Bid Meeting

1. A Pre-Bid Meeting will be held on **Tuesday, June 12, 2018 at 10:00am** at the Canton Water Reclamation Facility located at 3530 Central Ave. SE, Canton, OH 44707.

D. Questions and Addenda

1. All questions should be submitted in writing at least five (5) business days prior to the bid opening. This is **Thursday, June 21, 2018 at 2:00 PM.** Answers to questions will be issued in writing as official addenda no later than seventy two (72) business hours prior to the time of the bid opening. **This is Monday, June 25, 2018 at 2:00 PM.** Said addenda will become a component of the official bid packet and must be acknowledged as received on the signature page. Failure to acknowledge all official addenda in this manner may result in your bid being disqualified.

2. Bidders are expected to and are responsible for monitoring the City's website for all official addenda.

3. Oral instructions or decisions, unless confirmed by addenda, will not be considered valid, legal or binding.

4. All questions pertaining to the project should be directed to:
   Andrew Roth, Director of Public Service
   Email: andrew.roth@cantonohio.gov

E. Bid Proposal Form and Proposal Page

1. The proposal page is the only form upon which the proposed bid price can be offered. Bidder's quote sheets, letters, or other materials cannot be used in lieu of the proposal page. When descriptive literature is included with the bid submittal, they shall be considered only for informational purposes. Payment, warranty and other terms that may appear on such forms that vary from the terms of the contract documents shall be considered null and void.

F. Contract Award

1. The City of Canton Board of Control will evaluate the bids and award the contract on the basis of the lowest and best bid. The Board of Control reserves the right to reject any and all bids and to award the bid deemed in the best interests of the City. The Board of Control and Director of Public Service reserve the right to waive minor deficiencies contained within a bid.

2. One or more bidders may be required to submit information to the Owner or its representative to assist in the evaluation of the bid. A bidder may also be required to participate in an interview during which, among other things, the bidder would be requested to make a presentation regarding its organization, resources and its preliminary plan to perform the construction (schedule, means and methods, etc.).

G. Notice of Award and Execution of Contract Documents

1. The successful bidder will be notified in writing once the contract is awarded by the Board of Control.

2. At this time the contractor will be required to sign official contract documents and submit any remaining bid forms.

3. Once the completed contract is certified by the City of Canton Auditor, a copy of the contract, Purchase Order, and Notice to Proceed will be mailed to the contractor.

H. Pre-Construction Meeting

1. A pre-construction meeting will be held prior to the start of this project. This meeting will include the Contractor and the Owner's representative. The condition of the project limits shall be recorded and the contractor shall be responsible for the correction and/or repair of any additional damage to the facilities resulting from the related work and in addition to the conditions noted at the pre-construction meeting.

I. Notice to Proceed and Job Completion

1. The Contractor shall not start the work embraced in this contract before the date of a written Notice to Proceed from the City. The Contractor is required to start work within 10 days after receiving the Notice to Proceed. Work shall be completed as per applicable sections in the General Conditions.

2. If the work done under this contract conflicts with other work done for or by the City, or with its consent, the City shall determine the time and manner of the procedure of the operations carried on under this contract.

3. The Contractor is responsible for any additional costs due to weather-sensitive construction.

4. The permitting of the Contractor to complete the work or any part thereof, after the time fixed for its completion shall in no way operate as a waiver on the part of the City of any of its rights under this contract.

J. Document Order of Precedence

1. In the event of an internal conflict within the bid/contract documents the following will be the order of precedence.
   a. Change Order Documents
   b. Signed Contract Documents
   c. Official Addenda
   d. Invitation to Bid Signature and Proposal Pages
   e. Instructions to Bidders
   f. Project Drawings
   f. Project Manual and Technical Specifications
   g. General Conditions
   h. ODOT Construction and Manual Specifications
   i. Bid Forms
   j. Bid Form Instructions
   k. Additional Requirements and/or Conditions
   l. Legal Notice
   m. Bid Advertisement

K. Non-Exclusivity

1. The City reserves the right to contract for the same or similar services, or perform the same or similar work with City employees during the course of this contract, if found to be in the best interest of the City.

L. City of Canton Income Tax

1. All successful bidders shall be required to comply with all City of Canton income tax ordinances including the following:

   a. No person, partnership, corporation or unincorporated association may be awarded a contract with the City under Sections 105.09 or 105.10, unless the vendor is paid in full or is current and not otherwise delinquent in the payment of City income taxes, including any obligation to pay taxes withheld from employees under Section 182.05 and any payment on net profits under Section 182.06.

   b. Falsification of any information related to or any post-contractual violation of the requirement to pay City income taxes set forth in subsection (a) shall constitute cause for the rescission of the balance of the contract at the City's discretion.

   c. No partnership, corporation or unincorporated association which has as one of its partners, shareholders or owners a person who is a twenty percent (20%) or greater equity owner in such partnership, corporation or unincorporated association and who is delinquent in the payment of City

income taxes as set forth in subsection (a), may be awarded a contract with the City under Sections 105.09 or 105.10.

d. A person who is a twenty percent (20%) or greater equity owner in any partnership, corporation or unincorporated association which is delinquent in the payment of City income taxes as set forth in subsection (a) may not be awarded a contract with the City under Sections 105.09 or 105.10.

e. By entering into contract with the City of Canton the vendor agrees with the City regarding the manner of withholding of City income taxes as provided in Section 718.011(F) of the Ohio Revised Code including the following:

i. Municipal income tax withholding provisions of Sections 718.011(B)(1) and 718.011(D) ORC shall not apply to qualifying wages paid to employees for work done or services performed or rendered inside the City or on City property.

ii. The vendor agrees to withhold income tax for the City from employees' qualifying wages earned inside the City or on City property, beginning with the first day of work done or services performed or rendered inside the City.

2. The successful bidder will be registered with the City of Canton Income Tax Department to ensure that the above qualifications are met. Bidders are encouraged to contact the City of Canton Income Tax Department prior to bidding with any questions regarding these provisions and for registration. Please use the contact information below.

City of Canton Income Tax Department

Office Address	**Correspondence Address**
424 Market Ave. N	P.O. Box 9940
Canton OH 44702	Canton, OH 44711

Phone: (330) 430-7900
Fax: (330) 430-7944
Email: cantontax@cantonohio.gov

2. Additionally, all public improvement, professional services, and services contracts shall also contain the following provisions:

Provision 1

Said _____ hereby further agrees to withhold all City income taxes due or payable under Chapter 182 of the Codified Ordinances for wages, salaries, fees and commissions paid to its employees and further agrees that any of its subcontractors shall be required to agree to withhold any such City income taxes due for services performed under this

contract. Furthermore, any person, firm or agency that has a contract or agreement with the City shall be subject to City income tax whether a resident or nonresident in the City, and whether the work being done is in the City or out of the City. In addition to the tax withheld for employees, the net profits on the contract shall be subject to City income tax.

Provision 2

By entering into contract with the City of Canton _____ agrees with the City regarding the manner of withholding of City income taxes as provided in Section 718.011(F) of the Ohio Revised Code.

1. Municipal income tax withholding provisions of Sections 718.011(B)(1) and 718.011(D) ORC shall not apply to qualifying wages paid to employees for work done or services performed or rendered inside the City or on City property.
2. _____ agrees to withhold income tax for the City from employees' qualifying wages earned inside the City or on City property, beginning with the first day of work done or services performed or rendered inside the City.

SECTION II: GENERAL CONDITIONS

(The headings of the various sections are intended for convenience in reference and not to be considered a part of the specifications.)

(1) **Definitions:** The term "City" wherever used in these specifications shall mean the City of Canton, acting through its Director of Public Service, or his properly authorized agents, such agents acting severally within the scope of the particular duties entrusted to them.

The term "Director" wherever used shall mean the Director of Public Service of the City of Canton, duly appointed and holding office at the same time the contract was executed or during the fulfillment thereof.

The term "Engineer" whenever used, shall mean the City Engineer of said City or his properly authorized agents to the extent of the powers invested in them.

The term "Contractor" wherever used, shall mean the party of the second part entering into contract with the City for the performance of the work herein specified, or his properly authorized agents.

In all cases when the term "days" as used in these specifications shall be held to mean calendar days, unless otherwise noted.

The term "Work" wherever used, shall mean the furnishing of all labor, tools, machinery and the furnishing of all materials, except as herein otherwise specified, necessary to performing and completing of all the work herein specified. The methods and appliances used therefor must be such as will produce a satisfactory quality of work and ensure safety to the workmen, the public and to property.

Wherever, in the specifications, or upon the drawings and plans, the words directed, required, permitted, ordered, designated, prescribed, or words of like import are used, it shall be understood that the direction, requirement, permission, order, designation or prescription of the City is understood, and similarly, the words approved, acceptable, satisfactory to, refer to the City unless otherwise expressly so stated.

(2) **Decisions:** All the work under this contract shall be done to the satisfaction of the City, which in all cases shall determine the amount, quality, acceptability, and fitness of the several kinds of work and materials which are to be paid for hereunder, and shall decide all questions which may arise as to the fulfillment of this contract on the part of the Contractor, and the City's determination and decision thereon shall be final and conclusive; and the City's determination and decision in case of any question that may arise, shall be a condition precedent to the right of the Contractor to receive any money hereunder.

(3) **Orders to the Contractor and Failure to Execute:** The address given in the bid or proposal upon which this contract is founded is hereby designated as the place where all notices, letters and other communications to the Contractor shall be mailed or delivered. Such address may be changed at any time by a written notice from the Contractor and delivered to the City.

The Contractor must have on the work at all times, a foreman, superintendent or other competent representative, to whom orders and instructions may be given. Such orders and instructions shall have the same force and effect as if given directly to the Contractor.

Whenever instructions or orders which in the opinion of the Engineer require prompt or immediate attention, are neglected or ignored by the Contractor or his Superintendent, the Engineer shall have the power to place necessary men, machinery and materials on the work and charge the entire cost, including overhead expenses, to the Contractor, who shall either pay the entire cost and expenses into the City Treasury, or the amount thereof shall be deducted from money due the Contractor under the contract.

(4) **Subletting or assigning contract:** The Contractor shall give his personal attention to the faithful prosecution of the work, shall retain the same under his personal control and shall not assign by power of attorney or otherwise, nor sublet the work or any part thereof, without the previous written consent of the City, and shall not, either legally or equitably assign any of the money payable under this agreement, or his claim hereto except by and with the consent of the City.

Assigning or subletting of the whole or any portion of this contract shall not operate to release the Contractor or his bondsmen or surety hereunder from the contract obligations.

(5) **Subsidiary Contracts:** The Engineer may, when in his opinion, it becomes necessary, make alterations or modifications of the plans and specifications, or order additional materials and work, subject to the approval of the Director; and the Contractor shall be obliged to accept such alterations, modifications and additional work and materials not included in this contract. The price to be paid for the work under such altered or modified contract shall be agreed upon in writing, in a subsidiary contract for such portion of, or additional improvement and signed by the Director and Contractor, before such work is done; such additional work, alteration or modification shall be considered and treated as though originally contracted for and shall be subject to all the terms, conditions and provisions of the original contract, except that a material increase in the amount of work will be considered as a proper claim by the Contractor for an extension of the contract time for completion, by an amount to be determined by the City.

And it is expressly agreed and understood that such alterations, additions or modifications or omissions shall not, in any way, violate, or annul the original contract and the Contractor hereby agrees not to claim or bring suit for any damages, whether for loss of profits or otherwise, on account of such alterations, additions, modifications or omissions.

(6) **Permits:** The Contractor shall obtain and pay for all construction permits and licenses. City shall assist Contractor, when necessary, in obtaining such permits and licenses. Contractor shall pay all governmental charges and inspection fees necessary for the prosecution of the Work which are applicable at the time of opening of Bids, or, if there are no Bids, on the Effective Date of the Agreement. Contractor shall pay all charges by utility owners for connections for providing permanent service to the Work.

(7) **Inspection:** No material of any kind shall be used in the work until it has been inspected

and accepted by the City. The Contractor must furnish all labor necessary in handling such material for inspection. All materials rejected must be immediately removed from the vicinity of the work. Materials or workmanship found at any time to be defective shall be immediately remedied by the Contractor, regardless of previous inspection.

The Engineer, his assistants, inspectors and agents, together with other parties who may enter into contracts with the City for doing work within the territory covered by this contract, shall, for all purposes which may be required by their contracts, have access to the work and the premises used by the Contractor, and the Contractor shall provide safe and proper facilities therefor.

The Engineer, his assistants and agents shall at all times have immediate access to all places of manufacture where materials are being made for use under this contract, and shall have full facilities for inspecting the same.

No work shall be done except in the presence of the Engineer, his assistants, agents or inspectors. It shall be the duty of such agents or inspectors to see that all materials used and all work done shall be strictly in accordance with these specifications, but such agents and inspectors shall have no authority whatsoever to order any change in materials, manner of doing the work or quantity of work done.

The field inspection of the work, testing of materials, giving lines and grades, preparation of general and detail drawings, except as otherwise specified, will be done by the Engineer. The inspection and supervision by the Engineer is intended to aid the Contractor in supplying all materials and in doing all work in accordance with the drawings and specifications, but such inspection shall not operate to release him from any of his contract obligations.

(8) **Time for doing work:** The City is instructing the Contractor to base the project schedule upon a 5-day workweek, Monday through Friday from 8:00 am to 4:30 pm except on City recognized holidays; this is the "standard schedule". The Engineer may direct the Contractor to work outside of the standard schedule to save life or property or in case of emergencies. The City is open to alternative hours based upon written approval by the Engineer. The City is giving notice to the Contractor that there is deviation from this note in the plans. The deviation instructs the contractor to work weekends at specific designated intersections. The "standard schedule" does not relieve the contractor of these plan obligations. If the Contractor wishes to work outside of the standard schedule, in addition to times noted in the plans, the Contractor must submit this request in writing to the Engineer. The Engineer will review nonstandard scheduling and approve/deny the request. The Engineer will base his approval/denial upon benefit to the project, benefit to the City, and necessity to facilitate Contractor operations. Contractor must make special provisions for project inspection for nonstandard schedules and will be required to pay for all costs associated with inspection for approved nonstandard schedules. This includes both City personnel as well as consultants representing the City. However, the City does not require the Contractor to pay inspection overtime when the City orders the overtime. The Engineer shall determine method of payment when the need arises. (See also Section 44).

(9) **Working Season:** Work done under these specifications, such as grading of streets and placing foundation for paving, curb setting, brick or other roadway paving, sidewalk laying, shall

cease from the first day of December until the first day of April of the following year, unless otherwise directed by the Engineer. (See also Section 44). Paving shall be suspended from October 1 to April 30 unless otherwise directed the Engineer.

(10) **Lines and grades:** All work done under this contract shall be done in accordance with the lines, grades and instructions as given by the City and as directed in the plans.

(11) **Order of procedure of work:** The Contractor shall proceed with the work at such points as the Engineer may direct, and not more than two adjoining blocks or squares in length, shall be torn up at the same time, unless otherwise directed by the Engineer; nor shall any block be closed to traffic, except where the Contractor is actually working.

Whenever, in the opinion of the City, it is necessary that certain portions of the work be done immediately, the Contractor upon written order from the Engineer, shall proceed with such work without delay. Should he fail to so proceed, the City may do, or cause to be done, such work, and the cost of the same will be deducted from any money due, or to become due the Contractor under this contract.

(12) **Incompetent workmen:** Any employee of or persons connected with the Contractor who shall use profane or abusive language to the inspector, or other employees of the City, or otherwise interfere with them in the performance of their duties, or who shall disobey or evade the instructions of such employees of the City, or who is careless or incompetent, or who is objectionable to the City authorities, shall be discharged at the request of the Engineer, and shall not again be employed, except with his consent. Skilled labor only shall be used in the cases where the same is required.

(13) **Suspending the work:** The City, on account of public necessity, adverse weather conditions, or for other reasons, may order any portion or all work suspended, and thereupon the Contractor shall neatly pile up all materials, provide and maintain board walks and crossings, and take other means to properly protect the public and the work and to facilitate traffic. In case of such suspension of work, the time allowed for the completion of the work shall be extended in an amount equal to that lost by the Contractor, but the Contractor shall be entitled to no additional claim for damages therefor.

(14) **Forfeiture of contract:** Should the work to be done under this contract be abandoned by the Contractor, or if this contract or any part thereof be assigned or the work sublet by him without the previous written consent of the City or if at any time any official of the City or employee thereof become directly or indirectly interested in this contract or in furnishing the supplies or performing the work hereunder, or in any portion thereof; or if at any time the City may be of the opinion that the performance of the contract is unnecessarily or unreasonably delayed, or that the Contractor is willfully violating any of the provisions of this contract; or if the work be not fully completed within the time named in the contract; then and in any such case the City may notify the Contractor in writing to discontinue all work or any part hereof as may be designated, and the City may thereupon, according to law, enter upon and take possession of the work or part thereof, complete, or cause the same to be completed, and charge the entire expense of so completing the work or part thereof to the Contractor; and for such completion, the City itself or for its Contractors, may take possession of and use or cause to be used any

materials, machinery, or tools of every description provided by the Contractor for the purpose of this work, and may procure or cause to be procured other materials, machinery, or tools required for the completion of the work.

All cost and expenses, including those of re-letting, (and damages resulting from the non-completion of the work within the specified time) incurred under these clauses, or by virtue of this contract, shall be deducted and paid by the City out of any monies then due or to become due the Contractor under and by virtue of this contract or any part thereof. In case such cost and expenses shall exceed the amount which would have been payable under this contract if the same had been completed by the Contractor, the Contractor or his sureties shall pay the amount of such excess to the City; and should such expense be less than the amount payable under this contract had the same been completed by the Contractor, he shall receive the difference, after deducting the amount retained as hereinafter specified, but shall not be entitled to damages for not being allowed to complete the work himself.

In case of abandonment of the work by the contractor, or its termination by the City, the Director of Public Service shall at once cause the work already done under this contract to be measured. Five percent (5%) of the value of the amount thus shown will be set aside as a retainer under the provisions hereof. In such case no money, due or payable to the Contractor under this contract after the annulling of the same, shall be paid until the work is completed, accepted, and all claims and suits by reason of said work have been finally settled. The retained five percent (5%) shall be held for the full guaranty period, as specified herein and used as provided in other provisions hereof, for keeping in repair so much of the work as was done or completed under this contract.

(15) **Storing materials delivered on work:** All materials required in the work may be placed on the sides of the roadway, or parking area, or upon a portion of the sidewalk along the sides of the roadway to be improved and upon adjoining portions of intersecting streets, as directed by the Engineer; but all such materials shall be neatly and compactly piled in such a manner as to cause the least inconvenience to the property owners and the general public. All fire hydrants must at all times be kept free and unobstructed; water and gas shut off boxes must be left uncovered by such materials; and passageways must be left for store entrances, private driveways and street intersections.

No materials, tools or machinery shall be piled or placed against shade trees unless they be amply protected against injury therefrom, and all shade trees and other improvements must be protected from injury caused by the storing of materials or otherwise during the prosecution of the work.

All materials, tools, machinery, etc. stored upon public thoroughfares must be provided with red lights at night time, and danger signals by day, to warn the traffic of such obstructions.

(16) **Storage of materials, tools and machinery during suspension of work:** Upon the suspension, stoppage, or abandonment of the work, or any part thereof, all materials shall be neatly and compactly piled, and all tools and machinery so located as not to impede public traffic on roadways, sidewalks and crosswalks unnecessarily. All such stored materials, tools and

machinery shall be provided with danger signals by day and red lights by night.

(17) **Ownership of old materials:** All old curbing, stone walk, paving brick, brick crosswalks, gutter paving bricks, gutter plates and culverts, sewer pipe, iron pipe and castings, are the property of the City and all such materials as are not ordered replaced, shall be removed by and at the expense of the Contractor, to such places as the Engineer may direct. If the Engineer chooses to not accept such materials, the Contractor must dispose of them at no cost to the City.

(18) **Plans, profiles, and specifications:** The plans, profiles and specifications are intended to be explanatory and supplementary of each other. Should any discrepancy appear or if a misunderstanding arise, as to the import of anything contained in either, the explanation of the City shall be final and binding on the Contractor. Any correction of errors or omissions in the plans, profiles and specifications may be made when such corrections are necessary for the proper fulfillment of their intentions as construed by the City.

Any correction in the plans, drawings, and specifications made pursuant to the provisions of this paragraph shall not be retroactive, but shall take effect at the date of notification to the Contractor of such correction.

The City will furnish the Contractor with up to three (3) sets of additional copies of the plans (full size or half size, if available) as may be required, for the construction of the work herein specified.

(19) **Private rights of way:** Whenever it is required as a part of this contract to perform work within the limits of private property or private right of way, such work shall be done in conformity with the agreements between the City and such owners, and whether or not such a condition be a part of this agreement, care shall be taken to avoid injury to the premises entered, which premises must be left in a neat and orderly condition by the removal of rubbish and surplus materials and restoring vegetation to meet or exceed pre-contract condition.

(20) **Injunctions:** If legal obstructions to the prosecution of the work arise, the delay shall operate to extend the time allowed for the completion of the part or parts of the work obstructed, for the length of time obstruction continues and no longer, but no damages shall be claimed or allowed the Contractor for any such delay.

(21) **Related Work at Site:** City may perform other work related to the Project at the Site with City's employees, or through other direct contracts therefor, or have other work performed by utility owners. If such other work is not noted in the Contract Documents, then:

1. written notice thereof will be given to Contractor prior to starting any such other work; and
2. if City and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times that should be allowed as a result of such other work, a Claim may be filed.

Contractor shall afford each other contractor who is a party to such a direct contract, each utility owner, and City, if City is performing other work with City's employees, proper and safe

access to the Site, provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work, and properly coordinate the Work with theirs. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering such work; provided, however, that Contractor may cut or alter others' work with the written consent of Engineer and the others whose work will be affected. The duties and responsibilities of Contractor under this Paragraph are for the benefit of such utility owners and other contractors to the extent that there are comparable provisions for the benefit of Contractor in said direct contracts between City and such utility owners and other contractors.

If the proper execution or results of any part of Contractor's Work depends upon work performed by others, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.

(22) **Attested accounts:** In case any person who has performed labor or has furnished materials, tools, or machinery for the work herein specified, he may file sworn itemized statement of the amount of value therein, as required by law, and if such claims be not disputed by the Contractor, or if the same are disputed, after the amount and validity have been determined by law, the City may pay the amount of such claims out of any money due the Contractor under this contract.

(23) **Authorized Variations in Work:** City may authorize minor variations in the Work from the requirements of the Contract Documents which do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. These may be accomplished by a Field Order and will be binding on City and also on Contractor, who shall perform the Work involved promptly. If City or Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, or both, then the City or Contractor must provide written notification prior to performing the Field Order and the change order process must be utilized. If the parties are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a Claim may be made.

(24) **Claims for extra materials and work:** All claims for furnishing extra materials, or for doing extra work, for which the Contractor may consider himself entitled to receive extra compensation, must be presented to the Director of Public Service in writing, at the time the cause for such claim arises. Such statement must contain an itemized account of such materials and labor required, and unless such claim is so presented, it is expressly agreed, by the parties to this contract, that the Contractor has waived such claim, and that he shall not be entitled, subsequently to claim, or receive any pay for the same. No claim for extra labor and material shall be allowed, unless the necessity therefor has first been determined by the Director and the price to be paid therefor has been agreed upon, in writing, before such additional materials have been used, and such additional labor performed. See Change Order Policy in the Appendices for more information.

(25) **Claims for damage for omission or delays:** If any change or alteration involves the omission of any materials or work called for in the original plans and specifications, any claim for loss of profits, or any other cause growing out of any such omissions is hereby expressly waived by the Contractor.

No claims for prospective profits will be allowed, by reason of the inability of the City to proceed with all, or any part of the work provided for in this contract; nor for damages by reason of any delay on the part of the City, but any such delay shall entitle the Contractor to a corresponding extension of time for the completion of the work. See Claims Management Policy in the Appendices for more information.

(26) **Damages to property:** All damages to lawns, fences, trees, buildings, sidewalks, water, sewer or gas pipes, or other public or private property along or near the line of work, or the vicinity thereof, if the same are occasioned through neglect or failure on the part of the Contractor, or that of any person in his employ, to take all necessary precautions to prevent the same, must be replaced or made good by him, to the satisfaction of the owners of same and at his cost and expense whenever the Engineer may so direct.

(27) **Liability of contractor for injuries, patents, etc.:** It is expressly understood and is hereby agreed that the whole of the work to be done is at the Contractor's risk. The contractor assumes by bidding under these specifications, the full responsibility and risk of all damages to the work itself, the property along the line of the work, injury to persons or animals which may be occasioned by floods, stoppage of water in sewers or gutters, caving in of surface of grounds or trenches, neglect in properly protecting work by barricades, etc., or any manner whatsoever. He shall bear all losses resulting to him on account of character of the work, or because the nature of the ground in or on which the work is done, is different from what was estimated or expected, or as may have been indicated by borings or test pits, or on account of the weather, actions of the elements or other causes.

He shall assume the defense of any indemnity and save harmless the City and its individual officers and agents from all claims relating to labor and materials furnished for the work to inventions, patents and patent rights used in doing the work, to injuries to any person or corporation received or sustained by or from the Contractor and his agents and employees in doing the work, or in consequence of any improper materials, methods, implements or labor used therein, or by reason of any condition in the improvement created by the Contractor or for any other liability therefor.

The Contractor, if required at any time by the Director, shall furnish the City satisfactory evidence that all persons who have claims for labor performed or material furnished hereunder, or have suffered damages on account of his operations, have been fully paid or secured. And in case evidence be not furnished as aforesaid and such amounts as the Director may consider necessary to meet lawful claims of persons aforesaid, shall be retained from the monies otherwise due the Contractor hereunder, until the liabilities shall have been fully satisfied.

If the Contractor shall claim compensation for any damages sustained by reason of the acts of

the City, he shall within five (5) days after the sustaining of such damages, present a written statement to the City of the nature of the damage sustained. On or before the fifteenth day of the month succeeding that in which any such damage shall have been sustained, he shall file with the City an itemized statement of the details and amount of such damage, and unless such statement shall have been filed as thus required, his claim for compensation shall be forfeited and invalidated, and he shall not be entitled to any payment on account of such damage.

The statement of any specific duty or liability of the Contractor in any part of the specifications shall not be construed as a limitation or restriction upon any general liability or duty imposed upon the Contractor by these specifications, said reference to any specific duty or liability being merely for the purpose of explanation.

(28) **Safety measures -- barricades:** The Contractor must provide and maintain barricades to properly protect persons, animals, vehicles and property against injury. He shall also provide, place and maintain sign boards, letter "STREET CLOSED" in plain legible type, upon the streets and alleys in which the work is in progress and upon each street and alley intersection therewith at a distance of one block therefrom, as may be directed by the Engineer.

(29) **Traffic regulations:** The Contractor is responsible for all traffic control on the project whether or not it is called out in the detailed specifications or plans. All traffic control must comply with appropriate City, State, and Federal rules, regulation, and guidelines. During the progress of the work, the Contractor shall accommodate both the vehicular and foot traffic and shall maintain free access to fire hydrants, water and gas valves. Gutters and water ways must be kept open and other provisions made for the removal of storm water.

During the construction of the sewer work and other ditches, only one-half of the street intersections may be blocked at one time and the Contractor shall provide and maintain temporary driveways, bridges, and crosswalks over sewer and other trenches, such as, in the opinion of the Engineer in charge of the work, are necessary to reasonably accommodate the public.

To accommodate pedestrians during the progress of the work, the Contractor shall provide and maintain crosswalks on that portion of the street being improved, both across the main roadway and at the street and alley intersections. The crosswalks shall be constructed of planks two (2) inches thick, and within the fire limits of the City, they shall be at least five (5) feet wide, and outside the fire limits at least three (3) feet wide.

When the City deems it advisable or necessary to divert traffic from the work or any portion thereof, the Contractor shall provide and maintain detour signs, letter "DETOUR" in plain and legible type, and indicating the direction to be taken by traffic as directed by the Engineer.

In the event of the Contractor's failure to comply with the above provisions relative to traffic regulations, the City may cause said provisions to be carried out and the cost and expense of such work shall be deducted from any money due the Contractor under this contract, but the performance of any such work by the City, or at its insistence or request, shall in no way release the Contractor from his general or particular liability for the failure to provide for the safety of the public or the work under this contract.

The Contractor shall not place any material on any sidewalk so as to interfere with the free access to any crosswalk by pedestrians.

No additional compensation will be paid the Contractor by the provision and maintenance of bridges, crosswalks, etc., as above specified, but the cost and expense of maintaining the same shall be considered as part of the general contract and shall be included by the Contractor in the prices bid by him upon the several items as named upon the proposal therefor.

(30) **Hauling materials on paved streets:** During the progress of the work and in the cleaning up thereof, the Contractor shall provide and use vehicles in which the excavated or other materials are hauled over paved streets in the City, with tight bodies for transportation of fine materials and shall not overload the same so as to allow such materials to fall off the tops thereof upon the streets. The paved streets over which such material is hauled must be kept free from dirt and other materials in accordance with the provisions of City Ordinance regulating same.

(31) **Cleaning up during the progress and completion of work:** During the progress of the work the Contractor shall remove all surplus excavated materials, obstructions, old materials not used, trees, stumps, filth or rubbish of any kind that may be encountered in the execution of the work, at his own cost and expense except when the removal and transplanting of trees be specified and bids therefor are required upon the blank proposal attached thereto.

As fast as any portion of the work, such as the construction of sewers or drains not located in the street or streets to be improved under the contract is completed, the backfilling of trenches and the repaving over the same shall be done as soon as possible, as herein specified.

As fast as the roadway pavement is completed, the Contractor shall remove all rubbish and surplus materials which have accumulated during the progress of the work provided herein, from the new or existing sewers, the roadway, sidewalk space and intersecting streets and shall render the streets suitable, safe and convenient for traffic.

Upon the completion of the improvement and before the final acceptance thereof, the Contractor shall remove all machinery, tools, temporary building and shall clean the pavement, curb and sidewalks in such a thorough and effective manner by hand sweeping, scraping or by flushing, according to kind of pavement or condition of the street, as will be determined by the Engineer, so as to leave the entire surface of the pavement, curbs and sidewalks so exposed that the quality and texture of the materials used and workmanship may be readily determined. He shall also remove all centering, scaffolding and accumulations of sand, earth, materials, and rubbish of all kinds from the sewers, manholes, inlets, and catch basins. If the improvement is completed too late in the fall to permit all of the cleaning up as herein specified, that portion not completed shall be done the following spring within ten (10) days after written notice to do so from the Engineer.

All such cleaning and removal of cleanings shall be done by the Contractor and the cost and expense thereof shall be included in his price for furnishing of materials and laying of pavement.

In case the Contractor shall fail or neglect to do any cleaning within forty-eight (48) hours after the receipt of notice to do so, or in the manner specified, the Director of Public Service may and is hereby authorized to cause the same to be done and charge the cost and expense thereof to said Contractor and deduct the amount of such cost and expense from any estimate due him at any time thereafter.

(32) **Existing surface fixtures and structures:** At least forty-eight (48) hours before breaking ground, the Contractor shall notify all the City Departments and public service corporations, whose tracks, wires, pipes, conduit or other structures may be affected by his operations. He shall likewise notify the Chief of the Fire Department of the temporary blocking of any street.

Existing surface structures which may be encountered in the work shall be removed and replaced or maintained by the Contractor at his cost and expense, or by the parties interested, and in such a manner as to secure the safety of the public and structure. The use of pipes, conduits, etc. shall not be interrupted without the consent of the parties owning or controlling the same.

(33) **Existing sub-surface fixtures and structures:** Existing sub-surface structures encountered in the work shall be protected and maintained in complete operation, unless permission is given for their removal. Existing substructures, including old sewers, abandoned sewers, abandoned drains, etc., which may appear within the limits of the excavating, shall be removed, if required by the City, but such removal will not be paid for separately, except when expressly specified, being paid for in the price for excavation or other items including excavation.

In case the uncovering of sub-surface structures necessitates a change in the alignment of grade of the proposed work, the Contractor shall give immediate notice of such obstruction to the Engineer, and shall cease work at such points until ordered to proceed.

And in case any change of grade or alignment shall delay the work, the time allowed for the completion of the contract will be extended to the extent which the delay shall have operated, the decision of the Engineer upon this point being final.

(34) **City may construct sewers, drains, etc.:** The City reserves the right to suspend or stop the work on all or any part of the progressing improvement, for the purpose of laying, relaying or allowing to be laid, or re-laid, any sewers, drains, gas pipes, water pipes, conduits or appurtenances thereto, which, in the opinion of the Director of Public Service are necessary or expedient, or for any other reason, and at any stage of the work, and the Contractor shall not interfere with or place any impediment in the way of any person or persons engaged in such work; and in such cases the Contractor shall not be entitled to any damages or recompense, either for digging up the street, or delay or hindrance, but the time of completion shall be extended as many days as the delay shall have operated.

It is the intention of the City to require all property owners to have water and sewer connections made to all lots, and to cause to be laid all water mains, gas mains, sewers and sewer connections, and other pipes, conduits, etc., not included in the contract hereunder, in advance of the improvement, except when in the opinion of the Director of Public Service such procedure be

impracticable and the Contractor shall not be entitled to damages or recompense by reason of delay or hindrance, but he shall be granted an extension of time equal to that in which the delay shall have operated, as determined by the Director of Public Service.
If the Contractor hereunder finds that the trenches are not properly backfilled, he shall so notify the Engineer in writing, allowing ample time to have the defects remedied before proceeding with the improvement.

The Contractor may exercise the right to such supervision of the work, as he may deem necessary to insure good material and workmanship, in order that he may properly protect himself from defects in the finished pavement for which he will be responsible under his guaranty. The Contractor will be allowed and paid for any additional materials, the use of which is made necessary on his part by reason of the above specified work, such reasonable sum (not to exceed contract price) as may be agreed upon in writing between himself and the Director before such additional materials be used, and in the manner specified for subsidiary contracts.

(35) **Special repairs:** The City reserves the right, whenever in its judgment, to take up or permit the taking up of any part of the improvement during the progress of the work, or subsequent to the completion thereof and during the period of guaranty for the purpose of constructing, repairing, or renewal of any sewers, drains, water or gas pipes, or other improvements. Whenever any part of the improvement is taken up as herein specified, all the work of restoring the same will be done by or under the direction of the City and the Contractor hereunder will be relieved of any maintenance requirements on that portion of the completed improvement so disturbed.

(36) **Rejecting Defective Work:** The City will have authority to reject Work which the City believes to be defective, or that the City believes will not produce a completed Project that conforms to the Contract Documents or that will prejudice the integrity of the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. The City will also have authority to require special inspection or testing of the Work whether or not the Work is fabricated, installed, or completed.

(37) **Use of city water supply:** The City will furnish water at the hydrants for the purpose of puddling trenches, construction purposes, operation of machinery, mixing concrete, mortar, etc., but the cost of water and the proper facilities for conveying the same from the hydrants must be included by the Contractor in the unit prices bid for the various items of work wherein water will be used. All water used must pass through meters installed by the Water Department at its hydrants and subject to its regulation and paid for at the builder's rate per one thousand (1,000) cubic feet of water consumed, as established by said Department, plus the cost of meters and installation of same. A deposit will be required covering the cost of meter and installation thereof, which deposit of cost of meter will be refunded on return of meter in good condition.

The Contractor must notify the Water Department at least forty-eight (48) hours in advance of the time such installation is required.

(38) **Use of sewer:** At any time during the progress of the work the City may, by written notice to the Contractor, take over and utilize the whole or part of any sewer, drain or appurtenance thereof which has been completed, giving if desired, permits to tap and connect

therewith. In such event, the Contractor shall be relieved from the maintenance of such part as may be used except as provided under the section "Guaranty" and such will be deemed as final acceptance by the City of the part or parts used, subject to the responsibility of the Contractor for all defects in workmanship, etc., as provided under the "Guaranty" section of these specifications.

(39) **Sanitary regulations:** Necessary sanitary conveniences for the use of the laborers on the work, properly secluded from public observation, shall be constructed and maintained in a sanitary condition by the Contractor in such manner and at such points as shall be approved, and their use shall be strictly enforced.

(40) **OSHA standards:** It is the City's requirement, under OSHA Regulations, that all outside contractors hired by the City of Canton are and will be in full compliance with all OSHA standards and perform said work in accordance with all applicable OSHA standards.

(41) **Laws and ordinances:** The Contractor shall keep himself fully informed of all laws, municipal ordinances and regulations that in any manner affect the persons engaged in or employed upon the work, or the materials used in the work, or any way affecting the conduct of the work, and of the decrees of the bodies or tribunals having jurisdiction or authority over the same. He shall also himself observe and comply with and shall cause all of his agents and employees to observe and comply with all such existing and subsequent laws and ordinances, regulations, orders and decrees, and to protect and indemnify the City against claim or liability arising from or based upon the violation of such laws, ordinances, regulations, orders or decrees by himself or by his agents or employees.

References to special laws and ordinances in other sections of this contract shall in no way relieve the Contractor from compliance with all the provisions of this section.

(42) **Monuments and landmarks:** The Contractor shall preserve intact all City monuments, benchmarks and landmarks, as shown upon the plans or encountered in the excavation. In such case that such monument, benchmark or landmark not shown on the drawings be encountered in opening the excavation, the Contractor shall stop work at such point, immediately notify the Engineer of such findings and not disturb same until directed to do so by the Engineer.

(43) **Prices:** The City shall pay and the Contractor shall receive the prices hereafter stipulated as full compensation for everything furnished and done by the Contractor under this contract. This shall include all incidental work required but not specifically mentioned, and also for all loss or damage arising out of the nature of the work, or from the action of the weather, floods, or from unforeseen obstruction or difficulty encountered in the prosecution of the work, and for the expenses incurred by or in consequence of the suspension or discontinuance of the work as herein specified, and for well and faithfully completing the work and the whole thereof, as herein provided, together with the remedying of all defects developing during the prosecution of the work and during the period for which the work is guaranteed.

(44) **Starting and completing the work (Contract Duration):** The Contractor shall not start the work embraced in this contract before the date of a written notification from the Engineer, and shall commence at such points as the City may direct.

If the work done under this contract conflicts with other work done for or by the City, or with its consent, the City shall determine the time and manner of procedure of the operations carried on under this contract.

The duration of this agreement for the completion of the work embraced in this contract shall be **substantial completion 350 calendar days from the Notice to Proceed date and Final Completion 380 calendar days from the Notice to Proceed.** The City will use ODOT Specification 108.06 through 108.09 in regards to delays and time extensions.

Contractor is responsible for any additional costs due to weather-sensitive construction, such as, but not limited to, protecting concrete from freezing, heating of water as needed, etc. as well as insuring that all materials used satisfy appropriate specifications such as, but not limited to, asphalt temperature specifications, non-frozen backfill material, etc.

The permitting of the Contractor to complete the work or any part thereof, after the time fixed for its completion, shall in no way operate as a waiver on the part of the City of any of its rights under this contract.

(45) **Liquidated Damages and Paving Time Restrictions:** The Contractor guarantees that he can and will complete the work on or before the time affixed in his bid, or on or before the extended time as provided for in the contract. The payment to the City for such delay and failure on the part of the Contractor shall be Nine Hundred Dollars ($900.00) for each day by which the Contractor fails to complete the work, or any part (including Interim) thereof, in accordance with the provisions of the contract. The City will deduct and retain, from any money due or any money to become due under the contract, the amount of the liquidated damages. The Contractor shall be liable for the payment of the difference upon demand of the City.

All asphalt paving must take place on the city's road surfaces from May 1st to October 1st; and/or during optimal climatic conditions that are conducive to the best mix compacting and long term durability of the pavement, according to the highest and best practices of the asphalt paving industry.

(46) **Samples:** Each bidder shall submit samples of materials, or refer to samples of materials furnished by the Manufacturer or Producer, at the time of submitting the bid, as required in detail specifications under each item, for which bids are received. Whenever samples of any material or workmanship have been filed by the Contractor, or are on file as specimen of the work to be done or materials to be furnished for the work herein specified, such samples shall be the standard by which that kind and class of work shall be judged.

(47) **Measurements:** The contract will not use extra or customary measurements of any kind, unless specially noted, in measuring the work under these specifications; the length, area, solid contents or number only, are considered as a basis for payment as hereinafter specified.

The measurements as made by the City of the amount of the work done shall be final and conclusive.

Payments will be made upon the work done within the lines prescribed by the plans, drawings

or specifications, and in accordance with the unit prices for the items under which the work is done. Nothing therein contained depriving the City of any remedy or defense it may have under the same, for violation of the terms or conditions of this agreement.

(48) **Partial payments:** The Contractor shall, on a day of each calendar month as is mutually agreeable to the Contractor and the City, make an approximate estimate of the quantities and prices of the labor furnished and the materials incorporated into the project during the previous calendar month and forward such estimate to the Engineer for approval. More frequent estimate submission, at the option of the City, may be made at any time during the progress of the project.

Partial payments to the Contractor for work performed for a lump sum price shall be based on a well-balanced schedule prepared by the Contractor and approved by the Engineer which schedule shall apportion the lump sum price to the principal features entering into or forming a part of the work covered thereby.

The City shall pay the Contractor monthly, not less than the difference between the amount of each monthly estimate which has been approved by the Engineer and the sum of retainage and/or any other amounts which the City is authorized by the contract to withhold. The making of any monthly payment shall not be taken or construed as approval or acceptance by the City of any work included in the estimate upon which such payment is based.

Payment shall be made and retainage kept in accordance with applicable sections of Chapter 153 of the Ohio Revised Code. The Contractor agrees that the financial institution selected by the City for deposit of retained funds is acceptable to the Contractor and will sign any documents requested related to said account.

To aid in determining quantities of materials for pay, the Contractor shall, whenever requested by the Engineer, provide scales, equipment and assistance for weighing or for measuring such materials.

For estimating quantities in which computation of areas by geometric methods would be comparatively laborious, the City agrees that a planimeter or other agreed upon method may be used.

(49) **Change of Contract Price**: The Contract Price may only be changed by a Change Order. Any Claim for an adjustment in the Contract Price shall be based on written notice submitted by the party making the Claim to the City and the other party to the Contract.

The value of any Work covered by a Change Order or of any Claim for an adjustment in the Contract Price will be determined as follows:

1. Where the Work involved is covered by unit prices contained in the Contract Documents, by application of such unit prices to the quantities of the items involved;
   or
2. Where the Work involved is not covered by unit prices contained in the Contract Documents, by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with ODOT's Force Account procedures; or

3. Where the Work involved is not covered by unit prices contained in the Contract Documents and agreement to a lump sum is not reached under previous paragraph, on the basis of ODOT's Force Account procedures.

Contractor's Fee: The Contractor's fee for overhead and profit shall be determined as follows:

1. a mutually acceptable fixed fee; or
2. if a fixed fee is not agreed upon, then the fee shall be based upon ODOT's Force Account procedures.

(50) (51) **Pre-final and final estimates and payments:** As soon as practicable after the completion of work under the contract, the Engineer will perform a formal inspection of the project. If the project appears to be acceptable, the Engineer will recommend tentative acceptance thereof and make a pre-final estimate of the amount of the work done by the Contractor based on quantities and prices submitted by the Contractor. Upon such certified pre-final estimate, and pending the submission of all required forms and documents, the City will pay the Contractor all funds owed under the contract pending final acceptance of the project and submission of all required documentation deducting expenses of correcting any deficiencies in the work as determined by the Engineer. Such final inspection and payment will not discharge the liability of the Contractor under the contract or of the surety under the contract bond, but such liabilities and all guarantees shall remain in effect for the period fixed by law.

(52) **Additional contract:** It must be distinctly understood that should more than one contract be awarded to the same Contractor, he may be required to prosecute the work upon all of them at one and the same time. At the option of the Director, and he shall not be permitted to transfer men, tools, or machinery from one job to another without the consent of the Engineer. The contractor shall at all times have a competent foreman and a sufficient number of men, tools, and machinery upon each job, at the same time, as well, in the opinion of the Engineer, be sufficient for the proper prosecution of the work.

(53) **Insurance:** The Contractor shall at all times during the progress of the work, comply with all the provisions of the laws of Ohio relating to workmen's compensation and State insurance fund for the benefit of injured and the dependents of killed employees. The Contractor shall at all times during the progress of the work carry accident liability insurance in an amount sufficient to reasonably indemnify himself against loss from claims for personal injuries or fatal accidents occurring upon the work or caused thereby including injuries and accidents to employees of the Contractor, persons engaged on the work under another contractor, employees of any sub-contractor or other engaged on or about the work and the public. The City reserves the right to annul this contract at any time upon receiving evidence of the Contractor's failure to comply with the statutes as described above.

(54) **Last payment to terminate liability of City:** No person or corporation, other than the signer of this contract as Contractor, has now any interest hereunder, and no claim shall be made or be valid, and neither the City nor its agents shall be liable for, or be held to pay any money, except that provided in this contract. The acceptance by the Contractor of the last payment made as aforesaid shall operate as and shall be a release to the City and agents thereof, from all claims and liability to the Contractor for anything done or furnished for, or relating to the work, or for

any act or neglect of the City or of any person relating to or affecting the work, except the claim against the City for the remainder, if there be any, of the amount kept or retained.

(55) **Guaranty:** The Contractor, for and in consideration of the monies received and to be received by him, hereby agrees that the repairs of all defects in the work done and completed under this contract arising, in the opinion of the Director, out of the use of defective materials, settlements of sewers, structures, and foundations or improper workmanship in the construction thereof, and which repairs from such causes may become necessary during the period of years, as set forth below, after the date of the approval by the Director of the Engineer's certificate of the "FINAL COST", shall be made by him without cost and expense to the City, and the Contractor agrees to make such repairs when, and as ordered by the Director, by written notice served upon him and if after having received such notice, the Contractor fails to make such repairs within the number of days stated in such notice, from the date of receipt thereof, the Director shall thereupon have the power to cause said repairs to be made and charge the cost and expense thereof to the Contractor or his surety.

The failure of the Director to give notice within the specified period shall not preclude the operation of this section.

The guaranty periods referred to above in this section shall be as follows:

C.I.P.P. Rehabilitated Sewers, 2 years (for more information, see page 40, section 3.07, Post Installation)

Concrete curbing, 1 year

Concrete sidewalks, 1 year

Concrete masonry, 1 year

Brick masonry, 1 year

Sewers, manholes, catch basins, 1 year

Asphaltic concrete pavement, 1 year

Concrete foundation, 1 year

(56) **No estoppel:** The City shall not be precluded or estopped by any return or certificate made or given it, from showing at any time, either before or after the final completion and acceptance of the work and payment therefor pursuant to any such return or certificate, the true and correct amount and character of the work done and materials furnished by the Contractor or any other person under this agreement, or from showing at any time that any such return or certificate is untrue and incorrect or improperly made in any particular, or that the work and materials, or any part thereof, do not in fact conform to the specifications; and the City shall not be precluded or estopped, notwithstanding any such return or certificate and payment in accordance therewith, from demanding and recovering from the Contractor such damages as it

may sustain by reason of his failure to comply with the specifications.

Neither the acceptance by the City, nor any order, measurement, or certificate, by the City, nor any order for payment of money, nor any payment for, nor acceptance of the whole or any part of the work by the City, nor any extension of time, nor any possession taken by the City, or its employees, shall operate as a waiver of any portion of this contract or of any power herein reversed to the City, or any rights to damages herein provided; nor shall any waiver of any breach of this contract be held to be a waiver of any other or subsequent breach.

Section III: Additional Requirements and/or Conditions

A. Notwithstanding any provisions to contrary, Ohio Law shall govern this Agreement.

B. Contractor agrees that Canton's specifications and bid documents shall incorporate and be made part of any subsequent contract entered by the parties.

C. Once both parties have fully executed the contract, said contract shall be binding upon the parties' heirs, successors and assigns.

D. Contractor shall not assign or transfer any interest under this agreement without the express written consent of Canton.

E. Contractor agrees to indemnify and hold harmless the City of Canton, Ohio, its employees and agents from and against all demands, claims, causes of action, or judgments or omissions by Contractor, its agents, employees or subcontractors. Nothing herein shall be construed to hold Contractor liable for Canton's negligence.

F. Contractor's liability to the City of Canton for default shall not be limited and the City of Canton shall be entitled to all damages permitted under Ohio law upon Contractor's breach, default or non-performance under this Agreement.

G. A waiver of a breach of any of the terms or conditions of the contract will not be construed as a waiver of any subsequent breach. Any consent to delay in the performance of contractor of any obligation shall be applicable only to the particular transaction to which it relates, and it shall not be applicable to any other obligation or transaction. Delay in the enforcement of any remedy in the event of a breach of any term or condition of the contract or in the exercise by either party of any right under the contract shall not be construed as a waiver.

H. When, during the course of construction, it appears to the contractor that any work does not conform to the provisions of the contract documents, it will make necessary corrections so that such work will conform. Additionally, the Contractor will correct any defects caused by faulty materials, equipment or workmanship in work supervised by the Contractor or by a subcontractor. This shall apply to the Contractor or any subcontractor appearing within one year from the date of issuance of a certificate of substantial completion or within such longer periods as prescribed by law or by applicable special guarantees or warranties in the contract documents.

I. The owner reserves the right to order work changes in the nature of additions, deletions, or modifications, without invalidating the contract, and agrees to make corresponding adjustments in the contract price and time of termination if necessary. The Owner will authorize all changes by a written change order signed by the owner, or the architect of other designee of the owner. The change order will include conforming changes in the contract and termination time.

J. Work changed, and the contract price and termination time modified can be modified only as set out in the written change order. Any adjustment in the contract sum resulting in a credit or a charge to the owner will determined by mutual agreement of the parties before starting any work involved in the change order.

Section IV: City of Canton Codified Ordinances

Bidders shall take notice that they are to comply with the Codified Ordinances of the City of Canton, including but not limited to, the following:

1. **Chapter 105.02 – Public Paving Time Restrictions.**
   All City public paving contracts shall include a provision for liquidated damages in order to provide the City reasonable compensation for actual damages due to a failure to ensure that asphalt paving take place on the City's road surfaces from May 1st to October 1st; and/or during optimal climatic conditions that are conducive to the best mix compacting and long term durability of the pavement, according to the highest and best practices of the asphalt paving industry.
   (Ord. 270-2014. Passed 12-29-14.)

2. **Chapter 105.03 – U.S. Steel Usage Required; Exception.**
   All City contracts shall stipulate or provide that all steel necessary in the construction of any work performed under such contracts shall be steel that is produced in the United States unless a specific product which is required is not produced by manufacturers in the United States in which event this prohibition does not apply. This section shall apply to only contracts awarded by the Board of Control of the City.
   (Ord. 224-77. Passed 6-27-77.)

3. **Chapter 105.05 – Materials to be Purchased Locally.**
   In all future contracts for the construction of buildings, structures, or other improvements under the Capital Improvement Budget, the following clause shall be printed or typewritten on each contract:
   It is the desire of the City of Canton that all materials used in the construction covered by this contract shall be purchased in the Canton area except such materials which are unavailable in the Canton area.
   (Res. 49-77. Passed 2-7-77.)

4. **Chapter 105.06 – Minority Contract Provision.**
   a. All contracts with the City shall include the following clause:
      The bidder agrees to expend at least $_____of the Contract in the event the contract is awarded to such bidder for minority/women's business enterprises.

   For purposes of this pledge, the term "minority/women's business enterprise" means a bona fide business established as a sole proprietorship, partnership or corporation owned, operated and controlled by one or more minority persons or women who have at least fifty-one percent (51%) ownership. "Minority" includes African Americans, Asian/Pacific Islanders, Hispanic/Latino Americans and Native American Indians. The minority or woman must have operational and managerial control, interest in capital, and earnings commensurate with the percentage of ownership. Minority/women's business enterprises may be employed as construction contractors, subcontractors, vendors or suppliers.
   (Ord.185-2011. Passed 10-31-11.)

5. Chapter 105.12 – Local Bidder Preference.

a. The Board of Control, in determining the lowest and best bidder in the award of contracts to which this section is applicable, is authorized to award contracts to local bidders as hereinafter defined, whose bid is not more than five percent (5%) higher, subject to a maximum amount of twenty thousand dollars ($20,000.00), than the lowest dollar bid submitted by non-local bidders. The Board of Control's decision in making such an award shall be final.

b. For purposes of this section, "local bidder" means an individual or business entity which at the time of the award of the contract has a headquarters, division, sales office, sales outlet, manufacturing facility, or similar significant business-related location in Stark County, Ohio.

c. All contract specifications and/or bid documents that are distributed by Canton for the purpose of soliciting bids for goods and/or services shall contain the following notice:
Prospective bidders will take notice that the City of Canton, in determining the lowest and best bidder in the award of this contract, may award a local bidder preference to any qualified bidder pursuant to Section 105.12 of the Codified Ordinances of the City of Canton. The determination of whether a bidder qualifies for the local preference shall be made by Board of Control. The Board's decision shall be final. A copy of Section 105.12 is attached.

d. This section shall be applicable to all contracts for equipment, goods, machinery, materials, supplies, vehicles and/or services, which are purchased, leased and/or constructed at a cost in excess of twenty thousand dollars ($20,000.00) and which require bidding pursuant to Ohio R.C. 735.05 through 735.09 and Ohio R.C. 737.03.
(Ord. 95-2014. Passed 5-5-14.)

6. Chapter 105.15 – City Income Tax

a. No person, partnership, corporation or unincorporated association may be awarded a contract with the City under Sections 105.09 or 105.10, unless the bidder is paid in full or is current and not otherwise delinquent in the payment of City income taxes, including any obligation to pay taxes withheld from employees under Section 182.05 and any payment on net profits under Section 182.06.

b. Falsification of any information related to or any post-contractual violation of the requirement to pay City income taxes set forth in subsection (a) shall constitute cause for the rescission of the balance of the contract at the City's discretion.

c. No partnership, corporation or unincorporated association which has as one of its partners, shareholders or owners a person who is a twenty percent (20%) or greater equity owner in such partnership, corporation or unincorporated association and who is delinquent in the payment of City income taxes as set forth in subsection (a), may be awarded a contract with the City under Sections 105.09 or 105.10.

d. A person who is a twenty percent (20%) or greater equity owner in any partnership, corporation or unincorporated association which is delinquent in the payment of City income taxes as set forth in subsection (a) may not be awarded a contract with the City under Sections 105.09 or 105.10.

e. A contract awarded under Sections 105.09 or 105.10 for a public improvement project, services other than personal or professional services, and personal or professional services shall not be binding or valid unless such contract contains the following provisions:

Said _____ hereby further agrees to withhold all City income taxes due or payable under Chapter 182 of the Codified Ordinances for wages, salaries, fees and commissions paid to its employees and further agrees that any of its subcontractors shall be required to agree to withhold any such City income taxes due for services performed under this contract. Furthermore, any person, firm or agency that has a contract or agreement with the City shall be subject to City income tax whether a resident or nonresident in the City, and whether the work being done is in the City or out of the City. In addition to the tax withheld for employees, the net profits on the contract shall be subject to City income tax.
(Ord. 238-2015. Passed 11-30-15.)

7. Chapter 182.30 – Contract Provisions

a. No contract on behalf of the City under Sections 105.09 or 105.10 of the Codified Ordinances of Canton for a public improvement project, services other than personal or professional services, and personal or professional services shall be binding or valid unless such contract contains the following provisions:

Said _____ hereby further agrees to withhold all City income taxes due or payable under Chapter 182 of the Codified Ordinances for wages, salaries, fees and commissions paid to its employees and further agrees that any of its subcontractors shall be required to agree to withhold any such City income taxes due for services performed under this contract. Furthermore, any person, firm or agency that has a contract or agreement with the City shall be subject to City income tax whether a resident or nonresident in the City, and whether the work being done is in the City or out of the City. In addition to the tax withheld for employees, the net profits on the contract shall be subject to City income tax.

b. By entering into contract with the City of Canton _____ agrees with the City regarding the manner of withholding of City income taxes as provided in Section 718.011(F) of the Ohio Revised Code.

i. Municipal income tax withholding provisions of Sections 718.011(B)(1) and 718.011(D) ORC shall not apply to qualifying wages paid to employees for work done or services performed or rendered inside the City or on City property.

ii. _____ agrees to withhold income tax for the City from employees' qualifying wages earned inside the City or on City

property, beginning with the first day of work done or services performed or rendered inside the City.

(Ord. 238-2015. Passed 11-30-15.)

8. Chapter 507.03 – Equal Employment Opportunity Clause.

b. During the performance of this contract, the contractor agrees as follows:

1. The contractor shall not discriminate against any employee or applicant for employment because of race, age, handicap, religion, color, sex, national origin, sexual orientation or gender identity. The contractor shall take affirmative action to insure that applicants are employed and that employees are treated during employment without regard to race, religion, color, sex, national origin, military status, sexual orientation or gender identity. As used herein, the word "treated" shall mean and include without limitation the following: recruited, whether by advertising or other means; compensation, whether in the form of rates or pay or other forms of compensation; selected for training, including apprenticeship; promoted; demoted; upgraded; downgraded; transferred; laid off; and terminated. The contractor agrees to and shall post in conspicuous places available to employees and applicants for employment notices to be provided by the contracting officers setting forth the provisions of this nondiscrimination clause.
2. The contractor shall, in all solicitations or advertisements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive consideration for employment without regard to race, age, handicap, religion, color, sex, national origin, military status, sexual orientation or gender identity.
   (Ord. 153-2012. Passed 9-24-12.)
3. The contractor shall send to each labor union or representative of workers, with which he has a collective bargaining agreement or other contract or understanding, a notice advising the labor union or workers' representative of the contractor's commitments under the equal opportunity clause of the City; and he shall post copies of the notice in conspicuous places available to employees and applicants for employment.
4. The contractor shall submit in writing to the City his affirmative action plan, and each subcontractor and supplier of equipment or supplies shall submit to the general contractor his affirmative action plan. The responsibility for securing these affirmative action plans falls upon the general contractor and shall be on file at the office of the general contractor. The contractor shall furnish all information and reports required by the City or its representative pursuant to this chapter, and shall permit access to his books, records, and accounts by the contracting agency and by the Executive Secretary for purposes of investigation to ascertain compliance with the program.
5. The contractor shall take such action with respect to any subcontractor as the City may direct as a means of enforcing the provisions of this equal opportunity clause, including penalties and sanctions for noncompliance; provided, however, that in the event the contractor becomes involved in or is threatened with litigation as the result of such direction by the City,

the City will enter into such litigation as is necessary to protect the interests of the City and to effectuate the City's equal opportunity program and, in the case of contracts receiving Federal assistance, the contractor or the City may request the United States to enter into such litigation to protect the interests of the United States.

6. The contractor shall file and shall cause his subcontractors, if any, to file compliance reports with the City in the form and to the extent prescribed by the City or its representative. Compliance reports filed at such times as directed shall contain information as to the employment practices, policies, programs and statistics of the contractor and his subcontractors.
7. The contractor shall include the provisions of this equal employment opportunity clause in every subcontract or purchase order, so that such provisions will be binding upon each subcontractor or vendor.
8. Refusal by the contractor or subcontractor to comply with any portion of this program as herein stated and described will subject the offending party to any or all of the following penalties:
    A. Withholding of all future payments under the involved public contract to the contractor in violation, until it is determined that the contractor or subcontractor is in compliance with the provisions of this contract.
    B. Refusal of all future bids for any public contract with the City or any of its departments or divisions, until such time as the contractor of subcontractor demonstrates that he has established and shall carry out the policies of the program as herein outlined.
    C. Cancellation of the public contract and declaration of forfeiture of the performance bond.
    D. In cases in which there is substantial or material violation or the threat of substantial or material violation of the compliance procedure or as may be provided by contract, appropriate proceedings may be brought to enforce these provisions, including the enjoining within applicable laws of contractors, subcontractors or other organizations, individuals or groups who prevent, directly or indirectly, or seek to prevent, directly or indirectly, compliance with the policy as herein outlined.
    (Ord. 179-74. Passed 6-17-74.)

Section V: Bid Forms and Instructions

Failure to submit Bid Forms 1 through 8 with the bid may cause the bid to be deemed non-responsive, and therefore it may not be considered.

Bid Forms 9 through 14 will be required of the successful bidder but may be submitted after the awarding of the contract.

*****The City of Canton does encourage bidders to submit all bid forms with their bids*****

BID FORM 1 – BIDDER AND CONTRACTOR EMPLOYMENT PRACTICES REPORT

This form is designed to provide an evaluation of the bidder's policies and practices relating to the extension of equal employment opportunity to all persons without regard to race, religion, color, sex or national origin. The successful bidder will be required to complete and submit the Bidder and Contractor Employment Practices Report. Additionally, the successful bidder will be required to submit an "affirmative action plan" and/or "EEO policy." If the successful bidder does not have a formal EEO policy, he/she will be required to complete and submit the provided EEO policy statement.

BID FORM 2 – AUTHORITY OF SIGNATORY

The authority of the bid signatory must be established. Bid Form 3 provides the means by which the bidder can identify the type of business organization it is (corporation, partnership, etc.) and provides instructions as to how signature authority is commonly established.

BID FORM 3 – BID GUARANTY

Each proposal shall be accompanied by a bid guaranty which shall consist of one of the following:

1. Ohio Statutory Bid Guaranty and Contract Bond, substantially in the form prescribed by ORC 153.571. The 153.571 statutory bond form requires that the penal amount be an amount not less than the bid price. It is a bid error to write in an amount equal to ten percent (10%) of the amount bid.

2. A certified check or cashier's check in an amount not less than ten percent (10%) of the total amount bid for all items upon which the proposal is made. A bid guaranty check shall be made payable to the owner without condition. A contractor using a bid check will be required to furnish a performance bond in the amount of one hundred percent (100%) of the total bid within ten (10) days of notice of the award.

Bidders using the Ohio Statutory Bid Guaranty and Contract Bond Form can leave the penal amount blank, if such is acceptable to the bidder and the surety. The statutory bond form, per ORC 153.571, is read as having a penal amount equal to the price bid, if no amount is written.

In the case where a bidder to whom a contract award is made fails to execute and secure a contract within ten (10) days after the issuance of the notice of award in writing, the award may be vacated and the bid guarantee, in an amount not to exceed ten percent (10%) of the amount bid, forfeited. The Bid Bond must be provided by an approved surety company authorized to transact business in

the State of Ohio and with a local agent. Agents of bonding companies which write the Bid Bond for this contract shall be licensed to conduct business in the State of Ohio and have a local (Ohio) agent. Each bid shall contain the power of attorney, bearing the seal of the company and evidencing such agent's authority to execute the documents furnished. Identification of the local agent is to accompany each Bond.

The surety used for the bid bond shall be listed in the current edition of the U.S. Treasury Circular 570 and the Penal Sums shall be within the maximum specified for such company in said Circular 570.

BID FORM 4 – BIDDER INFORMATION

The bidder shall submit the required information on the included form and shall supplement the information there given as may be required by the City after the receipt of bids. Low bidders may be interviewed by the City and shall furnish such information as the City may deem necessary to consider prior to making an award.

BID FORM 5 – PROJECT REFERENCES

Each bidder shall provide references as set forth on Bid Form 6.

BID FORM 6 – NON-COLLUSION AFFIDAVIT

Each bidder is required to submit with the bid an affidavit stating that neither he nor his agents, nor any other party for him, has paid or agreed to pay, directly or indirectly, any person, firm or corporation any money or valuable consideration for assistance in procuring or attempting to procure the contract herein referred to, and further agreeing that no such money or reward will be hereafter paid. This affidavit must be on the form provided in this document.

BID FORM 7 – QUESTIONNAIRE IN DETERMINING LOWEST AND BEST BID

This form identifies a series of factors to be considered by the Board of Control in determining whether a bid is not only the lowest bid, but also the best bid.

BID FORM 8 – INSURANCE AFFIDAVIT AND REQUIREMENTS

The successful bidder will be required to submit the required insurance as outlined in Bid Form 9.

All bidders would be well advised to consult their insurance agent as soon as possible so that all questions and concerns can be given due consideration.

BID FORM 9 – AFFIDAVIT FOR FOREIGN CORPORATIONS

A successful bidder who is a foreign corporation, (a corporation not chartered in the State of Ohio), will be required to submit an affidavit duly executed by the authorized bid signatory stating in said affidavit that said foreign corporation has, in accordance with the provisions of the laws of the State of Ohio, obtained a certificate authorizing it to do business in the State of Ohio.

BID FORM 10 – LISTING OF SUBCONTRACTORS

The successful bidder shall provide the name, type of work to be performed and value of each subcontract. Note that subcontractors are distinguishable from suppliers.

BID FORM 11 – PERSONAL PROPERTY TAX CERTIFICATION (ORC 5719.042)

This form and/or certification must be retyped on the bidder's letterhead and notarized utilizing either paragraph (A) or (B) as it applies to the successful bidder's company.

BID FORM 12 – CERTIFICATION – AUDITOR OF THE STATE OF OHIO

This form is to be completed in which to certify that the bidder does not have outstanding unresolved finding for recovery issued by the Auditor of the State of Ohio.

BID FORM 13 – ARTICLES OF INCORPORATION

The successful bidder will be required to submit a copy of the company's articles of incorporation.

BID FORM 14 – W9 TAX FORM

Please provide an up to date copy of your Company's W9.

Bid Form 1: Bidder and Contractor Employment Practices Report

Bidder and Contractor Employment Practices Report

City of Canton Office of Compliance

I. INSTRUCTIONS

A. This form is designed to provide an evaluation of your policies and practices as they relate to the extension of equal employment opportunity to all persons regardless to race, religion, color, sex, age, national origin, disability, sexual orientation, or sexual identity.

B. City of Canton Codified Ordinance 507 and rules and regulations pursuant thereto provide for a contract compliance inspection of personnel policies and practices related to any contract with the City including contracts for work, labor, services, supplies, equipment, materials, leases, concession agreements, and permits.

C. Completion of this Contractor and Bidder Employment Practices Report is one of the steps which demonstrate compliance with the City's Equal Employment Opportunity Program. Responsibility for demonstrating compliance with the Program by the vendor and its subcontractors rests with the vendor or subcontractor. Such demonstration is a prerequisite for continued eligibility for the award City contracts.

II. VENDOR OR BIDDER INFORMATION

1. Reporting Status A. Prime Contractor B. Prime Subcontractor C. Supplier D. Other (Specify)
2. Name, Address and Telephone Number of Bidder Covered by This Report
3. Name, Address and Telephone Number of Principal Official or Manager of Bidder
4. Name, Address and Telephone Number of Principal Office of Bidder

Evaluation (Office Use Only)

- o Compliant
- o Non-Compliant
- o Follow up needed_____

III. POLICIES AND PRACTICES

The bidder and/or Contractor will indicate his/her willingness or unwillingness to comply with the requirements of the Equal Employment Opportunity Program of the City of Canton by circling the applicable letter associated with each item below. The letters are interpreted as follows:

A – Current Practice **B –** Company will immediately adopt this policy **C –** Company unwilling/unable to adopt policy.

Circle One	Items	State Reason if (C) is checked
A B C	1. The company will adopt a policy of non-discrimination on the basis of race, religion, color, sex, age, national origin, disability, sexual orientation, or sexual identity, with regard to recruitment, hiring, training, upgrading, promotion and discipline of employees or applicants for employment. This policy will be communicated in writing to all employees, subcontractors, recruitment sources and all relevant labor organizations and unions.	
A B C	2. The Company will develop procedures which will assure that this policy is understood and carried out by managerial, administrative, supervisory personnel.	
A B C	3. The company will use recruitment sources such as employment agencies, unions, and schools which have a policy of referring applicants on a non-discriminatory basis.	
A B C	4. The company will participate in training programs for the benefit of employees or prospective employees, according to the intent of City Codified Ordinance 507.	
A B C	5. Company recruiters will seek a broad recruitment base in order that a representative cross-section of applications might be obtained, and will refrain from a hiring policy which limits job applicants to persons recommended by company personnel.	
A B C	6. Company will take steps to integrate any position, departments, or plant locations which have no minority persons, or are almost completely staffed with one particular ethnic or racial group.	
A B C	7. The Company will review its qualifications for each job to determine whether such standards eliminate unemployed persons who could, if hired, perform the duties of the job adequately. The following qualifications should be reviewed: Education, Experience, Tests, and Criminal Records.	
A B C	8. Residence in a particular geographical area will not be a qualifying or disqualifying criterion for employment with the Company.	
A B C	9. The Company will provide that all bargaining agreements with employee organizations, including labor unions, have non-discrimination clauses requiring equal employment opportunity.	

IV. EMPLOYMENT DATA

Please note that this data may be obtained by visual survey or post-employment records. Neither visual surveys nor post-employment records are prohibited by any Federal, State or local law. All specified data is required to be filled in. Please provide truthful and accurate information. If information provided is found to be false, bidder/contractor will be subject to the loss of future awards.

				MALE:					**FEMALE:**				
Categories	**Overall Total**	**Total Male**	**Total Female**	**African American**	**Asian American**	**Native American**	**Hispanic**	**Caucasian**	**African American**	**Asian American**	**Native American**	**Hispanic**	**Caucasian**
Officials, Managers and Supervisors													
Professionals													
Technicians													
Part-Time Seasonal													
Office & Clerical													
Craftsman (skilled)													
Operatives (semi-skilled)													
Laborers (un-skilled)													
Service Workers													
Total:													

REMARKS: Please explain any identification data appearing on the last report which differs from that given above. This includes major changes in employment, changes in composition of reporting units, and other pertinent information. Use a separate sheet if additional space is required.

V. ADDITIONAL INFORMATION (Optional)

Describe any other actions taken which show that all employees are recruited, hired trained, and promoted without regard to their race, religion, color, sex, age, national origin, disability, sexual orientation, or sexual identity. Use a separate sheet if additional space is required.

VI. POLICY STATEMENT

The City of Canton, Ohio in conformance with local, state, and federal regulations, requires each vendor, contractor, and material suppliers working on City projects or awarded City contracts be signatures of the following statements:

1) It is the policy of _____ that equal employment opportunities be afforded to all qualified persons without regard to race, religion, color, sex, age, national origin, disability, sexual orientation, or sexual identity.

2) In support of this document _____ will not discriminate against any employee or applicant because of race, religion, color, sex, age, national origin, disability, sexual orientation, or sexual identity.

3) _____ will take affirmative action to ensure that applicants for employment and current employees are treated fairly without regard to race, religion, color, sex, age, national origin, disability, sexual orientation, or sexual identity. Such action will include but not be limited to recruitment, advertising, or solicitation for employment, hiring, placement, upgrading, transfer or demotion, selection for training including apprenticeship rates of pay or other forms of compensation, layoffs or termination.

4) _____ will make every effort to comply with minority utilization goals as follows: (9%) nine percent minorities in your workforce on the job, (6.9%) six point nine percent female utilization on this job, and (10%) ten percent of contract amount expended with minority business enterprises, women-owned business enterprises or a combination of both.

5) _____shall require each sub-contractor hired for this project to adhere to this statement.

VII. SIGNATURE

The undersigned certifies that he/she is legally authorized by the vendor/bidder to affirm all information and statements included in this employment practices report. That he/she has read all of the foregoing statements, representations, and affirmations and that they are true and correct to the best of his/her knowledge and belief. The undersigned, understands that if any of the statements and representations are made knowing them to be false or there is a failure to implement any of the stated intentions or objectives, set forth herein, without prior notice to the Office of Compliance, the bidder/contractor could be subject to the loss of current and future awards.

_____

Firm or Corporation Name

_____

Signature

_____

Title

_____

Date of Signing

Bid Form 2: Authority of Bid Signatory

The bidder shall indicate which of the following is the source of the bid signatory's authority to sign the bid on behalf of the bidder. The bidder shall follow the instructions noted.

_____ The party bidding is a sole partnership.

_____ The party bidding is a partnership and the party signing is one of the partners.

_____ The party is a corporation. The party signing is authorized to sign on behalf of the corporation. A copy of the resolution of the corporation's Board of Directors which delegates signatory authority to the individual signing is to be attached to this bid form. This resolution can be a general delegation of authority for signing bids or can be a specific authorization for this project. The Secretary of the corporation shall authenticate the resolution as currently being in full force and effect.

_____ Signatory authority is evidenced by other means noted below:

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Bid Form 3: Bid Guaranty

If a Bid Bond is supplied, the Ohio Statutory Bid Guaranty and Contract Bond, as set forth in ORC 153.571 is to be used.

*****Please include your bid bond or bid check at the front of your submitted bid packet*****

PERFORMANCE BOND AFFIDAVIT

Unless Bidder submits, with its bid, a Bid and Contract Bond per ORC. 153.571, Canton may request that the Bidder obtain, from its insurance representative, a performance bond affidavit that contains the representations noted below. The affidavit shall be made on the insurance agency's letterhead, reference this project by name and state at least the following:

(1) The representative certifies that, should the contract be awarded to the contractor on whose behalf the certificate is being provided, the performance bond specified will be provided.

(2) The name and A.M. Best Company ratings of companies which are expected to provide the required performance bond.

INCLUDE THE CITY OF CANTON, THE OHIO DEPARTMENT OF TRANSPORTATION, AND THEIR AGENTS, AS OBLIGEES ON ALL BONDS.

THE PERFORMANCE BOND AFFIDAVIT SHALL BE NOTARIZED

Bid Form 4: Bidder Information

Bidder Information Page 1 of 3

1. The Bidder shall provide the following information as part of its bid.

   a. Name of Bidder _____

   b. Business Address _____

   _____ _____ _____
   City State Zip

   c. Business Telephone Number (____) _____

   d. Person, address, email and telephone to whom official notices are to be sent _____
   _____
   _____
   _____

   e. Person, address, email and telephone for further information regarding this proposal _____
   _____
   _____
   _____

   f. State(s) of incorporation (w/dates of incorporation) _____
   _____

   g. Principal place of business _____

   h. Federal I.D. Number # _____

   i. Amount of Certified Check, Cashier's Check, Bid Bond $ _____

Bidder Information Page 2 of 3

2. Form of Business Organization.

____ Corporation ____ Partnership ____ Other

3. The bidder shall provide the names and addresses of all persons interested as principals (officers, partners, and associates) in this proposal. Write first name in full, and give titles for offices.

_____ _____
_____ _____
_____ _____
_____ _____

All of the above, including the signatory to this bid, are citizens of the United States, except the following. (Provide names and addresses of those not a citizen of the United States.)

_____ _____
_____ _____
_____ _____
_____ _____

4. Name and address of other person, firms or companies interested in this contract.

_____ _____
_____ _____
_____ _____
_____ _____

Bidder Information Page 3 of 3

The undersigned certifies that the bidder has the facilities, ability and financial resources available for the fulfillment of the contract if such be awarded to said bidder.

Upon request, the bidder will be expected to amplify the foregoing statements as necessary to satisfy the OWNER concerning his ability to successfully perform the work in a satisfactory manner.

Signed this _____ day of _____, 20_____

_____
Contractor

By _____

(Signature of individual, partner or officer signing the proposal.)

Sworn to and subscribed before me this _____ day of

_____, 20 ____.

Notary Public in and for

_____ County,

My Commission Expires:

_____, 20 ____.

Bid Form 5: Project References

Each bidder should provide a list of comparable projects performed over the last three (3) years (maximum of 10) indicating the following:

- Owner (with name, address and telephone number of Owner's project manager).

- General description of work, and size and type of project. Also indicate whether participation was as a prime or subcontractor. If the bidder's participation on the project was as a subcontractor, identify prime contractor with information requested above for the OWNER.

All previous work for the OWNER over the last five (5) years should be identified.

Bid Form 6: Bidder's Affidavit: Non-Collusion Statement, Page 1

This affidavit is to be filled out and executed by the bidder; if the bid is made by a corporation, then by its properly authorized agent.

STATE OF_____)
_____) SS: COUNTY OF _____)

being first duly sworn, deposes and says that he is

_____
(Sole Owner, a Partner, President, Secretary, etc.)

of _____

the party making the enclosed proposal or bid, and say further that

_____
(Give names of all persons, firms or corporations interested in the bid)

_____

_____

_____

_____

is/are the only party or parties interested with the party making this bid in the profits of any contract which may result from the herein contained proposal; that the said proposal is made without any connection or interest in the profits thereof with any other person making any other bid or proposal for said work; that no member of the City of Canton, head of any department or bureau or employee therein or any official or officer of City of Canton, is directly or indirectly interested therein; that said proposal or bid is genuine and not collusive or sham; that said bidder has not colluded, conspired, connived, or agreed, directly or indirectly, with any bidder or person, to put in a sham bid, or that such person shall refrain from bidding, and has not in any manner, directly or indirectly, sought by agreement or collusion, or communication or conference, with any person, to fix the bid price of affiant or any other bidder, or to fix any overhead, profit or cost element of said bid price, or of that of any other bidder, or to secure any advantage against the OWNER, or any person interested in the proposed contract; and that all

Bid Form 6: Page 2

statements contained in said proposal or bid are true; that such bidder has not, directly or indirectly submitted this bid, or the contents thereof, or divulged information or data relative thereto any association or to any member or agent thereof; and further says that all the statements made by him in said proposal or bid are true.

_____

Affiant

Sworn to and subscribed before me this _____ day of

_____, 20 ____.

Notary Public in and for

_____ County,

My Commission Expires:

_____, 20 ____.

Bid Form 7: Factors to Be Used When Determining Lowest and Best Bid, Page 1

NOTICE

All bidders shall hereby take notice of the factors to be considered by the Board of Control in determining whether a bid is not only the lowest bid, but the best bid. Said factors are contained in Canton Ordinance 86/2009, Chapter 105.01.

QUESTIONNAIRE

When completing Bid Form #8, please submit your answers, separately, on your company letterhead and attach to Bid Form #8.

In accordance with Canton Ordinance 86/2009, Chapter 105.01, Section (c), each bidder must complete the following questionnaire. This questionnaire is to be completed in a truthful and responsible manner by the bidder. The City reserves the right to consider the bidder in default for any false or misleading information supplied per this questionnaire. If the bid is made by a corporation, then this questionnaire is to be completed by its properly authorized agent.

1. Please describe the work, supplies and materials covered by the bidder's bid.

2. Please state the identification of all work to be subcontracted. **All subcontractors are also subject to the approval of the Board of Control based on the criteria contained in this section.**

3. Please provide the descriptions of the bidder's experience with projects of comparative size, complexity and cost within recent years, demonstrating the bidder's ability and capacity to perform a substantial portion of the project with its own forces.

4. Please provide documentation from previous, similar projects regarding timeliness of performance, quality of work, extension requests, fines and penalties imposed and payments thereof, liens field, explanations of the same.

5. Please state the number of years the bidder has been actively engaged as a contractor in the construction industry.

6. Please provide your recent experience record in the construction industry, including the original contract price for each construction job undertaken by the bidder, the amount of any change orders or cost overruns on each job, the reasons for the change orders or cost overruns, and the bidder's record for complying with and meeting completion deadlines on construction projects.

7. Please identify any project(s) within the previous five years that the bidder was determined by a public entity not to be a responsible bidder, the reasons given by the public entity, together with an explanation thereof.

Bid Form 7: Page 2

8. Please identify your financial responsibility to assure that the bidder processes adequate resources and availability of credit, the means and ability to procure insurance and acceptable performance bonds required for the project and whether any claims have been made against performance bonds secured by the bidder on other construction projects.

9. Please describe any suspension or revocations of any professional license of any director, officer, owner, or managerial employees of the bidder, to the extent that any work to be performed is within the field of such licensed professional.

10. Please describe any and all OSHA violations within the previous three years, as well as all notices of OSHA citations filed against the bidder in the same three year period, together with an explanation of remediation or other steps taken regarding such violations and notices of violation.

11. Please describe any and all violations within the previous five years pertaining to unlawful intimidation or discrimination against any employee by reason race, creed, color, disability, gender or national origin and/or violations of an employee's civil or labor rights or equal employment opportunities.

12. Please describe any litigation (including copies of pleadings) in which the bidder has been named as a defendant or third party defendant in an action involving a claim for personal injury or wrongful death arising from performance of work related to any project in which it has been engages within the previous five years.

13. Please describe any allegations of violations of the prevailing wage law and any other state or federal labor law, including, but not limited to, child labor violations, failure to pay wages, or unemployment insurance tax delinquencies or unfair practices within the past five years.

14. Please describe any violations of the worker compensation law.

15. Please describe any criminal convictions or criminal indictments, involving the bidder, its officers, directors, owners, and/or managers within the past five years.

16. Please describe any violation within the past five years or pending charges concerning federal, state, or municipal environmental and/or health laws, codes, rules and/or regulations.

17. Please provide documentation that the bidder provides health insurance and pension benefits to its employees.

18. Please state the experience and the continuity of the bidder's work force.

Bid Form 7: Page 3

19. Please submit the identity of the bidder's permanent work force that will be employed on the public contract, to include the number of employees (or contract labor) to be assigned to the contract, their city and state of residence, and their job descriptions or trade specialties.

20. Please provide the identity of any temporary work force that will be employed on the public contract, to include the number of employees (or contract labor) to be assigned to the contract, their city and state of residence, and their job descriptions or trade specialties.

21. Please state whether the bidder's work force is drawn mainly from local employees as defined below. The number of local employees, and their job descriptions or trade specialties that the bidder will employ on the public contract.

Local Employee Definition

A. A person residing within the City of Canton or Stark County,
B. A person working for a contractor or from a pool of labor located within the City of Canton or Stark County; or
C. Due to the specialty nature of the employment to be performed, where a suitable person meeting either subsection A or B hereof is not available, a person residing or working within a location as close to Canton as is available. A "suitable person" means a person who is qualified to perform the work or trainable within a reasonable period of time.

22. If the bidder claims that non-local employees (or non-local contract labor) are to be assigned to the public contract instead of local employees, please state in detail the reasons therefore.

23. If the bidder claims that local employees are not intended to be used by the bidder on the public contract because they are not available, qualified or trainable within a reasonable period of time, please state in detail the reasons therefore.

24. State whether the bidder participates in a bona fide apprenticeship program that is approved by the Ohio State Apprenticeship Council and the United States Department of Labor.

25. State whether the bidder has adopted and implemented a comprehensive drug and alcohol testing program for its employees.

26. State whether the bidder's employees are OSHA-10 and/or OSHA-30 certified.

Bid Form 8: Insurance Affidavit and Requirements

Insurance Requirements

A. The following standard indemnity agreement and minimum insurance requirements are incorporated in the Specifications for all work performed by the Contractor for the City of Canton, Ohio and its affiliated and associated organizations or subsidiaries hereinafter referred to as Owner.

I. The Contractor agrees to indemnify and save the **City of Canton, The Ohio Department of Transportation, and their agents** harmless from and against any and all costs, loss and expense, liability damages, or claims for damages, including cost for defending any action, on account of any injury to persons (including death) or damage to or destruction of property of the Owner, arising or resulting from the work provided for or performed, or from any act, omission, or negligence of the Contractor, subcontractor and his or their agents or employees. The foregoing provisions shall in no way be deemed released, waived or modified in any respect by reason of any insurance or surety provided by the Contractor.

II. The Contractor shall maintain insurance of the kinds and in amounts specified in the attached schedule and furnish the Director of Public Service with Certificates of Insurance as evidence thereof in the prescribed form. If any work provided for or to be performed under any Specifications is sublet (as otherwise permitted by the terms of such Specifications), the Contractor shall require the sub-contractors to maintain and furnish him with satisfactory evidence of Workmen's Compensation, Employers' Liability and such other forms and amounts of insurance which Contractor deems reasonably adequate.

III. In accordance with Item II, the Contractor shall maintain the following insurance:

l. Worker’s Compensation and Employer's Liability Insurance affording,
(a) Protection under the Workmen's Compensation Law in the State of Ohio.
(b) Employer's Liability protection subject to a minimum limit of $100,000.00.

2. Commercial General Liability Insurance in amounts not less than:

General Aggregate Limit	$2,000,000.00
Products - Completed Operations Aggregate Limit	$2,000,000.00
Personal and Advertising Injury Limit	$1,000,000.00
Each Occurrence Limit	$1,000,000.00
Fire Damage Limit	$100,000.00
Medical Expense Limit	$5,000.00

This insurance shall:

a. include coverage for the liability assumed by Contractor under Item I (Indemnity);

b. not to be subject to any of the special property damage

liability exclusions pertaining to blasting or explosion, collapse or structural damage and underground property;

c. not be subject to any exclusion of property used by the insured or property in the care, custody or control of the insured or property as to which the insured for any purpose is exercising physical control unless the required Builders Risk or Installation Floater coverage is indicated on the required Certificate of Insurance (Item III.4);

d. and the Certificates of Insurance furnished by the Contractor shall show by specific reference that each of the foregoing items have been provided for.

e. Include the City of Canton, Ohio and its agents, as an additionally named insured for purposes of coverage under the subject policy.

f. Include the Ohio Department of Transportation and its agents, as an additionally named insured for purposes of coverage under the subject policy.

3. Comprehensive Automobile Liability Insurance in the following minimum amounts:

Bodily Injury $1,000,000.00 for each person and $1,000,000.00 each accident.
Property Damage $1,000,000.0 for each accident

4. The contractor will provide and maintain Installation/Builders Risk Insurance to protect the interests of both the contractor and the owner for materials transported to the job, stored or installed on the premises, or stored at any temporary location off premises. Such insurance shall be written on an "All Risk" form to include the perils of Fire, Extended Coverage, Vandalism, Malicious Mischief, Theft, Collapse and Water Damage. The amount of Insurance shall be 100% of the insurable value of the work to be performed including all items of labor and materials incorporated therein, materials in storage on or off the job site to be used in completing the work, and such other supplies and equipment incidental to the work as are not owned or rented by the contractor, the cost of which is included in the direct cost of the work. This Insurance shall not cover any tools, derricks, machinery, tar buckets, ladders, engines, workmen's quarters, boilers, pumps, wagons, scaffolds, forms, compressors, shanties or other items owned or rented by the Contractor, the cost of which is not included in the direct cost of the work.

B. The Certificates of Insurance furnished by the Contractor as evidence of the Insurance maintained by him shall include a clause obligating the Insurer to give the City of Canton thirty (30) days prior written notice for cancellation or any material change in the insurance.

Insurance Affidavit
Each bidder should obtain from its insurance representative and include in the bid submittal an insurance affidavit that contains the representations noted below. Make the affidavit on the insurance agency's letterhead, reference this project by name, and state at least the following:

1. The representative has reviewed and understands the insurance requirements (including the cancellation/non-renewal provisions) set forth in Bid Form 9.

2. The representative certifies that the company will provide the specified insurance should the contract be awarded to the contractor on whose behalf the certificate is being provided.

3. The names and A.M. Best Company ratings of companies required to provide the required insurance.

You must have the insurance affidavit notarized.

The successful bidder will be required to provide evidence of the required insurance as outlined in this bid form.

Bid Form 9: Bidder's Affidavit: Foreign Corporation

***Any corporation that is not incorporated in the State of Ohio is a foreign corporation**.

The undersigned certifies that _____ is a foreign corporation incorporated in the State of _____, whose principal place of business is _____ and is required to obtain authorization to transact business in the State of Ohio.

The undersigned bidder further certifies that said authorization has been obtained and is in effect and the bidder has a designated statutory agent upon whom process against bidder corporation may be served within the State of Ohio. The designated

statutory agent is _____
(name and address)

_____.
Process served upon the designated statutory agent named above shall be effective service, unless the Owner has been informed, by certified mail or its equivalent (return receipt), of a change in the agent upon whom process can be served.

_____ _____
Date Signed

_____
Title

Note: This statement is to be reproduced on the bidder's letterhead, signed by the authorized bid signatory, notarized and submitted with the bid.

Bid Form 10: Listing of Subcontractors

The bidder shall set forth the name, location of principal place of business, proposed amount of subcontract, and type of work to be performed of each subcontractor who will perform work or labor or render service, as listed, to the bidder in or about the construction of the work or improvement to be performed under the Contract for which the attached bid is submitted, and where the portion of the work which will be performed by each subcontractor will be. Note that subcontractors are distinguishable from suppliers.

Subcontractor **– An individual or entity having a direct contract with CONTRACTOR or with any other Subcontractor for the performance of a part of the work at the site.**

Supplier **– A manufacturer, fabricator, supplier, distributor, material man, or vendor having a direct contract with CONTRACTOR or with any Subcontractor to furnish materials or equipment to be incorporated in the work by the CONTRACTOR or any Subcontractor.**

The Bidder understands that if he fails to specify a subcontractor for any portion of the work to be performed under the Contract, he shall be deemed to have agreed to perform such portion himself.

Bid Form 11: Personal Property Tax Certification (ORC 5719.042)

NOTE: The below form and/or certification must be retyped on the bidder's letterhead and notarized utilizing either paragraph (A) or (B), and paragraph (C) as it applies to your company.

Office of the Auditor
City of Canton
218 Cleveland Avenue S.W., 2nd floor
Canton, OH 44702

To Whom It May Concern:

(A) The undersigned hereby certifies that the party for whom the contract award is being considered was not charged with any delinquent personal property tax at the time of the bid opening for the project nor is said party currently charged with such a delinquency on the general tax list of personal property for Stark County, Ohio.

Or

(B) The undersigned hereby certifies that the party for whom the contract award is being considered has been charged with a delinquency regarding personal property tax on the general tax list of personal property for Stark County, Ohio, either currently, or at the time of bid opening for the project. The amount of the due and unpaid delinquent taxes, including any due and unpaid penalties and interest thereon is _____.

and

(C) It is understood that, under Ohio law, this statement is to be signed by the party whose bid has been tentatively accepted, and must be affirmed under oath. The law also requires that his statement is to be submitted to the City Auditor and this statement must be incorporated into the pending contract before any payment can be made under the subject contract.

_____ _____
Name of Company Signatory

_____
Secretary

Sworn to and subscribed in my presence this _____ day of _____, 20 _____

_____
(Notary Public)

Bid Form 12: Certification: Auditor of the State of Ohio

I, _____
(Name of person signing affidavit) (Title)

do hereby certify that _____ does not have an
(Company or Individual Name)

outstanding unresolved finding for recovery issued by the Auditor of the

State of Ohio as defined by Ohio Revised Code (ORC) Section 9.24 as of

_____.
(Current date)

_____
Signature of Officer or Agent

_____
Name (Print)

Sworn to and subscribed in my presence this _____ day of

_____, 20 _____

_____
(Notary Public)

Bid Form 13: Articles of Incorporation

Please provide a copy of the bidding company's articles of incorporation. The City of Canton may request this information if it is not provided.

Bid Form 14: W9 Tax Form

Please provide an up to date copy of your Company's W9.

Section VI: Project Utility Note

Project Utility Note:

Aerial Interconnect Cable – Fiber optic interconnect cable will be installed on AEP utility poles and city traffic signal poles. Contractor shall take care to not disturb existing utilities attached to the poles. On AEP poles which require new mounting hardware, contractor shall use AEP approved hardware and attachment methods.

Underground Interconnect Cable – All conduits and pull boxes used for the underground fiber optic interconnect cable are city owned and maintained. No conflicts should exist with existing utilities.

Section VII: Change Order Policy

Canton Engineering Change Order Policy

The need for a Change Order for work or materials not included in the scope of the contract or exceeding plan quantities may occur at any time during the contract. The LPA Construction Manager or the LPA Contractor may initiate the Change Order process. The LPA Project Inspector will document the date that the change is first encountered. The LPA Construction Manager will determine if a change in the contract is needed. (Note: LPA Project Inspector may be a Consultant Construction Contract Administrator or the Canton Project Inspector assigned to the project.) The project record shall include record of all changes.

Change Orders will be categorized into the following Tiers:

Tier 1: A quantity adjustment for projects less than $500,000.00 cannot exceed $25,000.00 to qualify as a Tier 1 Change Order. A quantity adjustment for projects greater than $500,000.00 cannot exceed the lesser of 5% or $100,000.00 to qualify as a Tier 1 Change Order. The change of the quantities will be adjusted on a Change Order that will address these changes after an accumulation of adjustments for the project is received. Requests for adjustment may occur at any time before the final payment is made.

Tier 2: Changes that cannot be addressed using contract unit prices, exceed the Tier 1 limits, extend the contract limits, or change the environmental impact will be presented formally on a Change Order. Contractor shall submit an estimated cost and scope of the work to be performed to the LPA Project Manager. The LPA Project Manager will assemble the documentation, including purpose and analysis of the cost of the proposed change for submission to the LPA Construction Manager. LPA Construction Manager shall review the submitted documentation for availability of funds, acceptability of costs and need for the said changes. Further, the LPA Construction Manager will secure concurrence from ODOT Construction Monitor and make recommendation to the Canton City Engineer for acceptance.

The Change Order will then be recommended to the Board of Control for approval. If the sum of all Change Orders exceeds the lesser of $100,000.00 or 10% of the total of the original contract cost, the Change Order will be presented to the Canton City Council for approval before being submitted to the Board of Control.

Execution of the work will not be performed until authorization is given to the contractor from the LPA. In the event that an agreed price cannot be negotiated, LPA will adhere to force account procedures.

Authorization of Change Order Work:

Tier 1: The Canton City Engineering will authorize the work prior to submission of the Change Order. Contractor cannot proceed until such authorization.

Tier 2: The contractor must receive written authorization, from the Canton City Engineer, before the execution of any of the Change Order work. This authorization will not be given until the Change Order has been approved by the Board of Control and Canton City Council, as needed. The Canton

City Engineer may override Tier 2 Authorization procedure for any circumstances to assure safety, environment, or protection of property.

NOTE: Canton City Council must approve all Change Orders prior to authorization for both Tier 1 and Tier 2 should the individual or aggregate cost of all Change Orders exceed the lesser of 100,000.00 or 10% of the project original cost.

Section VIII: Claims Management Policy

The City of Canton recognizes the need to contend with claims experienced by contractors that are not addressed by the contract. This policy is to act as a directive to provide stability and expertise in the management of claims and to ensure they are investigated, evaluated, and resolved in a timely and professional manner.

This policy attempts to resolve disputes in a fair and cost effective manner. The documentation resulting from this procedure will provide information needed to make a reasonable and unbiased decision. The city recognizes that costs can be kept to a minimum when the resolution is found at the departmental level.

Prior to entering into the formal claims management process, both the Prime Contractor and City's Project Manager agree to attempt to resolve any disputes in a good faith effort in accordance with the contract.

Please be advised that all disputes or claims must be presented by the Prime Contractor. Disputes or claims submitted by a sub-contractor or supplier against the City or the Prime Contractor shall not be accepted.

- DEFINITION OF KEY TERMS

City Department Head is defined as the City Engineer, Water Department Superintendent, Reclamation Facility Superintendent, Building Maintenance Superintendent, and Collection Systems Superintendent.

City Project Manager is defined as a representative from City Engineering Department, the City Water Department, City Sewer and Sanitation Department, Collection Systems, Building Maintenance or a party who has a contract with the City of Canton for construction engineering services for this particular project.

Claims are defined as disputes that are not settled in Steps One or Step Two of this process.

Contract Documents is defined those documents listed in the Document Order of Precedence.

Disputes are defined as include disagreements, matters in question, and differences of opinion that may result in a request for additional money and/or time.

Prime Contractor is defined as the contractor who has a contract directly with the City of Canton for this particular project.

- PROCESS

The Prime Contractor must follow this policy to be eligible for any compensation (time or monetary) for any and all claims not covered by the Change Order Policy. All steps in the policy must be completed prior to proceeding to the next step. The Prime Contractor shall immediately provide oral notification to the City Project Manager upon discovering a circumstance that may result in a dispute. The Prime Contractor shall continue all work, including that work that is the subject of the dispute or claim. The City will continue to pay for work being performed.

• STEP ONE CITY PROJECT MANAGER

Within two (2) business days of providing oral notification to the City Project Manager, the Contractor must provide a written notice to the same of any circumstance that may result in a dispute. The City Project Manager will confirm, in writing, receipt of the written notice. The City Project Manager will negotiate in an effort to reach a resolution according to the Contract Documents. The City Project Manager shall issue a written decision within fourteen (14) business days of the Step One meeting. If the dispute is not resolved, the Prime Contractor must either abandon or escalate the dispute to Step Two.

• STEP TWO CITY DEPARTMENT HEAD

Within seven (7) business days of receipt of the Step One decision, the Prime Contractor must submit a written request for a Step Two meeting to the City Department Head. The City Department Head will acknowledge the request, in writing, and assign the dispute a dispute number. Within fourteen (14) business days of the receipt of the City Department Head's written acknowledgment, the Prime Contractor shall submit dispute documentation as follows:

1. The Prime Contractor shall submit three (3) complete copies of the documentation of the dispute to the City Department Head.
2. The dispute documentation shall be identified on a cover page by the project name, the parties involved in the dispute and the dispute number.
3. All documentation must be original documents that details the required information for each item of additional compensation and/or time extension requested.
4. A narrative of the disputed work or project circumstance at issue. This section must include the dates of the disputed work and the date of the written notice as required in Step One.
5. References to the applicable provisions of the plans, specifications, proposal, or other contract documents. Copies of the cited provisions shall be included.
6. The dollar amount of additional compensation and length of time extension being requested, supported by documentation that serve as the basis for said amounts of compensation or time.
7. A detailed schedule analysis must be included for any dispute concerning additional time, actual or constructive acceleration, or delay damages. Failure to submit the required schedule analysis will result in denial of that portion of the Prime Contractor's request.
8. Copies of all relevant correspondence and other pertinent documents.

The City Department Head shall review the dispute documentation and make a written recommendation within fourteen (14) business days of receipt of the dispute documentation. If the Prime Contractor accepts, in writing, the City Department Head's recommendation, the dispute will cease and/or be processed as a Change Order. If the Prime Contractor does not accept the City Department Head's recommendation, in writing, the City Department Head will set a time for a Step Two meeting within fourteen (14) business days of receipt of the Prime Contractor's written response. The Step Two meeting shall be attended by the Prime Contractor and City Project Manager. Each party will have reasonable time to explain their positions regarding the dispute. Within ten (10) business days of the Step Two meeting, the City Department Head will issue a written determination of the dispute to the Prime Contractor and the City Project Manager. If the Prime Contractor accepts the City Department Head's determination, in writing, the dispute will cease and/or be processed as a Change Order. If the Prime Contractor does not accept the City Department Head's determination, the Prime Contractor may escalate to Step Three.

• STEP THREE DIRECTOR OF PUBLIC SERVICE CLAIMS COMMITTEE

Within fourteen (14) business days of receipt of the City Department Head's written determination, the Prime Contractor shall submit a *Notice of Intent to File a Claim* and four (4) copies of its claim documentation to the Director of Public Service by certified U.S. mail. This notice shall state the Prime Contractor's request for a Step Three Hearing on the claim. Within ten (10) calendar days of receipt of the *Notice of Intent to File a Claim*, the Director of Public Service shall submit the *Notice of Intent to File a Claim* and one (1) complete copy of the Prime Contractor's claim documentation to the City Department Head and City Project Manager. Within thirty (30) calendar days of the receipt of the *Notice of Intent to File a Claim* by the City Department Head and City Project Manager, the City Department Head and City Project Manager shall submit four (4) copies of its documentation to the Director of Public Service and one (1) copy to the Prime Contractor. After receiving the both the Prime Contractor and City Department Head and/or City Project Manager's documentation, the Director of Public Service shall set a hearing date not more than sixty (60) days from the date of receipt of said documentation. At any time between the receipt of either party's documentation and the hearing date, the Director of Public Service may request additional information. If the party fails to provide the requested information, the Director of Public Service may render his/her decision without it. The hearing date may be rescheduled one (1) time to allow time for additional review of submitted information.

The hearing will be conducted by the Director of Public Service Claims Committee. The Committee shall consist of, at the minimum, the Director of Public Service, a representative of the Canton Law Department, and a representative of the Canton Purchasing Department. The Director of Public Service may add members as he/she sees fit.

Upon completion of the hearing, the Committee will take both sides of the claim into consideration. Within thirty (30) calendar days of the Step Three hearing, the Director of Public Service will send a written decision to all parties. Within (14) calendar days, the Prime Contractor must either accept or reject the decision in writing. Step Three is the final step of the Claims Policy.

<u>Hearing Procedure</u>

The Prime Contractor and City Department Head and/or City Project Manager will each be allowed adequate time to present their respective positions. Each party's position will be presented by someone who is thoroughly knowledgeable about the claim. Each party will be allowed to have others assist in the presentation. Each party will also be allowed one (1) rebuttal period limited to the scope of the other party's presentation. The Committee may ask questions at any time during the presentation.

The parties shall behave in a professional manner. The parties shall refrain from interrupting and/or interfering with the other party's presentation. The Director of Public Service reserves the right to maintain order in the hearing. If a party continues to interrupt and/or interfere with the other party's presentation, after one warning, that party may: be removed from the hearing or forfeit their rebuttal time.

In the event that both parties do not behave in a professional manner, the Director of Public Service may choose to hear each party's presentation in caucus.

Claim Documentation

When submitting the claim documentation, the Prime Contractor must certify the claim in writing. Such certification shall attest to the following:

1. The claim is made in good faith.
2. To the best of the Prime Contractor's knowledge, all data offered to support the claim is accurate and complete.
3. The claim amount accurately reflects the Contractor's actual incurred costs and additional time impacts.

This claim certification shall also be notarized pursuant to the laws of the State of Ohio. The following is an example of the correct form for a claim certification:

(Prime Contractor) certifies that this claim is made in good faith, that all supporting data is accurate and complete to the best of the (Prime Contractor's) knowledge and belief, and that the claim amount accurately reflects the contract amendment for which (Prime Contractor) believes the City of Canton is liable.

*By:*_____

*Date of Execution:*_____

At a minimum, the Prime Contractor's Claim Documentation shall include:

1. A narrative of the disputed work or project circumstance at issue with sufficient description and information to enable understanding by a third party who has no knowledge of the dispute or familiarity with the project. This section must include the dates of the disputed work and the date of the written notice as required in Step One. This section must also list the steps the parties have taken to resolve this claim.
2. References to the applicable provisions of the plans, specifications, proposal, or other contract documents. Copies of the cited provisions shall be included.
3. The dollar amount of additional compensation and length of time extension being requested, supported by documentation that serve as the basis for said amounts of compensation or time.
4. A detailed schedule analysis must be included for any dispute concerning additional time, actual or constructive acceleration, or delay damages. Failure to submit the required schedule analysis will result in denial of that portion of the Prime Contractor's request.
5. Copies of all relevant correspondence and other pertinent documents

At a minimum, the City Department Head and/or City Project Manager's Claim Documentation shall include:

1. A narrative of the disputed work or project circumstance at issue with sufficient description and information to enable understanding by a third party who has no knowledge of the

dispute or familiarity with the project. This section must also list the steps the parties have taken to resolve this claim.

2. References to the applicable provisions of the plans, specifications, proposal, or other contract documents. Copies of the cited provisions shall be included.
3. Response to each argument set forth by the Prime Contractor.
4. Any counter-claims, accompanied by supporting documentation they wish to assert.
5. Copies of all relevant correspondence and other pertinent documents.

Section IX: Signature and Proposal Pages

Signature Page
Sludge Processing Modifications, Contract 27

To the Director of Public Service of the City of Canton:

The undersigned, having carefully examined the complete invitation to bid, herewith proposes to furnish all the labor and materials required to complete the **Sludge Processing Modifications, Contract 27** in accordance with the specifications on file, including any and all work and materials that may be necessary to complete the project in a proper and workmanlike manner, and in accordance with the instructions in the bid packet and under the direction of and to the satisfaction of the Director of Public Service of said City.

The bidder hereby agrees that the Director of Public Service has the right to reject any and all bids and to accept the bid(s) deemed most beneficial to the City of Canton.

The bidder hereby certifies that the undersigned is the only person interested in the bid and the bidder herewith certifies that no officer or employee of the City of Canton is in any manner interested therein.

The bidder herewith encloses a _____**(BID BOND, CERTIFIED/CASHIER'S CHECK)** in the sum of $ _____ dollars made payable to the CITY OF CANTON as a guaranty that if awarded the contract for the work included in the proposal, will enter into contract therefore, with sureties satisfactory to the Director of Public Service, within the prescribed time of ten (10) days from the date of service of notice of award, otherwise such bond or checks shall become the property of said City, as liquidated damages of the failure on the bidder's part to do said contract within the specified time.

The bidder acknowledges receipt of Addenda Numbers: _____.

SIGNATURE OF BIDDER: _____.

NOTE: If bidder is a corporation, set forth the legal name of the corporation, together with the signature of the officer or officers authorized to sign contracts on behalf of the corporation. If bidder is a partnership, set forth the name of the firm, together with the signature of the partner or partners authorized to sign contracts on behalf of the partnership.

Proposal Pages
Sludge Processing Modifications, Contract 27

BASIS OF BID

Bidder will complete the work in accordance with the Contract Documents for the following price(s):

ITEM NO.	DESCRIPTION	EST. QTY	ITEM TOTAL
1.	Sludge Processing Modifications, complete, lump sum	1	
2.	General Allowance	1	$200,000

TOTAL BID, IN FIGURES	$	
TOTAL BID, IN WORDS	$	

BASE BID MANUFACTURERS (CONTRACT B ONLY)

The Contract Documents have been prepared using specific manufacturers for certain equipment and materials, and the prices provided by Bidder shall be based on the manufacturers specified and listed below as Base Bid Manufacturers. For items that list only one manufacturer, that manufacturer's equipment or material shall be included in the Base Bid. For items that list more than one manufacturer, Bidder shall indicate, by placing an "X" in the spaces ( ) provided, the manufacturer proposed to be furnished as part of the Base Bid. One and only one "X" shall be entered for each Base Bid item with more than one listed manufacturer. If Bidder marks more than one manufacturer or fails to mark one where required for a particular piece of equipment or material, the equipment or material provided under the Contract shall be that as selected by Owner from the listed Base Bid Manufacturers.

Please check the box indicating which manufacturer is considered as the basis of your Cost Proposal.

SECTION NO.		EQUIPMENT OR MATERIAL		X	BASE BID MANUFACTURERS
46 76 33		Dewatering Centrifuges		( )	Alfa Laval, Inc.
				( )	GEA Westfalia Separator Division of GEA Mechanical Equipment U.S., Inc.

Appendix A: Prevailing Wage Requirements and Rates

Overview

This project will utilize Ohio Prevailing Wage Rates. All contractors and subcontractors are required to comply with all Prevailing Wage Requirements in the Ohio Revised Code. These requirements are outlined below and sample documents are contained in the following pages and will be utilized to comply with these requirements. **Please note that the City of Canton will withhold payroll and/or retainage for a pay application or for the project in total until all prevailing wage issues are resolved.**

Payroll Dates Form

Must be submitted to the Prevailing Wage Coordinator (PWC) on or before the date your company starts work under the contract. It is to be completed with the **actual payroll dates** and not a day of the week. This requirement applies to all contractors/subcontractors.

Letter of Authorization for Payroll Signature

The person signing the certified payrolls must be an Owner or Corporate Officer of the company, or an Authorization letter must be completed and sent to the Prevailing Wage Coordinator. The document sent **must be** the **original signed notarized document**. If the person signing the payroll changes during the course of the project then a new Letter of Authorization for payroll signature must be submitted.

Fringe Benefits Form

Please complete and return along with the payroll dates form and letter of authorization for payroll signature form.

Notification to Employee Form

If your company is a **non-union company** you **must provide a completed Notification form to each employee working on this site and provide the PWC a copy** (wage and fringe benefit amounts on Notification must match amounts listed on payrolls), the form must have the Prevailing Wage Coordinator information, if you are a **union company** you need to send the PWC **a copy of the contract/agreement your company has with the local Trade Union(s)**.

Certified Payroll

The **first certified payroll** must be sent to the Prevailing Wage Coordinator **within two weeks of 1st pay period on the job**, payrolls must be sent **weekly** to the Prevailing Wage Coordinator if your company is working **four months or less** on site, payrolls must be sent **at least monthly** if working **more than four months** on site. Certified payroll forms used by contractors **must include all the information that is on payroll form included** with this package, if the payroll form you use does not have sections for all the information, it must be included as an attachment to the certified payroll. (During the project you may send copies of the certified payroll but **by the end of the project you must provide the original signed documents to the Prevailing Wage Coordinator** before you will receive your final payment). Fringe benefit break down needs to be attached to **each** payroll. For any **work classifications** requiring a group number (1-5) such as laborer or operating engineer if the group number or identifying equipment employee is operating is not entered a revised payroll will be required.

Affidavit of Compliance

When each contractor/subcontractor has completed their work on the job site they're required to submit a Final Affidavit of Compliance before the primary contractor receives their final payment and any retainer. Must send Prevailing Wage Coordinator original signed document.

Apprentices

Any/all apprentices working on this project must be registered with the State of Ohio Apprenticeship Council, apprentices on site cannot exceed ratios in the wage decision rate schedule, contractors/subs must provide the Prevailing Wage Coordinator a copy of the Apprenticeship Agreement from the program for each apprentice on the project with the first payroll on which they appear. You must provide the apprentice level/year, i.e. 1, 2, 3, etc. and/or percent of Journeyman's pay rate, i.e. 50%, 55%, etc. on the certified payrolls.

Subcontractors

If any subcontractors will be used during this project then a list of subcontractors including their name, address, and phone number must be provided to the Prevailing Wage Coordinator. The Prime contractor is responsible for all forms to be furnished to subcontractors, **along with wage rates** or any other modification vital to the project.

Prevailing Wage Rates

Attached are the State of Ohio Prevailing Wage Rates as of the posting date of this bid. Actual rates due to workers will be those in affect at the time of work. Please note that the wages of the County where the work is be completed will be in effect. Due to the location of the water treatment plants, this could be either Stark or Tuscarawas counties. Both are attached. All applicable prevailing wage rates must be posted on the job site for the duration of the project.

PREVAILING WAGE COORDINATOR

The City of Canton has designated Cheryl Southwell as Prevailing Wage Coordinator, in accordance with Section 4115.071 of the Ohio Revised Code.

Her office is located at City of Canton, 218 Cleveland Ave SW, Canton, Ohio 47702
Cheryl Southwell: 330-438-4183

CONTRACTORS SUBMISSIONS TO THE WAGE COORDINATOR:

1) Contractors are required to supply to the Wage Coordinator, **a schedule of the dates during the life of the contract with City of Canton on which they are required to pay wages to the employees**. See Section 4115.03 (A) (2)

2) Contractors shall also deliver to the Wage Coordinator **a certified copy of the payroll within two weeks after the initial pay date and supplemental reports for each month thereafter, which shall exhibit for each employee, their name, current address, social security number, job classification, number of hours worked for project, rate of pay, project gross pay, fringe payments, total hours all jobs, total gross all jobs, and deductions from their wages.** See Section 4115.03 (A) (3)

3) If the life of the contract is expected to be no more than four months from the beginning of performance by the contractor or subcontractor, such supplemental reports shall be filed each week after the initial report. See Section 4115.03 (A) (6) (C)

4) The certification of each payroll shall be executed by the contractor, subcontractor, or duly appointed agent thereof and **include a State of Compliance** stating that the payroll is correct and complete and that during the payroll period, all persons employed on said project have been paid the full weekly wages earned, that no rebates have or will be made either directly or indirectly to, or on behalf of said contractor or subcontractor for the full weekly wages earned by any person and that no deductions have been made either directly or indirectly from the full wages earned by any person, other than permissible deductions. See Section 4115.03 (A) (6) (C)

5) Contractors will also provide **each month a copy of any Labor Union Fringe Benefit Fund reports that they submitted to the unions**. See Section 4115.03

PREVAILING WAGE COORDINATOR MONITORING PROCEDURES

The wage Coordinator's duties are those specified in Section 4115.071 and shall include:

1 Attend Pre-Construction Meetings to advise contractor of Prevailing Wage responsibilities

2 Wage Coordinator has the authority to spot check employees pay checks in the field on the scheduled pay days for full compliance, with regard to the prevailing wage rates, including benefits.

3 Wage Coordinator shall visit the project site to get names of employees performing work on the project site, to cross check with payroll reports submitted.

4 Wage Coordinator shall verify the subcontractors performing work on the project site with regard to whether they have been approved by the contracting authority.

5 Wage Coordinator shall check to see that the prevailing wages are posted on the project site in a place accessible to employees.

6 Ascertain that the statement of compliance accompanying the certified payroll is the correct one for the project

7 Wage Coordinator has the right to request any addition information they feel is required for proper wage verification.

8 Contact Contractors of delinquent payrolls

9 Notify contractors when necessary to request payroll corrections

10 Investigate wage complaints ,by self or with Ohio Department of Commerce Division of Labor & Worker Safety

PAYROLL DATES
PREVAILING WAGE LAW

Instructions to the Contractor: Please read the following and provide the required information noted on this form. This document must be submitted to the Prevailing Wage Coordinator for the public authority on or before your company begins any work under a contract for a public improvement. This requirement is also applicable to your subcontractors. Please make a copy of this document available to them. The prevailing wage laws state that contractors are responsible for their subcontractors.

_____ will begin performance under contract on the
(Name of Contractor)

_____ project on _____
(Name and Location of Project) (Start Date)

and will conclude work on said project on _____.
(End Date, if known)

In accordance with Section 4115.071 (C) of the Ohio Revised Code, listing of payroll dates, I hereby submit the following schedule of dates that my company is required to pay wages to its workers while on this project.
NOTE: If the life of the project is expected to be over three (3) months in length, provide only the days of the week your pay period starts and ends, plus the day you pay your workers.

_____ _____ _____

_____ _____ _____

_____ _____ _____

_____ _____ _____

Day Pay Period Starts:_____ Day Pay Period Ends:_____

Pay Day:_____

I acknowledge that I am required by section 4115.071 (C) of the Ohio Revised Code that I must submit a copy of my company's certified payroll records for this project to the Prevailing Wage Coordinator of the public authority within two weeks of the initial pay date listed above. I further acknowledge that I am responsible to collect and submit my subcontractor's prevailing wage documents, including their certified payroll records in accordance with the law.

_____ _____
(Contractor's Signature and Title) (Company Name)

_____
(Date)

LETTER OF AUTHORIZATION FOR PAYROLL SIGNATURE:

DATE: _____

COMPANY NAME: _____

ADDRESS: _____

_____

FEDERAL I.D.# _____

RE: _____

(Project Name) (Project Number)

_____

(Address)

_____ hereby authorizes

(Company Officer/Owner-Title)

_____ as the person to

complete and sign all certified payroll forms for the above project.

BY:_____

(Print Name)

_____

(Signature)

_____

(Title)

Sworn and subscribed in my presence this _____ day of _____ 20___

_____

Notary Public

FRINGE BENEFITS

PLEASE COMPLETE THIS FORM AND RETURN IT TO THE ADDRESS BELOW.

_____ FRINGE BENEFITS ARE ALL PAID IN CASH TO THE EMPLOYEE.

_____ FRINGE BENEFITS ARE PAID IN CASH AND TO THE BENEFIT PROGRAMS LISTED BELOW.

_____ FRINGE BENEFITS ARE ALL PAID TO THE FOLLOWING BENEFIT PROGRAMS:

HEALTH & WELFARE PLAN: _____

ADDRESS: _____

_____

PENSION PLAN: _____

ADDRESS: _____

_____

APPRENTICESHIP PROGRAM: _____

YOUR COMPANY IS: _____ UNION _____ NON-UNION

YOUR COMPANY PAYS ALL EMPLOYEES: _____ WEEKLY _____ BI-WEEKLY

FORWARD A BLANK FORM TO EACH SUBCONTRACTOR ON THE PROJECT FOR COMPLETION.
RETURN ALL FORMS TO:

CITY OF CANTON
218 CLEVELAND AVE SW
CANTON, OHIO 44702
ATTN: PREVAILING WAGE COORDINATOR

CONTRACTOR'S NAME: _____

ADDRESS: _____

PROJECT NAME: _____

PREVAILING WAGE NOTIFICATION to EMPLOYEE

4115.05 .....the contractor or subcontractor shall furnish each employee not covered by a collective bargaining agreement written notification of the job classification to which the employee is assigned, the prevailing wage determined to be applicable to that classification, separated into the hourly rate of pay and the fringe payments, and the identity of the prevailing wage coordinator appointed by the public authority. The contractor or subcontractor shall furnish the same notification to each affected employee every time the job classification of the employee is changed.

Project Name:	Job Number.
Contractor:	
Project Location:	
Jobsite posting of prevailing wage rates located:	

Prevailing Wage Coordinator	Employee
Name: City of Canton Attn: Cheryl Southwell	Name:
Street: 218 Cleveland Ave SW 6th Floor	Street:
City: Canton	City:
State/Zip: Ohio 44702	State/Zip:
Phone: 330-438-4183	Phone:

You will be performing work on this project that falls under these classifications. You will be paid the appropriate rate for the type of work you are performing.

Classification:	Prevailing Wage Rate Total Package:	Minus your fringe benefits:	Your hourly base rate:

Hourly fringe benefits paid on your behalf by this company:

Fringe	Amount	Fringe	Amount
Health Insurance		Vacation	
Life Insurance		Holiday	
Pension		Sick Pay	
Bonus		Training	
Other		**Total Hourly Fringes**	

ontractor's Signature:	Date:
Employee's Signature:	Date:

INSTRUCTIONS FOR PREPARING CERTIFIED PAYROLL REPORTS

General:

Contractors and subcontractors are required by law to submit certified payroll reports for work on projects covered by Ohio's Prevailing Wage Law. This form meets the reporting requirements established by Ohio Revised Code Chapter 4115. The use of this form is not mandatory; employers may submit their own forms provided that all of the required information is included. This form may be reproduced, or additional copies obtained from:

Ohio Department of Commerce
Division of Industrial Compliance
Bureau of Wage and Hour Administration
6606 Tussing Road, P.O. Box 4009
Reynoldsburg, Ohio 43068-9009
614-644-2239
www.com.ohio.gov

Certified Payroll Heading:

Employer name and address: Company's full name and address…Indicate if the company is a subcontractor.
Subcontractor: Check and list the name of the General Contractor or Prime.
Project: Name and location of the project, including county.
Contracting Public Authority: Name and address of the contracting public authority… (Owner of the project).
Week Ending: Month, day, and year for last day of reporting period.
Payroll # : Indicates first, second, third, etc. payroll filed by the company for the project.
Page indicator: number of pages included in the report.
Project Number: Determined by the public authority…If there is no number leave blank.

Payroll Information by column:

1. Employee Name, Address and Social Security number: This information must be provided for all employees that perform physical labor on the project. The Social Security number is required; the last four digits may be permitted by the public authority. Corporate officers, partners, and salaried employees are considered employees and must be paid the prevailing rate. Individual sole proprietors do not have to pay themselves prevailing rate but must report their hours on the project.

2. Work Class: List classification of work actually performed by employee. If unsure of work classification, consult the Ohio Department of Commerce-Division of Industrial Compliance & Labor-Bureau of Wage and Hour Administration. Employees working more than one classification should have separate line entries for each classification. Indicate what year/level for Apprentices. Be specific when using laborer and operator classifications; for example, Backhoe Operator or Asphalt Laborer or by "Group".

3. Hours Worked, Day & Date: In the first row of column 3, enter days of the company's pay period for example; M T W TH F S S. The second row is for the date that corresponds with each day for the pay period. In the employee information section, enter the number of hours worked on the prevailing wage project and which day the hours were worked. Separate rows are labeled for (ST) straight time hours and (OT) overtime hours. All hours worked after 40, must be paid at the appropriate overtime rate.

4. Project Total Hours : Total the hours entered for pay period.

5. Base Rate: Enter actual rate per hour paid to the employee. The overtime hourly rate is time and one-half the base rate listed in the prevailing wage schedule plus fringe benefits at straight time rate. The prevailing wage schedule lists the base rate plus fringe benefit amounts. These amounts added together equal the total prevailing wage rate. Employers must pay this total amount in one of three ways.
   1) Total rate may be paid in entirety in the base rate to the employee; in which case, the cash designation will be checked for fringe benefits.
   2) Total rate may be paid as listed in prevailing wage rate schedule with total fringe amounts paid approved plans.
   3) Total rate may be paid with a combination of base rate and fringe payments to approved plans in amounts other than those listed in schedule.

6. Project Gross: Enter total gross wages earned on the project for straight time and overtime. Project hours "X" base rate should equal project gross.

7. Fringes: If fringe benefits are paid in the hourly base rate, indicate this by marking the **Cash** space. If fringe benefits are paid to approved plans as listed in the prevailing wage rate schedule, mark the space **Approved Plans.** If fringe benefits are paid partially in the base rate and partially to approved plans, mark the space **Cash & Approved Plans.** List the hourly amount paid to approved plans for each fringe. If payments are not made on a per hour basis, ***calculate the hourly fringe credit by dividing the yearly employer contribution by*** the lesser of: hours actually worked in the year (these must be documented) or ***2080.*** Fringe benefits include: **Employer's share** of health insurance, life insurance, retirement plan, bonus/profit sharing, sick pay, holiday pay, personal leave, vacation, and education/training programs. If unsure of a possible fringe benefit, contact the Ohio Department of Commerce-Division of Industrial Compliance & Labor-Bureau of Wage and Hour Administration.

8. Total Hours All Jobs: Total all hours worked during the pay period including non-prevailing wage jobs.

9. Total Gross All Jobs: Gross amount earned in the pay period for all hours worked.

10. Self explanatory.

11. Self explanatory.

(a) The number of hours worked in each day and the total number of hours worked each week.

4. Hourly rate for each employee.
   (a) The minimum rate paid must be the wage rate for the appropriate classification. The Department's Wage Rate Schedule sets this rate.
   (b) All overtime worked is to be paid at time and one-half for all hours worked more than forty (40) per week.
5. Where fringes are paid into a bona fide plan instead of cash, list each benefit and amount per hour paid to program for each employee.
   (a) When the amount contributed to the fringe benefit plan and the total number of hours worked by the employee on all projects for the year are documented, the hourly amount is calculated by dividing the total contribution of the employer by the total number of hours worked by the employee.
   (b) When the amount contributed to the fringe benefit is documented but not the total hours worked, the hourly amount is calculated by **dividing the total yearly contribution by 2080.**
6. Gross amount earned on all projects during the pay period.
7. Total deductions from employee's wages.
8. Net amount paid.

J. The reports shall be certified by the contractor, subcontractor, or duly appointed agent stating that the payroll is correct and complete; and that the wage rates shown are not less than those required by the O.R.C. 4115.

K. Provide a Final Affidavit to the Prevailing Wage Coordinator upon the completion of the project.

CERTIFIED PAYROLL REPORT

Employer Name & Address	Name of General / Prime Contractor	Project Name & Location	Contracting Public Authority
Check if subcontractor ☐	Week Ending	Payroll # Page______Of______	Project Number

1. Employee Name, Address and Social Security Number	2. Work Class	3. Hours Worked - Day & Date								4. Project Total Hrs	5. Base Rate	6. Project Gross	7. Fringes: Cash ☐ Approved Plans ☐ Cash & Approved Plans ☐					8. Total Hours All Jobs	9. Total Gross All Jobs	10. Taxes Withheld	11. Other Deducts	12. NET Paid
													H&W	Pens	Vac	App	Other					
		OT																				
		ST																				
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Date________________My signature on this form signifies that I pay, or supervise the payment of the employees shown above. I am certifying: 1) That during the pay period reported on this form, all hours worked on this project have been paid at the appropriate prevailing wage rate for the class of work done. 2) That the fringe benefits have been paid as indicated above. 3) That no rebates or deductions have been or will be made, directly or indirectly from the total wages earned, other than permissable deductions as defined in the Ohio Revised Code Chapter 4115. 4) That apprentices are registered with the U.S. Department of Labor, Bureau of Apprenticeship and Training. The willful falsification of any of the above statements may subject the contractor or subcontractor to civil or criminal prosecution.

Name and Title ______________________________ Signature ______________________________

AFFIDAVIT OF CONTRACTOR OR SUBCONTRACTOR

PREVAILING WAGES

I, _____,
(Name of person signing the affidavit) (Title)

of the _____, do hereby certify that the
(Company Name)

wages paid to all employees for the full number of hours worked in connection with the Contract to the Improvement, Repair and Construction of:

_____
(Project name and location of the project)

during the following period from _____ to _____

in accordance with the prevailing wage prescribed by the contract document.

I further certify that no rebates of deductions for any wages due any person have been directly or indirectly made other that those provided by law.

_____
(Signature of officer or agent)

Sworn to and subscribed in my presence this _____ day of _____

20_____.

_____
(Notary Public)

The above affidavit must be executed and sworn to by the officer or agent of the Contractor or Subcontractor who supervises the payment of employees, before the owner will release the surety and/or make a final payment due under the terms of the Contract.

Prevailing Wage Determination Cover Letter

County: STARK
Determination Date: 05/31/2018
Expiration Date: 08/31/2018

THE FOLLOWING PAGES ARE PREVAILING RATES OF WAGES ON PUBLIC IMPROVEMENTS FAIRLY ESTIMATED TO BE MORE THAN THE AMOUNT IN O.R.C. SEC. 4115.03 (b) (1) or (2), AS APPLICABLE.

Section 4115.05 provides, in part: "Where contracts are not awarded or construction undertaken within ninety days from the date of the establishment of the prevailing wages, there shall be a redetermination of the prevailing rate of wages before the contract is awarded." The expiration date of this wage schedule is listed above for your convenience only. This wage determination is not intended as a blanket determination to be used for all projects during this period without prior approval of this Department.

Section 4115.04, Ohio Revised Code provides, in part: "Such schedule of wages shall be attached to and made a part of the specifications for the work, and shall be printed on the bidding blanks where the work is done by contract..."

The contract between the letting authority and the successful bidder shall contain a statement requiring that mechanics and laborers be paid a prevailing rate of wage as required in Section 4115.06, Ohio Revised Code.

The contractor or subcontractor is required to file with the contracting public authority upon completion of the project and prior to final payment therefore an affidavit stating that he has fully complied with Chapter 4115 of the Ohio Revised Code.

The wage rates contained in this schedule are the "Prevailing Wages" as defined by Section 4115.03, Ohio Revised Code (the basic hourly rates plus certain fringe benefits). These rates and fringes shall be a minimum to be paid under a contract regulated by Chapter 4115 of the Ohio Revised Code by contractors and subcontractors. The prevailing wage rates contained in this schedule include the effective dates and wage rates currently on file. In cases where future effective dates are not included in this schedule, modifications to the wage schedule will be furnished to the Prevailing Wage Coordinator appointed by the public authority as soon as prevailing wage rates increases are received by this office.

"There shall be posted in a prominent and accessible place on the site of work a legible statement of the Schedule of Wage Rates specified in the contract to the various classifications of laborers, workmen, and mechanics employed, said statement to remain posted during the life of such contract." Section 4115.07, Ohio Revised Code.

Apprentices will be permitted to work only under a bona fide apprenticeship program if such program exists and if such program is registered with the Ohio Apprenticeship Council.

Section 4115.071 provides that no later than ten days before the first payment of wages is due to any employee of any contractor or subcontractor working on a contract regulated by Chapter 4115, Ohio Revised Code, the contracting public authority shall appoint one of his own employees to act as the prevailing wage coordinator for said contract. The duties of the prevailing wage coordinator are outlined in Section 4115.071 of the Ohio Revised Code.

Section 4115.05 provides for an escalator in the prevailing wage rate. Each time a new rate is established, that rate is required to be paid on all ongoing public improvement projects.

A further requirement of Section 4115.05 of the Ohio Revised Code is: "On the occasion of the first pay date under a contract, the contractor shall furnish each employee not covered by a collective bargaining agreement or understanding between employers and bona fide organizations of Labor with individual written notification of the job classification to which the employee is assigned, the prevailing wage determined to be applicable to that

classification, separated into the hourly rate of pay and the fringe payments, and the identity of the prevailing wage Coordinator appointed by the public authority. The contractor or subcontractor shall furnish the same notification to each affected employee every time the job classification of the employee is changed."

Work performed in connection with the installation of modular furniture may be subject to prevailing wage.

THIS PACKET IS NOT TO BE SEPARATED BUT IS TO REMAIN COMPLETE AS IT IS SUBMITTED TO YOU. (Reference guidelines and forms are included in this packet to be helpful in the compliance of the Prevailing Wage law.)
wh1500

Prevailing Wage Rate
Skilled Crafts

Name of Union: Asbestos Local 207 OH

Change # : LCN01-2017fbLoc207OH

Craft : Asbestos Worker Effective Date : 10/04/2017 Last Posted : 10/04/2017

Classification	BHR	Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
		H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Asbestos Abatement	$25.00	$7.00	$6.05	$0.65	$0.00	$0.00	$0.07	$0.00	$0.00	$38.77	$51.27
Trainee	$16.30	$7.00	$1.40	$0.65	$0.00	$0.00	$0.07	$0.00	$0.00	$25.42	$33.57

Special Calculation Note :

Ratio :
3 Journeymen to 1 Trainee

Jurisdiction (* denotes special jurisdictional note) :
ADAMS, ASHLAND, ASHTABULA*, ATHENS, AUGLAIZE, BROWN, BUTLER*, CARROLL, CHAMPAIGN, CLARK, CLERMONT, CLINTON, COLUMBIANA, COSHOCTON, CRAWFORD, CUYAHOGA, DARKE, DELAWARE, FAIRFIELD, FAYETTE, FRANKLIN, GEAUGA, GREENE, GUERNSEY, HAMILTON, HARDIN, HARRISON, HIGHLAND, HOCKING, HOLMES, HURON, KNOX, LAKE, LICKING, LOGAN, LORAIN, MADISON, MAHONING, MARION, MEDINA, MIAMI, MONTGOMERY, MORGAN, MORROW, MUSKINGUM, NOBLE, PERRY, PICKAWAY, PORTAGE, PREBLE, RICHLAND, ROSS, SHELBY, STARK, SUMMIT, TRUMBULL, TUSCARAWAS, UNION, VINTON, WARREN*, WAYNE

Special Jurisdictional Note : Butler County:(townships of Fairfield,Hanover,Liberty,Milford,Morgan,Oxford,Ripley,Ross,StClair,Union & Wayne.) (Lemon & Madison) Warren County: (townships of: Deerfield, Hamilton, Harlan, Salem, Union & Washington). (Clear Creek, Franklin, Mossie, Turtle Creek & Wayney). Ashtabula County: (post offices & townships of Ashtabula, Austinburg, Geneva, Harperfield, Jefferson, Plymouth & Saybrook) (townships of Andover, Cherry Valley, Colbrook, Canneaut, Denmark, Dorset, East Orwell, Hartsgrove, Kingville, Lenox, Monroe,Morgan,New Lyme,North Kingsville, Orwell, Pierpoint, Richmond Rock Creek, Rome, Shefield, Trumbull, Wayne, Williamsfield & Windsor) Erie County:(post offices & townships of Berlin, Berlin Heights,Birmingham,Florence ,Huron, Milan, Shinrock & Vermilion)

Details :

Asbestos & lead paint abatement including,but not limited to the removal or encapsulation of asbestos & lead paint,all work in conjunction with the preparation of the removal of same & all work in conjunction with the clean up after said removal.The removal of all insulation materials, whether they contain asbestos or not, from mechanical systems (pipes, boilers, ducts, flues, breaching, etc.) is recognized as being the exclusive work of the Asbestos Abatement Workers.

On all mechanical systems (pipes, boilers, ducts, flues, breaching, etc.) that are going to be demolished, the removal of all insulating materials whether they contain asbestos or not shall be the exclusive work of the Laborers.
An Abatement Journeyman is anyone who has more than 300 hours in the Asbestos Abatement field.

Prevailing Wage Rate
Skilled Crafts

Name of Union: Asbestos Local 84 Heat & Frost Insulators

Change # : LCN01-2017fbLoc84

Craft : Asbestos Worker Effective Date : 11/08/2017 Last Posted : 11/08/2017

	BHR		Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Classification												
Asbestos Insulation Worker	$30.47		$9.49	$8.00	$0.42	$0.00	$3.39	$0.24	$0.00	$0.00	$52.01	$67.24
Apprentice	**Percent**											
1st Year	50.00	$15.24	$9.49	$8.00	$0.42	$0.00	$3.39	$0.24	$0.00	$0.00	$36.78	$44.39
2nd Year	60.00	$18.28	$9.49	$8.00	$0.42	$0.00	$3.39	$0.24	$0.00	$0.00	$39.82	$48.96
3rd Year	70.00	$21.33	$9.49	$8.00	$0.42	$0.00	$3.39	$0.24	$0.00	$0.00	$42.87	$53.53
4th Year	80.00	$24.38	$9.49	$8.00	$0.42	$0.00	$3.39	$0.24	$0.00	$0.00	$45.92	$58.10

Special Calculation Note : Other is Industry and Labor Management Fund

Ratio :
3 Journeymen to 1 Apprentice per shop

Jurisdiction (* denotes special jurisdictional note) :
ASHLAND, ASHTABULA*, CARROLL, COLUMBIANA, COSHOCTON, ERIE*, HARRISON, HOLMES, MAHONING, MEDINA, PORTAGE, RICHLAND, STARK, SUMMIT, TRUMBULL, TUSCARAWAS, WAYNE

Special Jurisdictional Note : Ashtabula County: except for the townships of Ashtabula, Austinburg, Geneva, Harpersfield, Jefferson, Plymouth and Saybrook.Erie except Sandusky city limits.

Details :
The removal of all insulation materials, whether they contain asbestos or not, from mechanical systems (pipes, boilers, ducts, flues, breaching, etc.) is recognized as being the exclusive work of the Asbestos Workers.
On all mechanical systems (pipes, boilers, ducts, flues, breaching, etc.) that are going to be demolished, the removal of all insulating materials whether they contain asbestos or not shall be the exclusive work of the Laborers.

Prevailing Wage Rate
Skilled Crafts

Name of Union: Boilermaker Local 744

Change # : CN01-2008Loc744

Craft : Boilermaker Effective Date : 07/01/2009 Last Posted : 06/30/2010

Classification	BHR		Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Boilermaker	$36.84		$6.82	$6.46	$0.35	$0.00	$3.75	$0.00			$54.22	$72.64
Apprentice	**Percent**											
1st 6 months	70.00	$25.79	$6.62	$6.46	$0.30	$0.00	$3.75	$0.00			$42.92	$55.81
2nd 6 months	72.52	$26.72	$6.62	$6.46	$0.30	$0.00	$3.75	$0.00			$43.85	$57.20
3rd 6 months	75.00	$27.63	$6.62	$6.46	$0.30	$0.00	$3.75	$0.00			$44.76	$58.58
4th 6 months	77.51	$28.55	$6.62	$6.46	$0.30	$0.00	$3.75	$0.00			$45.68	$59.96
5th 6 months	80.02	$29.48	$6.62	$6.46	$0.30	$0.00	$3.75	$0.00			$46.61	$61.35
6th 6 months	85.00	$31.31	$6.62	$6.46	$0.30	$0.00	$3.75	$0.00			$48.44	$64.10
7th 6 months	90.00	$33.16	$6.62	$6.46	$0.30	$0.00	$3.75	$0.00			$50.29	$66.86
8th 6 months	95.02	$35.01	$6.62	$6.46	$0.30	$0.00	$3.75	$0.00			$52.14	$69.64
Helper	60.00	$22.10	$6.82	$6.46	$0.35	$0.00	$3.75	$0.00			$39.48	$50.54

Special Calculation Note : No special calculations for this skilled craft wage rate are required at this time.

Ratio :

Jurisdiction (* denotes special jurisdictional note) :

5 Journeymen to 1 Apprentice to 1 Helper	ASHTABULA, CARROLL, COSHOCTON, CUYAHOGA, GEAUGA, HARRISON, HOLMES, LAKE, LORAIN, MAHONING, MEDINA, PORTAGE, STARK, SUMMIT, TRUMBULL, TUSCARAWAS, WAYNE

Special Jurisdictional Note :

Details :

Prevailing Wage Rate
Skilled Crafts

Name of Union: Bricklayer Local 6

Change # : LCN01-2018fbLoc6

Craft : Bricklayer Effective Date : 05/25/2018 Last Posted : 05/25/2018

	BHR		Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Classification												
Bricklayer	$28.29		$8.09	$6.61	$0.64	$0.00	$0.00	$0.05	$0.00	$0.00	$43.68	$57.83
Pointer Caulker Cleaner	$28.29		$8.09	$6.61	$0.64	$0.00	$0.00	$0.05	$0.00	$0.00	$43.68	$57.83
Stone Mason	$28.29		$8.09	$6.61	$0.64	$0.00	$0.00	$0.05	$0.00	$0.00	$43.68	$57.83
Cement Mason	$28.29		$8.09	$6.61	$0.64	$0.00	$0.00	$0.05	$0.00	$0.00	$43.68	$57.83
Plaster	$28.29		$8.09	$6.61	$0.64	$0.00	$0.00	$0.05	$0.00	$0.00	$43.68	$57.83
Apprentice	**Percent**											
1st 6 months	55.00	$15.56	$8.09	$6.61	$0.64	$0.00	$0.00	$0.05	$0.00	$0.00	$30.95	$38.73
2nd 6 months	60.00	$16.97	$8.09	$6.61	$0.64	$0.00	$0.00	$0.05	$0.00	$0.00	$32.36	$40.85
3rd 6 months	65.00	$18.39	$8.09	$6.61	$0.64	$0.00	$0.00	$0.05	$0.00	$0.00	$33.78	$42.97
4th 6 months	70.00	$19.80	$8.09	$6.61	$0.64	$0.00	$0.00	$0.05	$0.00	$0.00	$35.19	$45.09
5th 6 months	75.00	$21.22	$8.09	$6.61	$0.64	$0.00	$0.00	$0.05	$0.00	$0.00	$36.61	$47.22
6th 6 months	80.00	$22.63	$8.09	$6.61	$0.64	$0.00	$0.00	$0.05	$0.00	$0.00	$38.02	$49.34
7th 6 months	90.00	$25.46	$8.09	$6.61	$0.64	$0.00	$0.00	$0.05	$0.00	$0.00	$40.85	$53.58
8th 6 months	95.00	$26.88	$8.09	$6.61	$0.64	$0.00	$0.00	$0.05	$0.00	$0.00	$42.27	$55.70

Special Calculation Note : OTHER IS DRUG TESTING

Ratio :

1 Journeymen to 1 Apprentice
5 Journeymen to 2 Apprentice

Jurisdiction (* denotes special jurisdictional note) :

CARROLL, STARK, TUSCARAWAS

9 Journeymen to 3 Apprentice
13 Journeymen to 4 Apprentice

Special Jurisdictional Note :

Details :

Prevailing Wage Rate
Skilled Crafts

Name of Union: Bricklayer Local 8 Tile Finisher

Change # : LCN01-2014fbLoc8

Craft : Bricklayer Effective Date : 06/11/2014 Last Posted : 06/11/2014

	BHR		Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Classification												
Bricklayer Tile Marble Terrazzo Finisher	$23.17		$5.00	$7.85	$0.20	$0.00	$0.37	$0.37	$0.00	$0.00	$36.96	$48.55
Resilient flooring Wood Laminate Carpet Carpet Tile Finisher	$13.34		$5.00	$7.23	$0.00	$0.00	$0.00	$0.26	$0.00	$0.00	$25.83	$32.50
New Employees	**Percent**											
1st 30 days	59.89	$13.88	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$13.88	$20.81
2nd 30 days thru 6 months	59.89	$13.88	$5.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$18.88	$25.81
2nd 6 months	69.90	$16.20	$5.00	$7.85	$0.20	$0.00	$0.37	$0.37	$0.00	$0.00	$29.99	$38.08
3rd 6 months	74.93	$17.36	$5.00	$7.85	$0.20	$0.00	$0.37	$0.37	$0.00	$0.00	$31.15	$39.83
4th 6 months	79.88	$18.51	$5.00	$7.85	$0.20	$0.00	$0.37	$0.37	$0.00	$0.00	$32.30	$41.55
5th 6 months	84.88	$19.67	$5.00	$7.85	$0.20	$0.00	$0.37	$0.37	$0.00	$0.00	$33.46	$43.29
6th 6 months	89.88	$20.83	$5.00	$7.85	$0.20	$0.00	$0.37	$0.37	$0.00	$0.00	$34.62	$45.03

7th 6 months	94.88	$21.98	$5.00	$7.85	$0.20	$0.00	$0.37	$0.37	$0.00	$0.00	$35.77	$46.77
8th 6 months	94.88	$21.98	$5.00	$7.85	$0.20	$0.00	$0.37	$0.37	$0.00	$0.00	$35.77	$46.77

Special Calculation Note : Other $.40 is for International Masonry Training. Classification title contains "Bricklayer" because contract originates within the Bricklayer Local.
Note that the classification description is clarified after the local union number at the top of the page.

Ratio :

Journeymen 4 to 1 Apprentice

Journeymen 6 to 1 Apprentice thereafter

Jurisdiction (* denotes special jurisdictional note) :

ASHTABULA, CARROLL, COLUMBIANA, COSHOCTON, HARRISON, HOLMES, JEFFERSON, MAHONING, PORTAGE, STARK, TRUMBULL, TUSCARAWAS, WAYNE

Special Jurisdictional Note : Townships in Columbiana County are as follows: Salem, Perry, Fairfield, Center Elkrun, Middletown and Unity

Details :

Mechanic's assistants shall do all the handling, of sand, cement, lime, tile, marble, terrazzo and other materials used by the mechanics upon being delivered to the building or at the job. Hand rubbing, rolling, mixing, formulating, grinding, grouting, and cleaning of all marble, tile, mosaic, and terrazzo floors, and wainscoting, and such other work as is required in helping a mechanic as is the established custom of the trade. No limit to the tools, equipment or machinery used.

Prevailing Wage Rate
Skilled Crafts

Name of Union: Bricklayer Local 8 Zone 2 Tile Setters & Finishers

Change # : LCN1-2018fbLoc6

Craft : Bricklayer Effective Date : 06/01/2018 Last Posted : 05/30/2018

	BHR		Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Classification												
Bricklayer Tile Setter	$25.05		$7.00	$5.63	$0.58	$0.00	$0.00	$0.00	$0.00	$0.00	$38.26	$50.79
Marble Mason	$25.05		$7.00	$5.63	$0.58	$0.00	$0.00	$0.00	$0.00	$0.00	$38.26	$50.79
Terrazzo worker	$25.05		$7.00	$5.63	$0.58	$0.00	$0.00	$0.00	$0.00	$0.00	$38.26	$50.79
Finisher Support	$22.46		$7.00	$5.63	$0.58	$0.00	$0.00	$0.00	$0.00	$0.00	$35.67	$46.90
APPRENTICE Finisher Support Only												
1st 30 days	$13.48		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$13.48	$20.22
30 days-6 months	$13.48		$7.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$20.48	$27.22
2ND 6 months	$15.72		$7.00	$5.63	$0.56	$0.00	$0.00	$0.00	$0.00	$0.00	$28.91	$36.77
3RD 6 months	$16.85		$7.00	$5.63	$0.56	$0.00	$0.00	$0.00	$0.00	$0.00	$30.04	$38.47
4TH 6 months	$17.97		$7.00	$5.63	$0.56	$0.00	$0.00	$0.00	$0.00	$0.00	$31.16	$40.15
5TH 6 months	$19.09		$7.00	$5.63	$0.56	$0.00	$0.00	$0.00	$0.00	$0.00	$32.28	$41.83
6TH 6 months	$20.21		$7.00	$5.63	$0.56	$0.00	$0.00	$0.00	$0.00	$0.00	$33.40	$43.51
Apprentice	**Percent**											
1st 30 Days	60.00	$15.03	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$15.03	$22.54
30 days- 6 months	60.00	$15.03	$7.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$22.03	$29.54
2nd 6 months	70.00	$17.53	$7.00	$5.63	$0.58	$0.00	$0.00	$0.00	$0.00	$0.00	$30.74	$39.51
3rd 6 months	75.00	$18.79	$7.00	$5.63	$0.58	$0.00	$0.00	$0.00	$0.00	$0.00	$32.00	$41.39
4th 6 months	80.00	$20.04	$7.00	$5.63	$0.58	$0.00	$0.00	$0.00	$0.00	$0.00	$33.25	$43.27
5th 6 months	85.00	$21.29	$7.00	$5.63	$0.58	$0.00	$0.00	$0.00	$0.00	$0.00	$34.50	$45.15
6th 6 months	90.00	$22.55	$7.00	$5.63	$0.58	$0.00	$0.00	$0.00	$0.00	$0.00	$35.76	$47.03
7th 6 months	95.00	$23.80	$7.00	$5.63	$0.58	$0.00	$0.00	$0.00	$0.00	$0.00	$37.01	$48.91

8th 6 months	95.00	$23.80	$7.00	$5.63	$0.58	$0.00	$0.00	$0.00	$0.00	$37.01	$48.91

Special Calculation Note : Classification title contains "Bricklayer" because contract originates within the Bricklayer Local.
Note that the classification description is clarified after the local union number at the top of the page.

Ratio :

4 Journeymen to 1 Apprentice
6 Journeymen to 1 Apprentice (Thereafter)

Jurisdiction (* denotes special jurisdictional note) :

BELMONT, CARROLL, HARRISON, JEFFERSON, MONROE, STARK, TUSCARAWAS

Special Jurisdictional Note :

Details :

Prevailing Wage Rate
Skilled Crafts

Name of Union: Carpenter Commercial NE District C

Change # : LCN01-2017fbLocNEdistCantonC

Craft : Carpenter Effective Date : 06/07/2017 Last Posted : 06/07/2017

	BHR		Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Classification												
Carpenter	$25.98		$6.45	$8.77	$0.45	$0.00	$0.41	$0.00	$0.00	$0.00	$42.06	$55.05
Apprentice	Percent											
1st 3 Months	40.00	$10.39	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$10.39	$15.59
2nd 3 Months	45.00	$11.69	$6.45	$0.00	$0.45	$0.00	$0.00	$0.00	$0.00	$0.00	$18.59	$24.44
2nd 6 Months is 1st year	50.00	$12.99	$6.45	$0.00	$0.45	$0.00	$0.00	$0.00	$0.00	$0.00	$19.89	$26.38
3rd 6 Months	55.00	$14.29	$6.45	$0.00	$0.45	$0.00	$0.00	$0.00	$0.00	$0.00	$21.19	$28.33
4th 6 Months is 2nd year	60.00	$15.59	$6.45	$0.00	$0.45	$0.00	$0.00	$0.00	$0.00	$0.00	$22.49	$30.28
5th 6 Months	70.00	$18.19	$6.45	$6.14	$0.45	$0.00	$0.29	$0.00	$0.00	$0.00	$31.52	$40.61
6th 6 Months is 3rd year	75.00	$19.48	$6.45	$6.58	$0.45	$0.00	$0.31	$0.00	$0.00	$0.00	$33.28	$43.02
7th 6 Months	80.00	$20.78	$6.45	$7.02	$0.45	$0.00	$0.33	$0.00	$0.00	$0.00	$35.03	$45.43
8th 6 Months is 4th year	85.00	$22.08	$6.45	$7.45	$0.45	$0.00	$0.35	$0.00	$0.00	$0.00	$36.78	$47.82

Special Calculation Note :

Ratio :

3 Journeymen to 1 Apprentice

Jurisdiction (* denotes special jurisdictional note) :

CARROLL, STARK, TUSCARAWAS, WAYNE

Special Jurisdictional Note :

Details :

Prevailing Wage Rate
Skilled Crafts

Name of Union: Carpenter Local 509 NE District Interior Systems

Change # : LCN01-2010mmLoc509Int Systems

Craft : Carpenter Effective Date : 06/17/2010 Last Posted : 06/17/2010

Classification	BHR	Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
		H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Carpenter Window Shade Venetian Blinds Drapery Installer	$15.50	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00			$15.50	$23.25

Special Calculation Note : No special calculations for this skilled craft wage rate are required at this time.

Ratio :

Jurisdiction (* denotes special jurisdictional note) :
ADAMS, ALLEN, ASHLAND, ASHTABULA, ATHENS, AUGLAIZE, BELMONT, BROWN, BUTLER, CARROLL, CHAMPAIGN, CLARK, CLERMONT, CLINTON, COLUMBIANA, COSHOCTON, CRAWFORD, CUYAHOGA, DARKE, DEFIANCE, DELAWARE, ERIE, FAIRFIELD, FRANKLIN, FULTON, GALLIA, GEAUGA, GREENE, GUERNSEY, HAMILTON, HANCOCK, HARDIN, HARRISON, HENRY, HIGHLAND, HOCKING, HOLMES, HURON, JACKSON, JEFFERSON, KNOX, LAKE,

LAWRENCE, LICKING, LOGAN, LORAIN, LUCAS, MADISON, MAHONING, MARION, MEDINA, MEIGS, MERCER, MIAMI, MONROE, MONTGOMERY, MORGAN, MORROW, MUSKINGUM, NOBLE, OTTAWA, PAULDING, PERRY, PICKAWAY, PIKE, PORTAGE, PREBLE, PUTNAM, RICHLAND, ROSS, SANDUSKY, SCIOTO, SENECA, SHELBY, STARK, SUMMIT, TRUMBULL, TUSCARAWAS, UNION, VAN WERT, VINTON, WARREN, WASHINGTON, WAYNE

Special Jurisdictional Note :

Details :

Prevailing Wage Rate
Skilled Crafts

Name of Union: Carpenter Millwright NE District J

Change # : LCN01-2017fbLoc1090J

Craft : Carpenter Effective Date : 06/07/2017 Last Posted : 06/07/2017

Classification	BHR	Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
		H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Carpenter Millwright	$25.76	$6.45	$8.50	$0.45	$0.00	$1.66	$0.05	$0.00	$0.00	$42.87	$55.75
Certified Welder	$26.76	$6.45	$8.50	$0.45	$0.00	$1.66	$0.05	$0.00	$0.00	$43.87	$57.25
Lay-Out Man on Monorail	$27.26	$6.45	$8.50	$0.45	$0.00	$1.66	$0.05	$0.00	$0.00	$44.37	$58.00

Apprentice	Percent										
1st 6 months	55.00	$14.17	$6.45	$8.50	$0.45	$0.00	$1.66	$0.05	$0.00	$0.00	$31.28	$38.36
2nd 6 months	58.50	$15.07	$6.45	$8.50	$0.45	$0.00	$1.66	$0.05	$0.00	$0.00	$32.18	$39.71
3rd 6 months	62.00	$15.97	$6.45	$8.50	$0.45	$0.00	$1.66	$0.05	$0.00	$0.00	$33.08	$41.07
4th 6 months	65.50	$16.87	$6.45	$8.50	$0.45	$0.00	$1.66	$0.05	$0.00	$0.00	$33.98	$42.42
5th 6 months	69.00	$17.77	$6.45	$8.50	$0.45	$0.00	$1.66	$0.05	$0.00	$0.00	$34.88	$43.77
6th 6 months	72.50	$18.68	$6.45	$8.50	$0.45	$0.00	$1.66	$0.05	$0.00	$0.00	$35.79	$45.12
7th 6 months	76.00	$19.58	$6.45	$8.50	$0.45	$0.00	$1.66	$0.05	$0.00	$0.00	$36.69	$46.48
8th 6 months	80.00	$20.61	$6.45	$8.50	$0.45	$0.00	$1.66	$0.05	$0.00	$0.00	$37.72	$48.02

Special Calculation Note : Other $0.05 is UBC Millwright Promotional Fund

Ratio :

3 Journeymen to 1 Apprentice

Jurisdiction (* denotes special jurisdictional note) :

CARROLL, STARK, TUSCARAWAS, WAYNE

Special Jurisdictional Note :

Details :

certain projects warrant a larger percentage of apprentices, it will be agreed to increase the ratio of apprentices to journeymen, but Not to exceed (1) Apprentice to (4) Journeymen.
The following classifications will be paid at the amount above Journeyman Rate:
Certified Welder $1.00
Lay Out Man on Monorail $1.25

The term "Millwright and Machine Erectors'" jurisdiction shall mean the unloading, hoisting, rigging, skidding, moving, dismantling, aligning, erecting, assembling, repairing, maintenance and adjusting of all structures, processing areas either under cover, under ground or elsewhere, required to process material, handle, manufacture or service, be it powered or receiving power manually, by steam, gas, electricity, gasoline, diesel, nuclear, solar, water, air or chemically, and in industries such as and including, which are identified for the purpose of description, but not limited to, the following: woodworking plants; canning industries; steel mills; coffee roasting plants; paper and pulp; cellophane; stone crushing; gravel and sand washing and handling; refineries; grain storage and handling; asphalt plants; sewage disposal; water plants; laundries; bakeries; mixing plants; can, bottle and bag packing plants; textile mills; paint mills; breweries; milk processing plants; power plants; aluminum processing or manufacturing plants; and amusement and entertainment fields. The installation of mechanical equipment in atomic energy plants; installation of reactors in power plants; installation of control rods and equipment in reactors; and installation of mechanical equipment in rocket missile bases, launchers, launching gantry, floating bases, hydraulic escape doors and any and all component parts thereto, either assembled, semi-assembled or disassembled. The installation of, but not limited to, the following: setting-up of all engines, motors, generators, air compressors, fans, pumps, scales, hoppers, conveyors of all types, sizes and their supports; escalators; man lifts; moving sidewalks; hoists; dumb waiters; all types of feeding machinery; amusement devices; mechanical pin setters and spotters in bowling alleys; refrigeration equipment; and the installation of all types of equipment necessary and required to process material either in the manufacturing or servicing. The handling and installation of pulleys, gears, sheaves, fly wheels, air and vacuum drives, worm drives and gear drives directly or indirectly coupled to motors, belts, chains, screws, legs, boots, guards, booth tanks, all bin valves, turn heads and indicators, shafting, bearings, cable sprockets, cutting all key seats in new and old work, troughs, chippers, filters, calendars, rolls, winders, rewinders, slitters, cutters, wrapping machines, blowers, forging machines, rams, hydraulic or otherwise, planing, extruder, ball, dust collectors, equipment in meat packing plants, splicing of ropes and cables. The laying-out, fabrication and installation of protection equipment including machinery guards, making and setting of templates for machinery, fabrication of bolts, nuts, pans, drilling of holes for any equipment which the Millwrights install regardless of materials; all welding and burning regardless of type, fabrication of all lines, hose or tubing used in lubricating machinery installed by Millwrights; grinding, cleaning, servicing and any machine work necessary for any part of any equipment installed by the Millwrights; and the break-in and trial run of any equipment or machinery installed by the Millwrights. It is agreed the Millwrights shall use the layout tools and optic equipment necessary to perform their work.

Prevailing Wage Rate
Skilled Crafts

Name of Union: Carpenter NE District Industrial Dock & Door

Change # : LCN01-2014fbCarpNEStatewide

Craft : Carpenter Effective Date : 03/05/2014 Last Posted : 03/05/2014 fringe 4 6.20

	BHR		Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Classification												
Carpenter	$19.70		$5.05	$1.00	$0.15	$0.00	$0.00	$0.00	$0.00	$0.00	$25.90	$35.75
Trainee	**Percent**											
1st Year	60.00	$11.82	$5.05	$1.00	$0.15	$0.00	$0.00	$0.00	$0.00	$0.00	$18.02	$23.93
2nd Year	80.20	$15.80	$5.05	$1.00	$0.15	$0.00	$0.00	$0.00	$0.00	$0.00	$22.00	$29.90

Special Calculation Note : No special calculations for this skilled craft wage rate are required at this time.

Ratio :

1 Journeymen to 1 Trainee

Jurisdiction (* denotes special jurisdictional note) :

ADAMS, ALLEN, ASHLAND, ASHTABULA, ATHENS, AUGLAIZE, BELMONT, BROWN, BUTLER, CARROLL, CHAMPAIGN, CLARK, CLERMONT, CLINTON, COLUMBIANA, COSHOCTON, CRAWFORD, CUYAHOGA, DARKE, DEFIANCE, DELAWARE, ERIE, FAIRFIELD, FAYETTE, FRANKLIN, FULTON, GALLIA, GEAUGA, GREENE, GUERNSEY, HAMILTON, HANCOCK, HARDIN, HARRISON, HENRY, HIGHLAND, HOCKING, HOLMES, HURON, JACKSON, JEFFERSON, KNOX, LAKE, LAWRENCE, LICKING, LOGAN, LORAIN, LUCAS, MADISON, MAHONING,

MARION, MEDINA, MEIGS, MERCER, MIAMI, MONROE, MONTGOMERY, MORGAN, MORROW, MUSKINGUM, NOBLE, OTTAWA, PAULDING, PERRY, PICKAWAY, PIKE, PORTAGE, PREBLE, PUTNAM, RICHLAND, ROSS, SANDUSKY, SCIOTO, SENECA, SHELBY, STARK, SUMMIT, TRUMBULL, TUSCARAWAS, UNION, VAN WERT, VINTON, WARREN, WASHINGTON, WAYNE, WILLIAMS, WOOD, WYANDOT

Special Jurisdictional Note : Industrial Dock and Door is the installation of overhead doors, roll up doors and dock leveling equipment

Details :
10/27/10 New Contract jc

Prevailing Wage Rate
Skilled Crafts

Name of Union: Carpenter Insulation NE District C

Change # : LCN01-2017fbLocNEC

Craft : Carpenter Effective Date : 06/07/2017 Last Posted : 06/07/2017

	BHR		Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Classification												
Carpenter Insulation	$20.78		$6.45	$8.77	$0.45	$0.00	$0.41	$0.00	$0.00	$0.00	$36.86	$47.25
Apprentice	**Percent**											
1st 3 months	50.00	$10.39	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$10.39	$15.59
2nd 3 months	50.00	$10.39	$6.45	$0.00	$0.45	$0.00	$0.00	$0.00	$0.00	$0.00	$17.29	$22.48
2nd 6 months	50.00	$10.39	$6.45	$0.00	$0.45	$0.00	$0.00	$0.00	$0.00	$0.00	$17.29	$22.48
3rd 6 months	55.00	$11.43	$6.45	$0.00	$0.45	$0.00	$0.00	$0.00	$0.00	$0.00	$18.33	$24.04
4th 6 months	60.00	$12.47	$6.45	$0.00	$0.45	$0.00	$0.00	$0.00	$0.00	$0.00	$19.37	$25.60
5th 6 months	70.00	$14.55	$6.45	$6.14	$0.45	$0.00	$0.29	$0.00	$0.00	$0.00	$27.88	$35.15
6th 6 months	75.00	$15.59	$6.45	$6.58	$0.45	$0.00	$0.31	$0.00	$0.00	$0.00	$29.37	$37.17
7th 6 months	80.00	$16.62	$6.45	$7.02	$0.45	$0.00	$0.33	$0.00	$0.00	$0.00	$30.87	$39.19
8th 6 months	85.00	$17.66	$6.45	$7.45	$0.45	$0.00	$0.35	$0.00	$0.00	$0.00	$32.36	$41.19

Special Calculation Note : No special calculations for this skilled craft wage rate are required at this time.

Ratio :

2 Journeymen to 1 Apprentice

Jurisdiction (* denotes special jurisdictional note) :

CARROLL, STARK, TUSCARAWAS, WAYNE

Special Jurisdictional Note :

Details :

Prevailing Wage Rate
Skilled Crafts

Name of Union: Carpenter Pile Driver NE District O

Change # : LCN01-2017fbLoc1090O

Craft : Carpenter Effective Date : 06/07/2017 Last Posted : 06/07/2017

Classification	BHR		Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Carpenter Pile Driver	$25.56		$6.45	$8.50	$0.45	$0.00	$1.65	$0.00	$0.00	$0.00	$42.61	$55.39
Diver	$38.34		$6.45	$8.50	$0.45	$0.00	$1.65	$0.00	$0.00	$0.00	$55.39	$74.56
Certified Welder	$26.61		$6.45	$8.50	$0.45	$0.00	$1.65	$0.00	$0.00	$0.00	$43.66	$56.97
Apprentice	**Percent**											
1st 6 months	55.00	$14.06	$6.45	$8.50	$0.45	$0.00	$1.65	$0.00	$0.00	$0.00	$31.11	$38.14
2nd 6 months	58.50	$14.95	$6.45	$8.50	$0.45	$0.00	$1.65	$0.00	$0.00	$0.00	$32.00	$39.48
3rd 6 months	62.00	$15.85	$6.45	$8.50	$0.45	$0.00	$1.65	$0.00	$0.00	$0.00	$32.90	$40.82
4th 6 months	65.50	$16.74	$6.45	$8.50	$0.45	$0.00	$1.65	$0.00	$0.00	$0.00	$33.79	$42.16
5th 6 months	69.00	$17.64	$6.45	$8.50	$0.45	$0.00	$1.65	$0.00	$0.00	$0.00	$34.69	$43.50
6th 6 months	72.50	$18.53	$6.45	$8.50	$0.45	$0.00	$1.65	$0.00	$0.00	$0.00	$35.58	$44.85
7th 6 months	76.00	$19.43	$6.45	$8.50	$0.45	$0.00	$1.65	$0.00	$0.00	$0.00	$36.48	$46.19
8th 6 months	80.00	$20.45	$6.45	$8.50	$0.45	$0.00	$1.65	$0.00	$0.00	$0.00	$37.50	$47.72

Special Calculation Note : No special calculations for this skilled craft wage rate are required at this time.

Ratio :

3 Journeymen to 1 Apprentice

Jurisdiction (* denotes special jurisdictional note) :

STARK, WAYNE, CARROLL, TUSCARAWAS

Special Jurisdictional Note :

Details :

If certain projects warrant a larger percentage of apprentices, it will be agreed to increase the ratio of apprentices journeymen, but Not to exceed (1) Apprentice to (2) Journeymen.
Employees working with creosoted, chemically treated or toxic materials,shall receive $.50 above regular rate. Pile Drivers duties shall include but not limited to: Pile driving, milling, fashioning, joining assembling, erecting, fastening, or dismantling of all material of wood, plastic, metal, fiber, cork and composition and all other substitute materials: pile driving, cutting, fitting and placing of lagging, and the handling, cleaning, erecting, installing and dismantling of machinery, equipment and erecting pre-engineered metal buildings. Pile Drivers work but not limited to: unloading, assembling, erection, repairs, operation, signaling, dismantling and reloading all equipment that is used for pile driving including pule butts is defined as sheeting or scrap piling. Underwater work that may be required in connection with the installation of piling. The driver and his tender work as a team and shall arrive at their own financial arrangements with the contractor. Any configuration of wood, steel, concrete or composite that is jetted, driven or vibrated onto the ground by conventional pile driving equipment for the purpose of supporting a future load that may be permanent or temporary. The construction of all wharves and docks, including the fabrication and installation of floating docks. Driving bracing, plumbing, cutting off and capping of all piling whether wood, metal, pipe piling or composite, loading, unloading, erecting, framing, dismantling, moving and handling of pile driving equipment piling used in the construction and repair of all wharves, docks, piers, trestles, caissons, cofferdams and erection of all sea walls and breakwaters. All underwater and marine work on bulkheads, wharves, docks, shipyards, caissons, piers, bridges, pipeline, work, viaducts, marine cable and trestles, as well as salvage and reclamation work where divers are employed. Rate shall include carpenters, acoustic and ceiling installers, drywall installers, pile drivers and floorlayers.

Prevailing Wage Rate
Skilled Crafts

Name of Union: Carpenter Statewide Office Systems

Change # : LCR02-2010jcJurSTWIDEOfficeSystems

Craft : Carpenter Effective Date : 07/28/2010 Last Posted : 07/28/2010

	BHR		Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Classification												
Carpenter Installers	$16.00		$5.47	$1.00	$0.08	$0.00	$0.00	$0.00			$22.55	$30.55
Helper	$9.50		$5.47	$0.00	$0.08	$0.00	$0.00	$0.00			$15.05	$19.80
Installer Trainee	**Percent**											
1st 6 months	59.40	$9.50	$5.47	$0.00	$0.08	$0.00	$0.00	$0.00			$15.05	$19.81
2nd 6 Months	62.00	$9.92	$5.47	$0.00	$0.08	$0.00	$0.00	$0.00			$15.47	$20.43
3rd 6 Months	65.00	$10.40	$5.47	$0.00	$0.08	$0.00	$0.00	$0.00			$15.95	$21.15
4th 6 Months	67.95	$10.87	$5.47	$0.79	$0.08	$0.00	$0.00	$0.00			$17.21	$22.65
5th 6 months	70.95	$11.35	$5.47	$0.83	$0.08	$0.00	$0.00	$0.00			$17.73	$23.41
6th 6 Months	73.90	$11.82	$5.47	$0.86	$0.08	$0.00	$0.00	$0.00			$18.23	$24.15
7th 6 Months	76.90	$12.30	$5.47	$0.90	$0.08	$0.00	$0.00	$0.00			$18.75	$24.91
8th 6 Months	79.85	$12.78	$5.47	$0.93	$0.08	$0.00	$0.00	$0.00			$19.26	$25.64
9th 6 months	82.80	$13.25	$5.47	$1.00	$0.08	$0.00	$0.00	$0.00			$19.80	$26.42

Special Calculation Note : Helper H&W after 90 days probationary period

Ratio : **Jurisdiction (* denotes special**

1 Installer to 1 Trainee or 1 Helper

jurisdictional note) :
ADAMS, ALLEN, ASHLAND, ASHTABULA, ATHENS, AUGLAIZE, BELMONT, BROWN, BUTLER, CARROLL, CHAMPAIGN, CLARK, CLERMONT, CLINTON, COLUMBIANA, COSHOCTON, CRAWFORD, CUYAHOGA, DARKE, DEFIANCE, DELAWARE, ERIE, FAIRFIELD, FAYETTE, FRANKLIN, FULTON, GALLIA, GEAUGA, GREENE, GUERNSEY, HAMILTON, HANCOCK, HARDIN, HARRISON, HENRY, HIGHLAND, HOCKING, HOLMES, HURON, JACKSON, JEFFERSON, KNOX, LAKE, LAWRENCE, LICKING, LOGAN, LORAIN, LUCAS, MADISON, MAHONING, MARION, MEDINA, MEIGS, MERCER, MIAMI, MONROE, MONTGOMERY, MORGAN, MORROW, MUSKINGUM, NOBLE, OTTAWA, PAULDING, PERRY, PICKAWAY, PIKE, PORTAGE, PREBLE, PUTNAM, RICHLAND, ROSS, SANDUSKY, SCIOTO, SENECA, SHELBY, STARK, SUMMIT, TRUMBULL, TUSCARAWAS, UNION, VAN WERT, VINTON, WARREN, WASHINGTON, WAYNE, WILLIAMS, WOOD, WYANDOT

Special Jurisdictional Note :

Details :
Office systems is defined as modular systems with demountable units such as desks, partitions and shelving. All work in connection with the assembly, reconfiguration and repairof all work in the office system field.
INSTALLER: is defined as a qualified office systems mechanic capable of laying out, estimating and installing various office system manufactured products.
INSTALL TRAINEE: is defined as a person training in the estimating, layout and installation in all facets of the office systems industry. An installer trainee will work to assist an installer or lead installer in all installations. He is NOT permitted to work without the assistance of lead installer
INSTALL HELPER: is defined as a person who assists in the delivery,staging and clean up of related office system work. He is NOT to be involved with the installation or layout of work related to office systems.
Receiving,unloading,unpacking,& removal of rubbish shall be done by install helpers.

Prevailing Wage Rate
Skilled Crafts

Name of Union: Carpenter Floorlayer NE District C

Change # : LCN01-2017fbLocNEdistCantonC

Craft : Carpenter Effective Date : 06/07/2017 Last Posted : 06/07/2017

	BHR		Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Classification												
Carpenter Floorlayer	$25.98		$6.45	$8.77	$0.47	$0.00	$0.41	$0.00	$0.00	$0.00	$42.08	$55.07
Apprentice	**Percent**											
1st 3 Months	40.00	$10.39	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$10.39	$15.59
2nd 3 Months	45.00	$11.69	$6.45	$0.00	$0.47	$0.00	$0.00	$0.00	$0.00	$0.00	$18.61	$24.46
2nd 6 Months is 1st year	50.00	$12.99	$6.45	$0.00	$0.47	$0.00	$0.00	$0.00	$0.00	$0.00	$19.91	$26.40
3rd 6 Months	55.00	$14.29	$6.45	$0.00	$0.47	$0.00	$0.00	$0.00	$0.00	$0.00	$21.21	$28.35
4th 6 Months is 2nd year	60.00	$15.59	$6.45	$0.00	$0.47	$0.00	$0.00	$0.00	$0.00	$0.00	$22.51	$30.30
5th 6 Months	70.00	$18.19	$6.45	$6.14	$0.47	$0.00	$0.29	$0.00	$0.00	$0.00	$31.54	$40.63
6th 6 Months is 3rd year	75.00	$19.48	$6.45	$6.58	$0.47	$0.00	$0.31	$0.00	$0.00	$0.00	$33.30	$43.04
7th 6 Months	80.00	$20.78	$6.45	$7.02	$0.47	$0.00	$0.33	$0.00	$0.00	$0.00	$35.05	$45.45
8th 6 Months is 4th year	85.00	$22.08	$6.45	$7.45	$0.47	$0.00	$0.35	$0.00	$0.00	$0.00	$36.80	$47.84

Special Calculation Note :

Ratio :

Jurisdiction (* denotes special jurisdictional note) :

3 Journeymen to 1 Apprentice CARROLL, STARK, TUSCARAWAS, WAYNE

Special Jurisdictional Note :

etails :

Prevailing Wage Rate
Skilled Crafts

Name of Union: Cement Mason Bricklayer Local 97 HevHwy A

Change # : LCN01-2017fbHvyHwy

Craft : Bricklayer Effective Date : 06/01/2017 Last Posted : 05/31/2017

Classification	BHR		Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Cement Mason Bricklayer Sewer Water Treatment A	$28.65		$8.35	$5.77	$0.43	$0.00	$0.00	$0.00	$0.00	$0.00	$43.20	$57.53
Apprentice	**Percent**											
1st year	50.00	$14.33	$8.35	$5.77	$0.43	$0.00	$0.00	$0.00	$0.00	$0.00	$28.87	$36.04
2nd year	70.01	$20.06	$8.35	$5.77	$0.43	$0.00	$0.00	$0.00	$0.00	$0.00	$34.61	$44.64
3rd year	90.01	$25.79	$8.35	$5.77	$0.43	$0.00	$0.00	$0.00	$0.00	$0.00	$40.34	$53.23

Special Calculation Note : NOT FOR BUILDING CONSTRUCTION.

Ratio :

3 Journeymen to 1 Apprentice
6 Journeymen to 2 Apprentice
9 Journeymen to 3 Apprentice
12 Journeymen to 4 Apprentice
15 Journeymen to 5 Apprentice

Jurisdiction (* denotes special jurisdictional note) :

ADAMS, ALLEN, ASHLAND, ASHTABULA, ATHENS, AUGLAIZE, BELMONT, BROWN, BUTLER, CARROLL, CHAMPAIGN, CLARK, CLERMONT, CLINTON, COLUMBIANA, COSHOCTON, CRAWFORD, CUYAHOGA, DARKE, DEFIANCE, DELAWARE, ERIE, FAIRFIELD, FAYETTE, FRANKLIN, FULTON, GALLIA, GEAUGA, GREENE, GUERNSEY, HAMILTON, HANCOCK, HARDIN, HARRISON, HENRY, HIGHLAND, HOCKING, HOLMES, HURON, JACKSON, JEFFERSON, KNOX, LAKE,

LAWRENCE, LICKING, LOGAN, LORAIN, LUCAS, MADISON, MAHONING, MARION, MEDINA, MEIGS, MERCER, MIAMI, MONROE, MONTGOMERY, MORGAN, MORROW, MUSKINGUM, NOBLE, OTTAWA, PAULDING, PERRY, PICKAWAY, PIKE, PORTAGE, PREBLE, PUTNAM, RICHLAND, ROSS, SANDUSKY, SCIOTO, SENECA, SHELBY, STARK, SUMMIT, TRUMBULL, TUSCARAWAS, UNION, VAN WERT, VINTON, WARREN, WASHINGTON, WAYNE

Special Jurisdictional Note :

Details :

(A) Highway Construction, Sewer, Waterworks And Utility Construction, Industrial & Building Site Heavy Construction, Airport Construction Or Railroad Construction Work.
(B) Power Plant, Tunnels, Amusement Park, Athletic Stadium Site Work ,Pollution Control,Sewer Plant, Waste Plant, & Water Treatment Facilities, Construction.

Prevailing Wage Rate
Skilled Crafts

Name of Union: Cement Mason Bricklayer Local 97 HevHwy B

Change # : LCN01-2017fbHvyHwy

Craft : Bricklayer Effective Date : 06/01/2017 Last Posted : 05/31/2017

	BHR		Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Classification												
Cement Mason Bricklayer Power Plants Tunnels Amusement Parks B	$29.64		$8.35	$5.77	$0.44	$0.00	$0.00	$0.00	$0.00	$0.00	$44.20	$59.02
Apprentice	**Percent**											
1st year	50.00	$14.82	$8.35	$5.77	$0.44	$0.00	$0.00	$0.00	$0.00	$0.00	$29.38	$36.79
2nd year	70.00	$20.75	$8.35	$5.77	$0.44	$0.00	$0.00	$0.00	$0.00	$0.00	$35.31	$45.68
3rd year	90.00	$26.68	$8.35	$5.77	$0.44	$0.00	$0.00	$0.00	$0.00	$0.00	$41.24	$54.57

Special Calculation Note : NOT FOR BUILDING CONSTRUCTION.

Ratio :

3 Journeymen to 1 Apprentice
6 Journeymen to 2 Apprentice
9 Journeymen to 2 Apprentice
12 Journeymen to 4 Apprentice
15 Journeymen to 5 Apprentice

Jurisdiction (* denotes special jurisdictional note) :

ADAMS, ALLEN, ASHLAND, ASHTABULA, ATHENS, AUGLAIZE, BELMONT, BROWN, BUTLER, CARROLL, CHAMPAIGN, CLARK, CLERMONT, CLINTON, COLUMBIANA, COSHOCTON, CRAWFORD, CUYAHOGA, DARKE, DEFIANCE, DELAWARE, ERIE, FAIRFIELD, FAYETTE, FRANKLIN, FULTON, GALLIA, GEAUGA, GREENE, GUERNSEY, HAMILTON, HANCOCK, HARDIN, HARRISON, HENRY, HIGHLAND, HOCKING, HOLMES, HURON,

JACKSON, JEFFERSON, KNOX, LAKE, LAWRENCE, LICKING, LOGAN, LORAIN, LUCAS, MADISON, MAHONING, MARION, MEDINA, MEIGS, MERCER, MIAMI, MONROE, MONTGOMERY, MORGAN, MORROW, MUSKINGUM, NOBLE, OTTAWA, PAULDING, PERRY, PICKAWAY, PIKE, PORTAGE, PREBLE, PUTNAM, RICHLAND, ROSS, SANDUSKY, SCIOTO, SENECA, SHELBY, STARK, SUMMIT, TRUMBULL, TUSCARAWAS, UNION, VAN WERT, VINTON, WARREN, WASHINGTON, WAYNE

Special Jurisdictional Note :

Details :

(A) Highway Construction, Sewer, Waterworks And Utility Construction, Industrial & Building Site Heavy Construction, Airport Construction Or Railroad Construction Work.

(B) Power Plant, Tunnels, Amusement Park, Athletic Stadium Site Work ,Pollution Control,Sewer Plant, Waste Plant, & Water Treatment Facilities, Construction.

Prevailing Wage Rate
Skilled Crafts

Name of Union: Cement Mason Statewide HevHwy Exhibit A District II

Change # : LCN01-2017fbCementHevHwy

Craft : Cement Mason Effective Date : 05/01/2018 Last Posted : 04/11/2018

	BHR		Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Classification												
Cement Mason	$28.86		$7.65	$6.50	$0.65	$0.00	$2.25	$0.00	$0.00	$0.00	$45.91	$60.34
Apprentice	**Percent**											
1st Year	60.00	$17.32	$7.65	$6.50	$0.65	$0.00	$2.25	$0.00	$0.00	$0.00	$34.37	$43.02
2nd Year	75.00	$21.64	$7.65	$6.50	$0.65	$0.00	$2.25	$0.00	$0.00	$0.00	$38.70	$49.52
3rd Year	90.00	$25.97	$7.65	$6.50	$0.65	$0.00	$2.25	$0.00	$0.00	$0.00	$43.02	$56.01

Special Calculation Note : No special calculations for this skilled craft wage rate are required at this time.

Ratio :

1 Journeymen to 1 Apprentice
2 to 1 thereafter

Jurisdiction (* denotes special jurisdictional note) :

BROWN, BUTLER, CLERMONT, COLUMBIANA, DEFIANCE, ERIE, HAMILTON, HIGHLAND, HURON, LORAIN, MAHONING, MEDINA, OTTAWA, PAULDING, PORTAGE, SANDUSKY, SENECA, STARK, SUMMIT, TRUMBULL, WARREN, WILLIAMS

Special Jurisdictional Note : (A) Highway Construction, Sewer, Waterworks And Utility Construction, Industrial & Building Site, Heavy
Construction, Airport Construction Or Railroad Construction Work.

Details :

Prevailing Wage Rate
Skilled Crafts

Name of Union: Cement Mason Statewide HevHwy Exhibit B District II

Change # : LCN01-2018fbCementHevHwy

Craft : Cement Mason Effective Date : 05/01/2018 Last Posted : 04/11/2018

	BHR		Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Classification												
Cement Mason	$29.73		$7.65	$6.50	$0.65	$0.00	$2.25	$0.00	$0.00	$0.00	$46.78	$61.64
Apprentice	**Percent**											
1st Year	60.00	$17.84	$7.65	$6.50	$0.65	$0.00	$2.25	$0.00	$0.00	$0.00	$34.89	$43.81
2nd Year	75.00	$22.30	$7.65	$6.50	$0.65	$0.00	$2.25	$0.00	$0.00	$0.00	$39.35	$50.50
3rd Year	90.00	$26.76	$7.65	$6.50	$0.65	$0.00	$2.25	$0.00	$0.00	$0.00	$43.81	$57.19

Special Calculation Note : No special calculations for this skilled craft wage rate are required at this time.

Ratio :

1 Journeymen to 1 Apprentice
2 to 1 thereafter

Jurisdiction (* denotes special jurisdictional note) :

BROWN, BUTLER, CLERMONT, COLUMBIANA, DEFIANCE, ERIE, HAMILTON, HIGHLAND, HURON, LORAIN, MAHONING, MEDINA, OTTAWA, PAULDING, PORTAGE, SANDUSKY, SENECA, STARK, SUMMIT, TRUMBULL, WARREN, WILLIAMS

Special Jurisdictional Note : (B) Power Plant, Tunnels, Amusement Park, Athletic Stadium Site Work ,Pollution Control,Sewer Plant,
Waste Plant, & Water Treatment Facilities, Construction.

Details :

Prevailing Wage Rate
Skilled Crafts

Name of Union: Cement Mason & Plasterer Local 109

Change # : LCN01-2018fbLoc109

Craft : Cement Effective Date : 06/01/2018 Last Posted : 05/30/2018

	BHR		Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Classification												
Cement Mason	$29.54		$8.19	$6.50	$0.40	$0.00	$3.50	$0.06	$0.00	$0.00	$48.19	$62.96
Plasterer	$28.83		$7.69	$6.50	$0.40	$0.00	$3.25	$0.06	$0.00	$0.00	$46.73	$61.14
Apprentice Cement Mason	**Percent**											
1st year	60.00	$17.72	$8.19	$6.50	$0.40	$0.00	$3.50	$0.06	$0.00	$0.00	$36.37	$45.24
2nd year	75.00	$22.16	$8.19	$6.50	$0.40	$0.00	$3.50	$0.06	$0.00	$0.00	$40.81	$51.88
3rd year	90.00	$26.59	$8.19	$6.50	$0.40	$0.00	$3.50	$0.06	$0.00	$0.00	$45.24	$58.53
Plasterer Apprentice												
1st year	58.58	$17.30	$7.69	$6.50	$0.40	$0.00	$3.25	$0.06	$0.00	$0.00	$35.20	$43.86
2nd year	73.20	$21.62	$7.69	$6.50	$0.40	$0.00	$3.25	$0.06	$0.00	$0.00	$39.52	$50.33
3rd year	87.85	$25.95	$7.69	$6.50	$0.40	$0.00	$3.25	$0.06	$0.00	$0.00	$43.85	$56.83

Special Calculation Note : Other is for International Training.

Ratio :

1 Journeymen to 1 Apprentice
5 Journeymen to 2 Apprentice

Jurisdiction (* denotes special jurisdictional note) :

CARROLL, HOLMES, MEDINA, PORTAGE, STARK, SUMMIT, TUSCARAWAS, WAYNE

Special Jurisdictional Note :

Details :

Finishers when applying colorshake shall be paid an additional $2.00 per DAY.
Swing Scaffolds up to 50 feet shall be paid $0.25 above the Journeymen rate.
Swing Scaffolds over 50 feet shall be paid $0.35 above the Journeymen rate.

Prevailing Wage Rate
Skilled Crafts

Name of Union: Electrical Local 540 Inside

Change # : LCN01-2018fbLoc540in

Craft : Electrical Effective Date : 01/10/2018 Last Posted : 01/10/2018

Classification	BHR		Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Electrician	$31.49		$6.00	$8.20	$0.97	$3.15	$3.51	$1.04	$0.00	$0.00	$54.36	$70.11
Apprentice	Percent											
1st 1000 hrs	40.00	$12.60	$6.00	$0.00	$0.47	$0.00	$0.00	$0.38	$0.00	$0.00	$19.45	$25.74
2nd 1000 hrs	45.00	$14.17	$6.00	$0.00	$0.51	$0.00	$0.00	$0.43	$0.00	$0.00	$21.11	$28.20
3rd 1500 hrs	50.00	$15.75	$6.00	$1.64	$0.57	$1.26	$0.70	$0.51	$0.00	$0.00	$26.42	$34.30
4th 1500 hrs	60.00	$18.89	$6.00	$3.28	$0.65	$1.51	$1.40	$0.61	$0.00	$0.00	$32.34	$41.79
5th 1500 hrs	70.00	$22.04	$6.00	$4.92	$0.73	$1.76	$2.11	$0.71	$0.00	$0.00	$38.27	$49.29
6th 1500 hrs	80.00	$25.19	$6.00	$6.56	$0.80	$2.02	$2.81	$0.82	$0.00	$0.00	$44.20	$56.80

Special Calculation Note : OTHER = (NEBF) National Electrical Benefit Fund. Vacation contribution is equal to 8% of the gross weekly wages.

Ratio :
The first person assigned to any job site shall be a Journeyman Wireman. Ratio thereafter:

1-3 Journeymen to 2 Apprentices
4 to 6 Journeymen up to 4 Apprentices
7 to 9 Journeymen up to 6 Apprentices

Jurisdiction (* denotes special jurisdictional note) :
CARROLL*, COLUMBIANA*, HOLMES, MAHONING*, STARK, TUSCARAWAS*, WAYNE*

Special Jurisdictional Note : Carroll County: North half including; Fox, Harrison, Rose and Washington Townships.
Columbiana County: Knox Township only.
Mahoning County: Smith Township only.
Tuscarawas County: That portion North of Auburn, Clay, Rush and York Townships.
Wayne County: That portion south of Baughman, Chester, Green, Wayne and Wooster Townships.

Details :

Prevailing Wage Rate
Skilled Crafts

Name of Union: Electrical Local 540 Inside Lt Commercial Northern

Change # : LCN01-2018fbLoc540in

Craft : Electrical Effective Date : 01/10/2018 Last Posted : 01/10/2018

Classification	BHR	Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
		H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Electrician	$31.49	$6.00	$8.20	$0.97	$3.15	$3.51	$1.04	$0.00	$0.00	$54.36	$70.11
CE-3 12,001-14,000 Hrs	$24.51	$5.75	$0.00	$0.81	$0.00	$0.74	$0.84	$0.00	$0.00	$32.65	$44.91
CE-2 10,001-12,000 Hrs	$19.26	$5.75	$0.00	$0.81	$0.00	$0.58	$0.68	$0.00	$0.00	$27.08	$36.71
CE-1 8,001-10,000 Hrs	$17.51	$5.75	$0.00	$0.81	$0.00	$0.53	$0.63	$0.00	$0.00	$25.23	$33.99
CW-4 6,001-8,000 Hrs	$15.76	$5.75	$0.00	$0.81	$0.00	$0.47	$0.57	$0.00	$0.00	$23.36	$31.24
CW-3 4,001-6,000 Hrs	$14.00	$5.75	$0.00	$0.81	$0.00	$0.42	$0.52	$0.00	$0.00	$21.50	$28.50
CW-2 2,001-4,000 Hrs	$13.13	$5.75	$0.00	$0.81	$0.00	$0.39	$0.49	$0.00	$0.00	$20.57	$27.13
CW-1 0-2,000 Hrs	$12.25	$5.75	$0.00	$0.81	$0.00	$0.37	$0.47	$0.00	$0.00	$19.65	$25.77
Apprentice	**Percent**										
1st 1000 hrs	40.00	$12.60	$5.80	$0.00	$0.47	$0.00	$0.00	$0.37	$0.00	$0.00	$19.24	$25.53
2nd 1000 hrs	45.00	$14.17	$5.80	$0.00	$0.50	$0.00	$0.00	$0.42	$0.00	$0.00	$20.89	$27.98
3rd 1500 hrs	50.00	$15.75	$5.80	$1.62	$0.56	$1.23	$0.66	$0.50	$0.00	$0.00	$26.11	$33.99
4th 1500 hrs	60.00	$18.89	$5.80	$3.24	$0.64	$1.48	$1.32	$0.60	$0.00	$0.00	$31.97	$41.42
5th 1500 hrs	70.00	$22.04	$5.80	$4.86	$0.71	$1.72	$1.99	$0.70	$0.00	$0.00	$37.82	$48.84
6th 1500 hrs	80.00	$25.19	$5.80	$6.48	$0.79	$1.97	$2.65	$0.80	$0.00	$0.00	$43.68	$56.28

Special Calculation Note : OTHER = (NEBF) National Electrical Benefit Fund and Aministration Fee..

Ratio :
1 to 3 Journeymen to 2 Apprentices
4 to 6 Journeymen up to 4 Apprentices
7 to 9 Journeymen up to 6 Apprentices

Construction Electrician and Construction Wireman Ratio
There shall be a minimum ratio of one inside Journeyman Wireman to every (4) employees of different classifications per jobsite. An Inside Journeyman Wireman is required on the project as the fifth (5th) worker or when apprentices are used.

Jurisdiction (* denotes special jurisdictional note) :
CARROLL*, COLUMBIANA*, HOLMES, MAHONING*, STARK, TUSCARAWAS*, WAYNE*

Special Jurisdictional Note : Carroll County: North half including; Fox, Harrison, Rose and Washington Townships.
Columbiana County: Knox Township only.
Mahoning County: Smith Township only.

Tuscarawas County: That portion North of Auburn, Clay, Rush and York Townships.
Wayne County: That portion south of Baughman, Chester, Green, Wayne and Wooster Townships.

The scope of work for the light commercial agreement shall apply to the following small medical clinics, stand-alone doctor and dentist offices with up to 600 amp service (not attached to a hospital), gas stations/convenience stores, fast food restaurants and franchised chain restaurants including independent bars and taverns, places of worship, funeral homes, nursing homes, assisted ing facilities and day-care facilities under 15,000 sq ft, small office, retail/wholesale facilities under 15,000 sq ft with less than 10 units attached, storage units, car washes, express hotels and motels (4 stories or less) without conference or restaurants facilities, residential units (subject to Davis Bacon Rates) small stand-alone manufacturing facilities when free standing and not part of a larger facility (less than 15,000 sq ft) solar projects (500 panels or less) unless other wise covered under this agreement, lighting retrofits (when not associated with remodels involving branch re-circuiting) Lighting retrofits shall be defined as the changing of lamps and ballasts in existing light fixtures and shall also include the one for one replacement of existing fixtures.

Details :

Prevailing Wage Rate
Skilled Crafts

Name of Union: Electrical Local 540 Voice Data Video

Change # : LCN01-2017fbLoc540VDV

Craft : Voice Data Video Effective Date : 01/10/2018 Last Posted : 01/10/2018

Classification	BHR		Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Electrical Installer Technician	$21.25		$5.85	$4.59	$0.53	$2.13	$1.23	$0.70	$0.00	$0.00	$36.28	$46.91
Cable Puller	$10.63		$5.85	$4.59	$0.26	$1.06	$1.23	$0.35	$0.00	$0.00	$23.97	$29.29
Apprentice	**Percent**											
1st period	55.00	$11.69	$5.85	$0.00	$0.26	$0.00	$0.00	$0.35	$0.00	$0.00	$18.15	$23.99
2nd period	65.00	$13.81	$5.85	$0.00	$0.34	$1.10	$0.00	$0.45	$0.00	$0.00	$21.55	$28.46
3rd period	75.00	$15.94	$5.85	$4.59	$0.39	$1.28	$1.23	$0.52	$0.00	$0.00	$29.80	$37.77
4th period	80.00	$17.00	$5.85	$4.59	$0.41	$1.36	$1.23	$0.55	$0.00	$0.00	$30.99	$39.49
5th period	85.00	$18.06	$5.85	$4.59	$0.44	$1.44	$1.23	$0.59	$0.00	$0.00	$32.20	$41.23
h period	90.00	$19.12	$5.85	$4.59	$0.46	$1.53	$1.23	$0.62	$0.00	$0.00	$33.41	$42.97

Special Calculation Note : OTHER = (NEBF) National Electrical Benefit Fund.

VACATION PAY - For Journeymen is 10% of wages and 8% for Apprentices.

Ratio :
1-3 Journeyman to 2 Apprentice
4-6 Journeyman to 4 Apprentice

Jurisdiction (* denotes special jurisdictional note) :
CARROLL*, COLUMBIANA*, HOLMES, MAHONING*, STARK, TUSCARAWAS*, WAYNE*

** Exception - When fire alarm falls within the scope of this addendum, Cable Pullers can be used to aid in test and be the 2nd Teledata employee on the job

Special Jurisdictional Note : Carroll County includes the following townships: North half including Fox, Harrison, Rose and Washington. Tuscarawas County includes the following townships: The portion North of Auburn, Clay, Rush and York. Wayne County includes the following townships: The portion South of Baughman, Chester, Green, and Wayne. Columbiana County includes Knox township. Mahoning County includes Smith township.

Details :
CABLE PULLERS - are for the installation of cable from one termination point to another.

The following work is EXCLUDED from the Teledata Technician work scope:

Installation of computer systems in industrial applications such as assembly lines, robotics, computer controller manufacturing systems.
* - Installation of conduit and/ or raceways shall be installed by Inside Wireman . On sites where there is no Inside Wireman employed, the Teledata Technician may install raceway, or conduit not greater than 10 feet.

* - Fire Alarm work on all new construction sites or wherever the fire alarm system is installed in conduit.
* - All HVAC control work.

Prevailing Wage Rate
Skilled Crafts

Name of Union: Electrical Local 71 High Tension Pipe Type Cable

Change # : LCN01-2018fbLoc7

Craft : Lineman Effective Date : 03/28/2018 Last Posted : 03/28/2018

Classification	BHR	Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
		H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Electrical Lineman	$42.32	$5.75	$1.27	$0.42	$0.00	$9.31	$0.35	$0.00	$0.00	$59.42	$80.58
Certified Lineman Welder	$42.32	$5.75	$1.27	$0.42	$0.00	$9.31	$0.35	$0.00	$0.00	$59.42	$80.58
Certified Cable Splicer	$42.32	$5.75	$1.27	$0.42	$0.00	$9.31	$0.35	$0.00	$0.00	$59.42	$80.58
Operator A	$37.98	$5.75	$1.14	$0.38	$0.00	$8.36	$0.35	$0.00	$0.00	$53.96	$72.95
Operator B	$33.67	$5.75	$1.01	$0.34	$0.00	$7.41	$0.35	$0.00	$0.00	$48.53	$65.36
Operator C	$27.18	$5.75	$0.82	$0.27	$0.00	$5.98	$0.35	$0.00	$0.00	$40.35	$53.94
Groundman 0-12 months Exp	$21.16	$5.75	$0.63	$0.21	$0.00	$4.66	$0.35	$0.00	$0.00	$32.76	$43.34
Groundman 0-12 months Exp w/CDL	$23.28	$5.75	$0.70	$0.23	$0.00	$5.12	$0.35	$0.00	$0.00	$35.43	$47.07
Groundman 1 yr or more	$23.28	$5.75	$0.70	$0.23	$0.00	$5.12	$0.35	$0.00	$0.00	$35.43	$47.07
Groundman 1 yr or more w/CDL	$27.51	$5.75	$0.83	$0.28	$0.00	$6.05	$0.35	$0.00	$0.00	$40.77	$54.53
Equipment Mechanic A	$33.67	$5.75	$1.01	$0.34	$0.00	$7.41	$0.35	$0.00	$0.00	$48.53	$65.36
Equipment Mechanic B	$30.42	$5.75	$0.91	$0.30	$0.00	$6.69	$0.35	$0.00	$0.00	$44.42	$59.63
Equipment Mechanic C	$27.18	$5.75	$0.82	$0.27	$0.00	$5.98	$0.35	$0.00	$0.00	$40.35	$53.94
X-Ray Technician	$42.32	$5.75	$1.27	$0.42	$0.00	$9.31	$0.35	$0.00	$0.00	$59.42	$80.58
Apprentice	**Percent**										
	60.00 $25.39	$5.75	$0.76	$0.25	$0.00	$5.59	$0.35	$0.00	$0.00	$38.09	$50.79

1st 1000 hrs												
2nd 1000 hrs	65.00	$27.51	$5.75	$0.83	$0.28	$0.00	$6.05	$0.35	$0.00	$0.00	$40.77	$54.52
3rd 1000 hrs	70.00	$29.62	$5.75	$0.89	$0.30	$0.00	$6.52	$0.35	$0.00	$0.00	$43.43	$58.25
4th 1000 hrs	75.00	$31.74	$5.75	$0.95	$0.32	$0.00	$6.98	$0.35	$0.00	$0.00	$46.09	$61.96
5th 1000 hrs	80.00	$33.86	$5.75	$1.02	$0.34	$0.00	$7.45	$0.35	$0.00	$0.00	$48.77	$65.69
6th 1000 hrs	85.00	$35.97	$5.75	$1.08	$0.36	$0.00	$7.91	$0.35	$0.00	$0.00	$51.42	$69.41
7th 1000 hrs	90.00	$38.09	$5.75	$1.14	$0.38	$0.00	$8.38	$0.35	$0.00	$0.00	$54.09	$73.13

Special Calculation Note : Other is Health Retirement Account

Operator "A"
John Henry Rock Drill, D-6 (or equivalent) and above, Trackhoe Digger, (320 Track excavator), Cranes (greater then 25 tons and less than 45 tons).

Operator "B"
Cranes (greater than 6 tons and up to 25 tons), Backhoes, Road Tractor, Dozer up to D-5, Pressure Digger- wheeled or tracked, all Tension wire Stringing equipment.

Operator "C"
Trench, Backhoe, Riding type vibratory Compactor, Ground Rod Driver, Boom Truck (6 ton & below), Skid Steer Loaders, Material Handler.

*All Operators of cranes 45 ton or larger shall be paid the journeyman rate of pay. $0.30 is for Health Retirement Account.

Ratio :

1 Journeyman to 1 Apprentice

Jurisdiction (* denotes special jurisdictional note) :

ADAMS, ASHLAND, ASHTABULA, ATHENS, AUGLAIZE, BELMONT, BROWN, BUTLER, CARROLL, CHAMPAIGN, CLARK, CLERMONT, CLINTON, COLUMBIANA, COSHOCTON, CRAWFORD, CUYAHOGA, DARKE, DELAWARE, FAIRFIELD, FAYETTE, FRANKLIN, GALLIA, GEAUGA, GREENE, GUERNSEY, HAMILTON, HARRISON, HIGHLAND, HOCKING, HOLMES, JACKSON, JEFFERSON, KNOX, LAKE, LAWRENCE, LICKING, LOGAN, LORAIN, MADISON, MAHONING, MARION, MEDINA, MEIGS, MERCER, MIAMI, MONROE, MONTGOMERY, MORGAN, MORROW, MUSKINGUM, NOBLE, PERRY, PICKAWAY, PIKE, PORTAGE, PREBLE, RICHLAND, ROSS, SCIOTO, SHELBY, STARK, SUMMIT, TRUMBULL, TUSCARAWAS, UNION, VINTON, WARREN, WASHINGTON, WAYNE

Special Jurisdictional Note :

Details :

Heli - Arc Welding will be paid $.30 above Journeyman rate. Additional compensation of 10% over the Journeyman Lineman and Journeyman Technician for performing work on structures outside of buildings such as water towers, smoke stacks, radio and television towers, more than 75' above the ground.

Prevailing Wage Rate
Skilled Crafts

Name of Union: Electrical Local 71 Outside Utility Power

Change # : LCN01-2018fbLoc7

Craft : Lineman Effective Date : 03/28/2018 Last Posted : 03/28/2018

	BHR		Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Classification												
Electrical Lineman	$40.12		$5.75	$1.20	$0.40	$0.00	$8.83	$0.35	$0.00	$0.00	$56.65	$76.71
Substation Technician	$40.12		$5.75	$1.20	$0.40	$0.00	$8.83	$0.35	$0.00	$0.00	$56.65	$76.71
Cable Splicer	$41.99		$5.75	$1.26	$0.42	$0.00	$9.24	$0.35	$0.00	$0.00	$59.01	$80.00
Operator A	$36.01		$5.75	$1.08	$0.36	$0.00	$7.92	$0.35	$0.00	$0.00	$51.47	$69.47
Operator B	$31.90		$5.75	$0.96	$0.32	$0.00	$7.02	$0.35	$0.00	$0.00	$46.30	$62.25
Operator C	$25.73		$5.75	$0.77	$0.26	$0.00	$5.66	$0.35	$0.00	$0.00	$38.52	$51.39
Groundman 0-12 months Exp	$20.06		$5.75	$0.60	$0.20	$0.00	$4.41	$0.35	$0.00	$0.00	$31.37	$41.40
Groundman 0-12 months Exp w/CDL	$22.07		$5.75	$0.66	$0.22	$0.00	$4.86	$0.35	$0.00	$0.00	$33.91	$44.95
Groundman 1 yr or more	$22.07		$5.75	$0.66	$0.22	$0.00	$4.86	$0.35	$0.00	$0.00	$33.91	$44.95
Groundman 1 yr or more w/CDL	$26.08		$5.75	$0.78	$0.26	$0.00	$5.74	$0.35	$0.00	$0.00	$38.96	$52.00
Equipment Mechanic A	$31.90		$5.75	$0.96	$0.32	$0.00	$7.02	$0.35	$0.00	$0.00	$46.30	$62.25
Equipment Mechanic B	$28.83		$5.75	$0.86	$0.29	$0.00	$6.34	$0.35	$0.00	$0.00	$42.42	$56.84
Equipment Mechanic C	$25.73		$5.75	$0.77	$0.26	$0.00	$5.66	$0.35	$0.00	$0.00	$38.52	$51.39
Line Truck w/uuger	$28.39		$5.75	$0.85	$0.28	$0.00	$6.25	$0.35	$0.00	$0.00	$41.87	$56.07
Apprentice	**Percent**											
1st 1000 hrs	60.00	$24.07	$5.75	$0.72	$0.24	$0.00	$5.30	$0.35	$0.00	$0.00	$36.43	$48.47
2nd 1000 hrs	65.00	$26.08	$5.75	$0.78	$0.26	$0.00	$5.74	$0.35	$0.00	$0.00	$38.96	$52.00
3rd 1000 hrs	70.00	$28.08	$5.75	$0.84	$0.28	$0.00	$6.18	$0.35	$0.00	$0.00	$41.48	$55.53
4th 1000 hrs	75.00	$30.09	$5.75	$0.90	$0.30	$0.00	$6.62	$0.35	$0.00	$0.00	$44.01	$59.05
	80.00	$32.10	$5.75	$0.96	$0.32	$0.00	$7.06	$0.35	$0.00	$0.00	$46.54	$62.58

hrs												
6th 1000 hrs	85.00	$34.10	$5.75	$1.02	$0.34	$0.00	$7.50	$0.35	$0.00	$0.00	$49.06	$66.11
7th 1000 hrs	90.00	$36.11	$5.75	$1.08	$0.36	$0.00	$7.94	$0.35	$0.00	$0.00	$51.59	$69.64

Special Calculation Note : Other is Health Retirement Account
Operator "A"
John Henry Rock Drill, D-6 (or equivalent) and above, Trackhoe Digger, (320 Track excavator), Cranes (greater then 25 tons and less than 45 tons).

Operator "B"
Cranes (greater than 6 tons and up to 25 tons), Backhoes, Road Tractor, Dozer up to D-5, Pressure Digger-wheeled or tracked, all Tension wire Stringing equipment.

Operator "C"
Trench, Backhoe, Riding type vibratory Compactor, Ground Rod Driver, Boom Truck (6 ton & below), Skid Steer Loaders, Material Handler.

Ratio :
(1) Journeyman Lineman to (1) Apprentice

Jurisdiction (* denotes special jurisdictional note) :
ADAMS, ASHLAND, ASHTABULA, ATHENS, AUGLAIZE, BELMONT, BROWN, BUTLER, CARROLL, CHAMPAIGN, CLARK, CLERMONT, CLINTON, COLUMBIANA, COSHOCTON, CRAWFORD, CUYAHOGA, DARKE, DELAWARE, FAIRFIELD, FAYETTE, FRANKLIN, GALLIA, GEAUGA, GREENE, GUERNSEY, HAMILTON, HARRISON, HIGHLAND, HOCKING, HOLMES, JACKSON, JEFFERSON, KNOX, LAKE, LAWRENCE, LICKING, LOGAN, LORAIN, MADISON, MAHONING, MARION, MEDINA, MEIGS, MERCER, MIAMI, MONROE, MONTGOMERY, MORGAN, MORROW, MUSKINGUM, NOBLE, PERRY, PICKAWAY, PIKE, PORTAGE, PREBLE, RICHLAND, ROSS, SCIOTO, SHELBY, STARK, SUMMIT, TRUMBULL, TUSCARAWAS, UNION, VINTON, WARREN, WASHINGTON, WAYNE

Special Jurisdictional Note : 0.30 is for Health Retirement Account.

Details :
Heli - Arc Welding will be paid $.30 above Journeyman rate. Additional compensation of 10% over the Journeyman Lineman and Journeyman Technician for performing work on structures outside of buildings such as water towers, smoke stacks, radio and television towers, more than 75' above the ground.

Prevailing Wage Rate
Skilled Crafts

Name of Union: Electrical Local 71 Outside (North Central Ohio)

Change # : LCN01-2018fbLoc71CentralOhio

Craft : Lineman Effective Date : 03/21/2018 Last Posted : 03/21/2018

	BHR		Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Classification												
Electrical Lineman	$37.36		$5.75	$1.12	$0.37	$0.00	$6.72	$0.06	$0.00	$0.00	$51.38	$70.06
Traffic Signal & Lighting Journeyman	$35.93		$5.75	$1.08	$0.36	$0.00	$6.47	$0.06	$0.00	$0.00	$49.65	$67.61
Equipment Operator	$32.84		$5.75	$0.99	$0.33	$0.00	$5.91	$0.06	$0.00	$0.00	$45.88	$62.30
Groundman 0-12 months (W/O CDL)	$19.98		$5.75	$0.60	$0.20	$0.00	$3.60	$0.06	$0.00	$0.00	$30.19	$40.18
Groundman 0-12 months (W/CDL) plus	$21.83		$5.75	$0.65	$0.22	$0.00	$3.93	$0.06	$0.00	$0.00	$32.44	$43.35
Groundsman greater than 1 Year (W/CDL)	$23.65		$5.75	$0.71	$0.24	$0.00	$4.26	$0.06	$0.00	$0.00	$34.67	$46.50
Traffic Signal Apprentices												
1st 1,000 hours	$21.56		$5.75	$0.65	$0.22	$0.00	$3.88	$0.06	$0.00	$0.00	$32.12	$42.90
2nd 1,000 hours	$23.35		$5.75	$0.70	$0.23	$0.00	$4.20	$0.06	$0.00	$0.00	$34.29	$45.97
3rd 1,000 hours	$25.15		$5.75	$0.75	$0.25	$0.00	$4.53	$0.06	$0.00	$0.00	$36.49	$49.07
4th 1,000 hours	$26.95		$5.75	$0.81	$0.27	$0.00	$4.85	$0.06	$0.00	$0.00	$38.69	$52.17
5th 1,000 hours	$28.74		$5.75	$0.86	$0.29	$0.00	$5.17	$0.06	$0.00	$0.00	$40.87	$55.24
6th 1,000 hours	$32.34		$5.75	$0.97	$0.32	$0.00	$5.82	$0.06	$0.00	$0.00	$45.26	$61.43
Apprentice Lineman	**Percent**											
1st 1,000 Hours	60.00	$22.42	$5.75	$0.67	$0.22	$0.00	$4.04	$0.06	$0.00	$0.00	$33.16	$44.36

2nd 1,000 Hours	65.00	$24.28	$5.75	$0.73	$0.24	$0.00	$4.37	$0.06	$0.00	$0.00	$35.43	$47.58
3rd 1,000 Hours	70.00	$26.15	$5.75	$0.78	$0.26	$0.00	$4.71	$0.06	$0.00	$0.00	$37.71	$50.79
4th 1,000 Hours	75.00	$28.02	$5.75	$0.84	$0.28	$0.00	$5.04	$0.06	$0.00	$0.00	$39.99	$54.00
5th 1,000 Hours	80.00	$29.89	$5.75	$0.90	$0.30	$0.00	$5.38	$0.06	$0.00	$0.00	$42.28	$57.22
6th 1,000 Hours	85.00	$31.76	$5.75	$0.95	$0.32	$0.00	$5.72	$0.06	$0.00	$0.00	$44.56	$60.43
7th 1,000 Hours	90.00	$33.62	$5.75	$1.01	$0.34	$0.00	$6.05	$0.06	$0.00	$0.00	$46.83	$63.65

Special Calculation Note : Other is Safety & Education Fund.

Ratio :

1 Journeymen to 1 Apprentice

Jurisdiction (* denotes special jurisdictional note) :

BELMONT, CARROLL, HARRISON, HOLMES, JEFFERSON, MEDINA, PORTAGE, STARK, SUMMIT, WAYNE

Special Jurisdictional Note :

Details :

A groundman when directed shall assist a Journeyman in the performance of his/her work on the ground, including the use of hand tools. A Groundman under no circumstances shall climb poles, towers,ladders, or work from an elevated platform or bucket truck.

No more than three (3) Groundmen shall work alone. Jobs with more that three Groundmen shall be supervised by a Groundcrew Foreman, Journeyman Lineman, Journeyman Traffic Signal Technician or an Equipment Operator.

Scope of Work: installation and maintenance of highway and street lighting, highway and street sign lighting, electronic message boards and traffic control systems, camera systems, traffic signal work, substation and line construction including overhead and underground projects for private and industrial work as in accordance with the IBEW Constitution. This Agreement includes the operation of all tools and equipment necessary for the installation of the above projects.

Prevailing Wage Rate
Skilled Crafts

Name of Union: Electrical Local 71 Voice Data Video Outside

Change # : LCR01-2017fbLoc71VDV

Craft : Voice Data Video Effective Date : 10/18/2017 Last Posted : 10/18/2017

Classification	BHR	Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
		H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Electrical Installer Technician I	$23.46	$5.50	$0.70	$0.00	$0.00	$0.30	$0.00	$0.00	$0.00	$29.96	$41.69
Installer Technician II	$22.37	$5.50	$0.67	$0.00	$0.00	$0.30	$0.00	$0.00	$0.00	$28.84	$40.03
Equipment Operator I	$22.37	$5.50	$0.67	$0.00	$0.00	$0.30	$0.00	$0.00	$0.00	$28.84	$40.03
Equipment Operator II	$18.43	$5.50	$0.55	$0.00	$0.00	$0.30	$0.00	$0.00	$0.00	$24.78	$33.99
Installer /Repair Outside	$22.37	$5.50	$0.67	$0.00	$0.00	$0.30	$0.00	$0.00	$0.00	$28.84	$40.03
Ground Driver W/CDL	$15.83	$5.50	$0.47	$0.00	$0.00	$0.30	$0.00	$0.00	$0.00	$22.10	$30.01
Groundman	$13.24	$5.50	$0.40	$0.00	$0.00	$0.30	$0.00	$0.00	$0.00	$19.44	$26.06
Cable Splicer	$23.46	$5.50	$0.70	$0.00	$0.00	$0.30	$0.00	$0.00	$0.00	$29.96	$41.69

Special Calculation Note :

Ratio :

Jurisdiction (* denotes special jurisdictional note) :
ADAMS, ASHLAND, ASHTABULA, ATHENS, AUGLAIZE, BELMONT, BROWN, BUTLER, CARROLL, CHAMPAIGN, CLARK, CLERMONT, CLINTON, COLUMBIANA, COSHOCTON, CRAWFORD, CUYAHOGA, DARKE, DELAWARE, FAIRFIELD, FAYETTE, FRANKLIN, GALLIA, GEAUGA, GREENE, GUERNSEY, HAMILTON, HARRISON, HIGHLAND, HOCKING, HOLMES, JACKSON, JEFFERSON, KNOX, LAKE, LAWRENCE, LICKING, LOGAN, LORAIN, MADISON, MAHONING, MARION, MEDINA, MEIGS, MERCER, MIAMI, MONROE, MONTGOMERY, MORGAN, MORROW, MUSKINGUM, NOBLE, PERRY, PICKAWAY, PIKE, PORTAGE, PREBLE, RICHLAND, ROSS, SCIOTO, SHELBY, STARK, SUMMIT, TRUMBULL, TUSCARAWAS, UNION, VINTON, WARREN, WASHINGTON, WAYNE

Special Jurisdictional Note :

Details :
Cable Splicer: Inspect and test lines or cables, analyze results, and evaluate transmission characteristics. Cover conductors with insulation or seal splices with moisture-proof covering. Install, splice, test, and repair cables using tools or mechanical equipment. This will include the splicing of

fiber.

Journeyman Technician I: Must know all aspects of telephone and cable work. This is to include aerial, underground, and manhole work. Must know how to climb and run bucket. Must have all the tools required to perform these tasks. Must be able to be responsible for the safety of the crew at all times. Must also have CDL license and have at least 5 years experience.

Installer/Repairman: Perform tasks of repairing, installing, and testing phone and CATV services.

Technician II: Have at least three years of telephone and CATV experience. Must have the knowledge of underground, aerial, and manhole work. Must be able to climb and operate bucket. Must have CDL. Must have all tools needed to perform these tasks.

Equipment Operator I: Able to operate a digger derrick or bucket truck. Have at least 5 years of experience and must have a valid CDL license.

Equipment Operator II: Able to operate a digger derrick or bucket truck. Have at least 3 years of experience and must have a valid CDL license.

Groundman W/CDL: Must have a valid CDL license and be able to perform tasks such as: climbing poles, pulling downguys, making up material, and getting appropriate tools for the job. Must have at least 5 year's experience.

Groundman: Perform tasks such as: climbing poles, pulling downguys, making up material, and getting appropriate tools for the job. Experience 0-5 years.

Prevailing Wage Rate
Skilled Crafts

Name of Union: Elevator Local 45

Change # : LCN01-2012kpLoc45

Craft : Elevator Effective Date : 04/04/2012 Last Posted : 04/04/2012

Classification	BHR		Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Elevator Mechanic	$41.92		$11.03	$6.96	$0.55	$3.35	$5.00	$0.00	$0.00	$0.00	$68.81	$89.77
Helper	$29.34		$11.03	$6.96	$0.55	$1.76	$5.00	$0.00	$0.00	$0.00	$54.64	$69.31
0-6 months Probation	50.00	$20.96	$11.03	$6.96	$0.55	$1.26	$5.00	$0.00	$0.00	$0.00	$45.76	$56.24
1st year	55.00	$23.06	$11.03	$6.96	$0.55	$1.38	$5.00	$0.00	$0.00	$0.00	$47.98	$59.50
2nd year	65.00	$27.25	$11.03	$6.96	$0.55	$1.64	$5.00	$0.00	$0.00	$0.00	$52.43	$66.05
3rd year	70.00	$29.34	$11.03	$6.96	$0.55	$1.76	$5.00	$0.00	$0.00	$0.00	$54.64	$69.32
4th year	80.00	$33.54	$11.03	$6.96	$0.55	$2.01	$5.00	$0.00	$0.00	$0.00	$59.09	$75.85

Special Calculation Note : Vacation moves to 8% of BHR after 5 years

Ratio :

The total number of Helpers & Apprentices employed shall not exceed the number of Mechanics on any one job, except on jobs where (2) teams or more are working, (1) extra Helper or Apprentice may be employed for the first (2) teams and an extra Helper or Apprentice for each additional (3) teams.

Jurisdiction (* denotes special jurisdictional note) :

ASHLAND, CARROLL, COLUMBIANA, COSHOCTON, HARRISON, HOLMES, MAHONING, MEDINA, PORTAGE, RICHLAND, STARK, SUMMIT, TRUMBULL, TUSCARAWAS, WAYNE

Special Jurisdictional Note :

Details :

Vacation 6%/under 5 years based on regular hourly rate for all hours worked. 8%/over 5 years based on regular hourly rate for all hours worked.

Prevailing Wage Rate
Skilled Crafts

Name of Union: Glazier Local 1162

Change # : LCN02-2017fbLoc1162

Craft : Glazier Effective Date : 11/08/2017 Last Posted : 11/08/2017

Classification	BHR		Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Glazier	$25.00		$6.48	$5.76	$0.30	$0.00	$0.00	$0.25	$0.00	$0.00	$37.79	$50.29
Apprentice	**Percent**											
1st 6 months	50.00	$12.50	$6.48	$5.76	$0.30	$0.00	$0.00	$0.25	$0.00	$0.00	$25.29	$31.54
2nd 6 months	55.00	$13.75	$6.48	$5.76	$0.30	$0.00	$0.00	$0.25	$0.00	$0.00	$26.54	$33.42
3rd 6 months	60.00	$15.00	$6.48	$5.76	$0.30	$0.00	$0.00	$0.25	$0.00	$0.00	$27.79	$35.29
4th 6 months	65.00	$16.25	$6.48	$5.76	$0.30	$0.00	$0.00	$0.25	$0.00	$0.00	$29.04	$37.17
5th 6 months	70.00	$17.50	$6.48	$5.76	$0.30	$0.00	$0.00	$0.25	$0.00	$0.00	$30.29	$39.04
6th 6 months	75.00	$18.75	$6.48	$5.76	$0.30	$0.00	$0.00	$0.25	$0.00	$0.00	$31.54	$40.92
7th 6 months	80.00	$20.00	$6.48	$5.76	$0.30	$0.00	$0.00	$0.25	$0.00	$0.00	$32.79	$42.79
8th 6 months	90.00	$22.50	$6.48	$5.76	$0.30	$0.00	$0.00	$0.25	$0.00	$0.00	$35.29	$46.54

Special Calculation Note : OTHER IS : Supplemental Unemployment Benefits

Ratio :

1 Journeyman to 1 Apprentice
3 Journeymen to 1 Apprentice Thereafter

Jurisdiction (* denotes special jurisdictional note) :

ASHLAND, CARROLL, COSHOCTON, HOLMES, MEDINA, PORTAGE, RICHLAND, STARK, SUMMIT, TUSCARAWAS, WAYNE

Special Jurisdictional Note :

Details :

Add $1.25 per hour for High Pay which is all work that requires the employee be supported by equipment which hangs or suspends from the roof of a building or structure including all repelling .

Prevailing Wage Rate
Skilled Crafts

Name of Union: Ironworker Local 550

Change # : LCN01-2018fbLoc550

Craft : Ironworker Effective Date : 05/01/2018 Last Posted : 04/11/2018

	BHR		Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Classification												
Ironworker	$27.60		$7.68	$8.34	$0.71	$0.00	$2.73	$0.15	$0.00	$0.00	$47.21	$61.01
Apprentice	**Percent**											
1st 6 months	60.00	$16.56	$7.68	$8.34	$0.71	$0.00	$2.73	$0.15	$0.00	$0.00	$36.17	$44.45
2nd 6 months	65.00	$17.94	$7.68	$8.34	$0.71	$0.00	$2.73	$0.15	$0.00	$0.00	$37.55	$46.52
3rd 6 months	70.00	$19.32	$7.68	$8.34	$0.71	$0.00	$2.73	$0.15	$0.00	$0.00	$38.93	$48.59
4th 6 months	75.00	$20.70	$7.68	$8.34	$0.71	$0.00	$2.73	$0.15	$0.00	$0.00	$40.31	$50.66
5th 6 months	80.00	$22.08	$7.68	$8.34	$0.71	$0.00	$2.73	$0.15	$0.00	$0.00	$41.69	$52.73
6th 6 months	85.00	$23.46	$7.68	$8.34	$0.71	$0.00	$2.73	$0.15	$0.00	$0.00	$43.07	$54.80
7th 6 months	90.00	$24.84	$7.68	$8.34	$0.71	$0.00	$2.73	$0.15	$0.00	$0.00	$44.45	$56.87
8th 6 months	95.00	$26.22	$7.68	$8.34	$0.71	$0.00	$2.73	$0.15	$0.00	$0.00	$45.83	$58.94

Special Calculation Note : OTHER IS: JOURNEYMAN UPGRADE AND WELLNESS FUND.

Ratio :

4 Journeymen to 1 Apprentice
1 Journeymen to 1 Apprentice, spinning of cable for suspension bridge
1 Journeymen to 1 Apprentice, ornamental work
2 Journeymen to 1 Apprentice, reinforcing work
1 Journeymen to 2 Apprentice, roadway sinage/sound barrier
***the ratio of apprentices to journeymen may be

Jurisdiction (* denotes special jurisdictional note) :

ASHLAND, CARROLL, COLUMBIANA*, COSHOCTON, HOLMES*, HURON, MAHONING*, MEDINA*, PORTAGE*, RICHLAND, STARK, SUMMIT*, TUSCARAWAS, WAYNE

adjusted higher on a job-to job basis with the approval of the business manager and/or business agent.

Special Jurisdictional Note : The jurisdictional line between Local 17 and Local 550 is determined as follows: All territory North of Old Route 224 line to be within the jurisdiction of Local 17. All territory South of Old Route 224 line is to be the jurisdiction of Local 550, except for everything within the City limits of Barberton which shall be under the jurisdiction of Local 17.

Details :

Prevailing Wage Rate
Skilled Crafts

Name of Union: Ironworker Local 550 Glass & Curtain Wall

Change # : LCN01-2017fbLoc550

Craft : Ironworker Effective Date : 07/01/2017 Last Posted : 06/28/2017

Classification	BHR		Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Ironworker Glass & Curtain Wall	$22.00		$7.00	$7.47	$0.09	$0.00	$0.33	$0.00	$0.00	$0.00	$36.89	$47.89
Apprentice	Percent											
1st 6 months	60.00	$13.20	$7.00	$7.47	$0.09	$0.00	$0.33	$0.00	$0.00	$0.00	$28.09	$34.69
2nd 6 months	65.00	$14.30	$7.00	$7.47	$0.09	$0.00	$0.33	$0.00	$0.00	$0.00	$29.19	$36.34
3rd 6 months	70.00	$15.40	$7.00	$7.47	$0.09	$0.00	$0.33	$0.00	$0.00	$0.00	$30.29	$37.99
4th 6 months	75.00	$16.50	$7.00	$7.47	$0.09	$0.00	$0.33	$0.00	$0.00	$0.00	$31.39	$39.64
5th 6 months	80.00	$17.60	$7.00	$7.47	$0.09	$0.00	$0.33	$0.00	$0.00	$0.00	$32.49	$41.29
6th 6 months	85.00	$18.70	$7.00	$7.47	$0.09	$0.00	$0.33	$0.00	$0.00	$0.00	$33.59	$42.94
7th 6 months	90.00	$19.80	$7.00	$7.47	$0.09	$0.00	$0.33	$0.00	$0.00	$0.00	$34.69	$44.59
8th 6 months	95.00	$20.90	$7.00	$7.47	$0.09	$0.00	$0.33	$0.00	$0.00	$0.00	$35.79	$46.24

Special Calculation Note :

Ratio :

1 Apprentice to 1 Journeymen

Jurisdiction (* denotes special jurisdictional note) :

ASHLAND, CARROLL, COLUMBIANA*, COSHOCTON, HOLMES, HURON*, MAHONING*, MEDINA*, PORTAGE*, RICHLAND, STARK, SUMMIT*, TUSCARAWAS, WAYNE

Special Jurisdictional Note : The jurisdictional line between Locals 17 and 550 is determined as follows: All territory North of Old Route 224 line is to be within the jurisdiction of Local 17.
All territory South of Old Route 224 line is to be the jurisdiction of Local 550, except for everything within the City limits of Barberton which shall be under the jurisdiction of Local 17.

Details :

Prevailing Wage Rate
Skilled Crafts

Name of Union: Labor HevHwy 2

Change # : LCN01-2018fbLaborHevHwy2

Craft : Laborer Group 1 Effective Date : 05/01/2018 Last Posted : 04/11/2018

	BHR		Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Classification												
Laborer Group 1	$31.05		$6.90	$3.60	$0.45	$0.00	$0.00	$0.00	$0.10	$0.00	$42.10	$57.63
Group 2	$31.22		$6.90	$3.60	$0.45	$0.00	$0.00	$0.00	$0.10	$0.00	$42.27	$57.88
Group 3	$31.55		$6.90	$3.60	$0.45	$0.00	$0.00	$0.00	$0.10	$0.00	$42.60	$58.38
Group 4	$32.00		$6.90	$3.60	$0.45	$0.00	$0.00	$0.00	$0.10	$0.00	$43.05	$59.05
Watch Person	$23.35		$6.90	$3.60	$0.45	$0.00	$0.00	$0.00	$0.10	$0.00	$34.40	$46.08
Apprentice	**Percent**											
0-1000 hrs	60.00	$18.63	$6.90	$3.60	$0.45	$0.00	$0.00	$0.00	$0.10	$0.00	$29.68	$39.00
1001-2000 hrs	70.02	$21.74	$6.90	$3.60	$0.45	$0.00	$0.00	$0.00	$0.10	$0.00	$32.79	$43.66
2001-3000 hrs	80.00	$24.84	$6.90	$3.60	$0.45	$0.00	$0.00	$0.00	$0.10	$0.00	$35.89	$48.31
3001-4000 hrs	90.00	$27.94	$6.90	$3.60	$0.45	$0.00	$0.00	$0.00	$0.10	$0.00	$39.00	$52.97
More Than 4000 hrs	100.00	$31.05	$6.90	$3.60	$0.45	$0.00	$0.00	$0.00	$0.10	$0.00	$42.10	$57.63

Special Calculation Note : Watchman has no Apprentices. Tunnel Laborer rate with air-pressurized add $1.00 to the above wage rate.

Ratio :

1 Journeymen to 1 Apprentice
3 Journeymen to 1 Apprentice thereafter

Jurisdiction (* denotes special jurisdictional note) :

ASHTABULA, ERIE, HURON, LORAIN, LUCAS, MAHONING, MEDINA, OTTAWA, PORTAGE, SANDUSKY, STARK, SUMMIT,

TRUMBULL, WOOD

Special Jurisdictional Note : Hod Carriers and Common Laborers - Heavy, Highway, Sewer, Waterworks, Utility, Airport, Railroad, Industrial and Building Site, Sewer Plant, Waste Water Treatment Facilities Construction

Details :

Group 1

Laborer (Construction); Plant Laborer or Yardman, Right-of-way Laborer, Landscape Laborer, Highway Lighting Worker, Signalization Worker, (Swimming) Pool Construction Laborer, Utility Man, *Bridge Man, Handyman, Joint Setter, Flagperson, Carpenter Helper, Waterproofing Laborer, Slurry Seal, Seal Coating, Surface Treatment or Road Mix Laborer, Riprap Laborer & Grouter, Asphalt Laborer, Dump Man (batch trucks), Guardrail & Fence Installer, Mesh Handler & Placer, Concrete Curing Applicator, Scaffold Erector, Sign Installer, Hazardous Waste (level D), Diver Helper, Zone Person and Traffic Control.

*Bridge Man will perfomr work as per the October 31, 1949, memorandum on concrete forms, byand between the United Brotherhood of Caprpenters and Joiners of Americ and the Laborers' International Union of North America, which states in; "the moving, cleaning, oiling and carrying to the next point of erection, and the stripping of forms which are not to be re-used, and forms on all flat arch work shall be done by memebers of the Laborers' International Union of North America."

Group 2

Asphalt Raker, Screwman or Paver, Concrete Puddler, Kettle Man (pipeline), All Machine-Driven Tools (Gas, Electric, Air), Mason Tender, Brick Paver, Mortar Mixer, Skid Steer, Sheeting & Shoring Person, Surface Grinder Person, Screedperson, Water Blast, Hand Held Wand, Power Buggy or Power Wheelbarrow, Paint Striper, Plastic fusing Machine Operator, Rodding Machine Operator, Pug Mill Operator, Operator of All Vacuum Devices Wet or Dry, Handling of all Pumps 4 inches and under (gas, air or electric), Diver, Form Setter, Bottom Person, Welder Helper (pipeline), Concrete Saw Person, Cutting with Burning Torch, Pipe Layer, Hand Spiker (railroad), Underground Person (working in sewer and waterline, cleaning, repairing and reconditioning). Tunnel Laborer (without air),Caisson, Cofferdam (below 25 feet deep), Air Track and Wagon Drill, Sandblaster Nozzle Person, Hazardous Waste (level B), ***Lead Abatement, Hazardous Waste (level C)

***Includes the erecting of structures for the removal, including the encapsulation and containment of Lead abatement process.

Group 3

Blast and Powder Person, Muckers will be defined as shovel men working directly with the miners, Wrencher (mechanical joints & utility pipeline), Yarner, Top Lander, Hazardous Waste (level A), Concrete Specialist, Curb Setter and Cutter, Grade Checker, Concrete Crew in Tunnels. Utility pipeline Tappers, Waterline, Caulker, Signal Person will receive the rate equal to the rate paid the Laborer classification for which the Laborer is signaling.

Group 4
Miner,Welder, Gunite Nozzle Person

A.) The Watchperson shall be responsible to patrol and maintain a safe traffic zone including but not limited to barrels, cones, signs, arrow boards, message boards etc.
The responsibility of a watchperson is to see that the equipment, job and office trailer etc. are secure.

Prevailing Wage Rate
Skilled Crafts

Name of Union: Labor Local 1015 Building

Change # : LCN01-2018fbLoc1015

Craft : Laborer Effective Date : 05/01/2018 Last Posted : 04/11/2018

	BHR		Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Classification												
Laborer Group 1	$27.02		$6.90	$3.60	$0.40	$0.00	$0.00	$0.00	$0.10	$0.00	$38.02	$51.53
Group 2	$27.42		$6.90	$3.60	$0.40	$0.00	$0.00	$0.00	$0.10	$0.00	$38.42	$52.13
Group 3	$27.77		$6.90	$3.60	$0.40	$0.00	$0.00	$0.00	$0.10	$0.00	$38.77	$52.66
Group 4	$27.72		$6.90	$3.60	$0.40	$0.00	$0.00	$0.00	$0.10	$0.00	$38.72	$52.58
Group 5	$20.06		$6.90	$3.60	$0.40	$0.00	$0.00	$0.00	$0.10	$0.00	$31.06	$41.09
Apprentice	**Percent**											
0-1000 hrs	60.00	$16.21	$6.90	$3.60	$0.40	$0.00	$0.00	$0.00	$0.10	$0.00	$27.21	$35.32
1001-2000 hrs	70.00	$18.91	$6.90	$3.60	$0.40	$0.00	$0.00	$0.00	$0.10	$0.00	$29.91	$39.37
2001-3000 hrs	80.00	$21.62	$6.90	$3.60	$0.40	$0.00	$0.00	$0.00	$0.10	$0.00	$32.62	$43.42
3001-4000 hrs	90.00	$24.32	$6.90	$3.60	$0.40	$0.00	$0.00	$0.00	$0.10	$0.00	$35.32	$47.48
More than 4000 hrs	100.00	$27.02	$6.90	$3.60	$0.40	$0.00	$0.00	$0.00	$0.10	$0.00	$38.02	$51.53

Special Calculation Note : No special calculations for this skilled craft wage rate are required at this time.

Ratio :

1 Journeyman to 1 Apprentice
4 Journeyman to 1 Apprentice

Jurisdiction (* denotes special jurisdictional note) :
CARROLL, STARK, WAYNE

Special Jurisdictional Note :

Details :
Group 1
Building & Construction Laborer, Signalman, Flagman, Tool Cribman, Carpenter Tender, Finisher Tender, Concrete Handler, Utility Construction Laborer, Guard Rail Erectors, Hazardous Waste (Level D)

Group 2
Bottom Man, Scaffold Builder, Tunnel laborer, Pipe Layer, Air and Power Driven Tools, Burner on Demolition Work, Swinging Scaffold, Mucker, Caisson Worker, Cofferdam Worker, Powder Men and Dynamite Blaster, Creosote Worker, Form Setter, Plasterer Tender, Hod Carrier Laser Beam Set-up Man, All confined space work, furnaces, pickel tubs, acid-pits, and Hazardous Waste Level (C)

Group 3
Mason Tender, Mortar Mixer, Stonemason Tender,skid-loader, Hazardous Waste Level (B)

Group 4
Gunnite Operator, Hazardous Waste Level (A)

Group 5
Watchman

Prevailing Wage Rate
Skilled Crafts

Name of Union: Operating Engineers - Building Local 18 - Zone III

Change # : LCN01-2017fbLoc18zone3

Craft : Operating Engineer Effective Date : 08/02/2017 Last Posted : 08/02/2017

Classification	BHR		Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Operator Class 1	$34.84		$8.01	$6.00	$0.75	$0.00	$0.00	$0.09	$0.00	$0.00	$49.69	$67.11
Class 2	$34.72		$8.01	$6.00	$0.75	$0.00	$0.00	$0.09	$0.00	$0.00	$49.57	$66.93
Class 3	$33.68		$8.01	$6.00	$0.75	$0.00	$0.00	$0.09	$0.00	$0.00	$48.53	$65.37
Class 4	$32.50		$8.01	$6.00	$0.75	$0.00	$0.00	$0.09	$0.00	$0.00	$47.35	$63.60
Class 5	$27.04		$8.01	$6.00	$0.75	$0.00	$0.00	$0.09	$0.00	$0.00	$41.89	$55.41
Class 6	$35.09		$8.01	$6.00	$0.75	$0.00	$0.00	$0.09	$0.00	$0.00	$49.94	$67.49
Class 7	$35.34		$8.01	$6.00	$0.75	$0.00	$0.00	$0.09	$0.00	$0.00	$50.19	$67.86
Class 8	$35.84		$8.01	$6.00	$0.75	$0.00	$0.00	$0.09	$0.00	$0.00	$50.69	$68.61
Class 9	$36.09		$8.01	$6.00	$0.75	$0.00	$0.00	$0.09	$0.00	$0.00	$50.94	$68.99
Apprentice	**Percent**											
1st Year	50.00	$17.42	$8.01	$6.00	$0.75	$0.00	$0.00	$0.09	$0.00	$0.00	$32.27	$40.98
2nd Year	60.00	$20.90	$8.01	$6.00	$0.75	$0.00	$0.00	$0.09	$0.00	$0.00	$35.75	$46.21
3rd Year	70.00	$24.39	$8.01	$6.00	$0.75	$0.00	$0.00	$0.09	$0.00	$0.00	$39.24	$51.43
4th Year	80.00	$27.87	$8.01	$6.00	$0.75	$0.00	$0.00	$0.09	$0.00	$0.00	$42.72	$56.66
Field Mechanic Trainee												
1st Year	49.83	$17.36	$8.01	$6.00	$0.75	$0.00	$0.00	$0.09	$0.00	$0.00	$32.21	$40.89
2nd Year	59.80	$20.83	$8.01	$6.00	$0.75	$0.00	$0.00	$0.09	$0.00	$0.00	$35.68	$46.10
3rd Year	69.75	$24.30	$8.01	$6.00	$0.75	$0.00	$0.00	$0.09	$0.00	$0.00	$39.15	$51.30
4th Year	79.75	$27.78	$8.01	$6.00	$0.75	$0.00	$0.00	$0.09	$0.00	$0.00	$42.63	$56.53

Special Calculation Note : Other: Education & Safety $0.09

Ratio :
For every (3) Operating Engineer Journeymen employed by the company there may be employed (1) Registered Apprentice or trainee Engineer through the referral when they are available. An apprenice, while employed as part of a crew per Article VIII, paragraph 77, will not be subject to the apprenticeship ratios in this collective bargaining agreement

Jurisdiction (* denotes special jurisdictional note) :
ADAMS, ALLEN, ASHLAND, ATHENS, AUGLAIZE, BELMONT, BROWN, BUTLER, CARROLL, CHAMPAIGN, CLARK, CLERMONT, CLINTON, COSHOCTON, CRAWFORD, DARKE, DEFIANCE, DELAWARE, FAIRFIELD, FAYETTE, FRANKLIN, FULTON, GALLIA, GREENE, GUERNSEY, HAMILTON, HANCOCK, HARDIN, HARRISON, HENRY, HIGHLAND, HOCKING, HOLMES, JACKSON, JEFFERSON, KNOX, LAWRENCE, LICKING, LOGAN, MADISON, MARION, MEIGS, MERCER, MIAMI, MONROE, MONTGOMERY, MORGAN, MORROW, MUSKINGUM, NOBLE, OTTAWA, PAULDING, PERRY, PICKAWAY, PIKE, PREBLE, PUTNAM, RICHLAND, ROSS, SANDUSKY, SCIOTO, SENECA, SHELBY, STARK, TUSCARAWAS, UNION, VAN WERT, VINTON, WARREN, WASHINGTON, WAYNE, WILLIAMS, WYANDOT

Special Jurisdictional Note :

Details :
**Apprentices will receive a 10% increase on top of the percentages listed above provided they are operating mobile equipment. Mechanic Trainees will receive 10% increase if required to have CDL

Class 1 - Barrier Moving Machine; Boiler Operators or Compressor Operators, when compressor or boiler is mounted on crane (Piggyback Operation); Boom Trucks (all types); Cableways Cherry Pickers; Combination - Concrete Mixers & Towers; All Concrete Pumps with Booms; Cranes (all types) Derricks (all types); Draglines Dredges (dipper, clam or suction) 3-man crew; Elevating Graders or Euclid Loaders; Floating Equipment; Gradalls; Helicopter Operators; hoisting building materials; Helicopter Winch Operators, Hoisting building materials; Hoes (All types); Hoists (with two or more drums in use): Hydraulic Gantry (lift system); Laser Finishing Machines; Lift Slab or Panel Jack Operators; Locomotives (all types); Maintenance Engineers (Mechanic and/or Welder); Mixers, paving (multiple drum); Mobile Concrete Pumps, with booms, Panelboards, (all types on site); Pile Drivers; Power Shovels; Prentice Loader; Rail Tamper (with automatic

lifting and aligning device);' Rotary Drills (all) used on caissons for foundations and sub-structure work; Side Booms; Slip Form Pavers; Straddle Carriers (Building Construction on site); Tug Boats. Horizontal Directional Drill, Rough Terrain Fork-lift with Winch/Hoist, Laser Screed, and Like equipment;Compact Cranes,track or rubber over 4,000 pound capacity,self-erecting cranes:stationary,track or truck (all configurations) bucket trench machines (over 24 " wide).

Class 2 - Asphalt Pavers; Bobcat-type and/or skid steer loader with hoe attachment greater than 7000 lbs. Bulldozers; CMI type Equipment; Endloaders; Hydro Milling Machine; Kolman-type Loaders (Dirt Loading); Lead Greasemen; Mucking Machines; Pettibone-Rail Equipment; Power Graders; Power Scoops; Power Shapers; Push Cats; Vermeer Type Concrete Saw;All rotomills, grinders & planers of all types. Articulating/end dumps (minus $4.00/hour from Class 2 rate)

Class 3 - A Frames; Air Compressors, Pressurizing Shafts or Tunnels; All Asphalt Rollers; Bobcat-type and/or skid steer loader with or without attachments; Boilers (15 lbs pressure and over); All concrete Pumps (without booms with 5 inch system); Fork Lifts (except masonry); Highway Drillers - all types (with integral power); Hoists (with one drum); House Elevators (except those automatic call button controlled); Man lifts; Mud Jacks; Pressure Grouting; Pump Operators (installing or operating Well Points or other types of Dewatering Systems); Pumps (4 inches and over discharge); Railroad Tie Inserter/Remover; Rotator (Lime-Soil Stabilizer); Submersible Pumps (4 inches and over discharge); Switch & Tie Tampers (without lifting and aligning device); Trench Machines (24 inches and under); Utility Operators; Material hoist/elevators.

Class 4 - Ballast Re-locator; Backfillers and Tampers; Batch Plant Operators; Bar and Joint Installing Machines; Bull Floats; Burlap and Curing Machines; Clefplanes; Compressors, on building construction; Concrete Spreader; Conveyors, used for handling building materials; Concrete Mixers, one bag capacity (side loader); Concrete Mixers, capacity more than one bag; Crushers; Deck Hands; Drum Fireman (in Asphalt Plant); Farm type tractors pulling attachments; Finishing Machines; Form Trenchers; Generators: Gunite Machines; Hydro-Seeders; Pavement Breakers (hydraulic or cable); Post Drivers; Post Hole Diggers; Pressure Pumps (over 1/2 inch discharge); Road Widening Trenchers; Rollers (except asphalt); All Concrete pumps (without Boom with 4 inch or smaller systems); Self-Propelled Power Spreaders; Concrete Spreaders; Self-Propelled Sub-graders; Shotcrete Machines; Tire Repairmen; Tractors, pulling sheepfoot rollers or graders; VAC/ALLS; Vibratory Compactors, with integral power; Welder Operators.

Class 5 - Boilers (less than 15 lbs. pressure); Inboard/outboard Motor Boat Launches; Light Plant Operators; Masonry Fork Lifts; Oilers/Helpers; Power Driven Heaters (oil fired); Power Scrubbers; Power Sweepers; Pumps (under 4 inch discharge); Signalmen, Submersible Pumps (under 4 inch discharge). Directional Drill Locator and Allen Screed Concrete Paver. Fueling and greasing (plus $3.00), compact cranes; track or rubber under 4,000 pounds.

Class 6 - Master Mechanic

Class 7 - Boom & Jib 150 - 180 feet

Class 8 - Boom & Jib 180 - 249 feet

Class 9 - Boom & Jib 250 - or over

Prevailing Wage Rate
Skilled Crafts

Name of Union: Operating Engineers - HevHwy Zone II

Change # : LCN01-2017fbLoc18hevhwyII

Craft : Operating Engineer Effective Date : 08/02/2017 Last Posted : 08/02/2017

Classification	BHR		Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Operator Class 1	$34.84		$8.01	$6.00	$0.75	$0.00	$0.00	$0.09	$0.00	$0.00	$49.69	$67.11
Class 2	$34.72		$8.01	$6.00	$0.75	$0.00	$0.00	$0.09	$0.00	$0.00	$49.57	$66.93
Class 3	$33.68		$8.01	$6.00	$0.75	$0.00	$0.00	$0.09	$0.00	$0.00	$48.53	$65.37
Class 4	$32.50		$8.01	$6.00	$0.75	$0.00	$0.00	$0.09	$0.00	$0.00	$47.35	$63.60
Class 5	$27.04		$8.01	$6.00	$0.75	$0.00	$0.00	$0.09	$0.00	$0.00	$41.89	$55.41
Class 6	$35.09		$8.01	$6.00	$0.75	$0.00	$0.00	$0.09	$0.00	$0.00	$49.94	$67.49
Apprentice	Percent											
1st Year	50.00	$17.42	$8.01	$6.00	$0.75	$0.00	$0.00	$0.09	$0.00	$0.00	$32.27	$40.98
2nd Year	60.00	$20.90	$8.01	$6.00	$0.75	$0.00	$0.00	$0.09	$0.00	$0.00	$35.75	$46.21
3rd Year	70.00	$24.39	$8.01	$6.00	$0.75	$0.00	$0.00	$0.09	$0.00	$0.00	$39.24	$51.43
4th Year	80.00	$27.87	$8.01	$6.00	$0.75	$0.00	$0.00	$0.09	$0.00	$0.00	$42.72	$56.66
Field Mech Trainee Class 2												
1st year	49.82	$17.36	$8.01	$6.00	$0.75	$0.00	$0.00	$0.09	$0.00	$0.00	$32.21	$40.89
2nd year	59.78	$20.83	$8.01	$6.00	$0.75	$0.00	$0.00	$0.09	$0.00	$0.00	$35.68	$46.09
3rd year	69.75	$24.30	$8.01	$6.00	$0.75	$0.00	$0.00	$0.09	$0.00	$0.00	$39.15	$51.30
4th year	79.73	$27.78	$8.01	$6.00	$0.75	$0.00	$0.00	$0.09	$0.00	$0.00	$42.63	$56.52

Special Calculation Note : Other: Education & Safety Fund is $0.09 per hour.

Ratio :
For every (3) Operating Engineer Journeymen employed by the company , there may be employed (1) Registered Apprentice or Trainee Engineer through the referral when they are available. An apprentice, while employed as part of a crew per Article VIII paragraph 65, will not be subject the apprenticeship ratios in this collective bargaining agreement.

Jurisdiction (* denotes special jurisdictional note) :
ADAMS, ALLEN, ASHLAND, ATHENS, AUGLAIZE, BELMONT, BROWN, BUTLER, CARROLL, CHAMPAIGN, CLARK, CLERMONT, CLINTON, COSHOCTON, CRAWFORD, DARKE, DEFIANCE, DELAWARE, FAIRFIELD, FAYETTE, FRANKLIN, FULTON, GALLIA, GREENE, GUERNSEY, HAMILTON, HANCOCK, HARDIN, HARRISON, HENRY, HIGHLAND, HOCKING, HOLMES, HURON, JACKSON, JEFFERSON, KNOX, LAWRENCE, LICKING, LOGAN, LUCAS, MADISON, MARION, MEIGS, MERCER, MIAMI, MONROE, MONTGOMERY, MORGAN, MORROW, MUSKINGUM, NOBLE, OTTAWA, PAULDING, PERRY, PICKAWAY, PIKE, PREBLE, PUTNAM, RICHLAND, ROSS, SANDUSKY, SCIOTO, SENECA, SHELBY, STARK, TUSCARAWAS, UNION, VAN WERT, VINTON, WARREN, WASHINGTON, WAYNE, WILLIAMS, WOOD, WYANDOT

Special Jurisdictional Note :

Details :
**Apprentices will receive a 10% increase on top of the percentages listed above provided they are operating mobile equipment. Mechanic Trainees will receive 10% increase if they are required to have CDL.

Class 1 - Air Compressors on Steel Erection; Barrier Moving Machine; Boiler Operators, on Compressors or Generators, when mounted on a rig: Cableways, Combination Concrete mixers & Towers; Concrete Pumps; Concrete Plants (over 4 yd capacity); Cranes (all types, including Boom Trucks, Cherry Pickers); Derricks; Draglines, Dredgers (dipper, clam or suction); Elevating Graders or Euclid Loaders; Floating Equipment (all types); Gradalls, Helicopter Crew (Operator- hoist or winch); Hoes (all types); Hoisting Engines, on shaft or tunnel work; Hydraulic Gantry (lifting system); Industrial - Type Tractors; Jet Engine Dryers (D8 or D9), Diesel Tractors; Locomotives (standard gage); Maintenance Operators (class A); Mixers, paving (single or double drum); Mucking Machines; Multiple Scrapers; Piledriving Machines (all types); Power Shovels, Prentice Loader; Quad 9 (double pusher); Rail Tamper (with automatic lifting and aligning device); Refrigerating Machines (freezer operation); Side Booms; Slip Form Pavers; Tower Dericks; Tree Shredders; Truck Mounted Concrete Pumps; Tug Boats; Tunnel Machines and /or Mining Machines; Wheel Excavators. Rough Terrain Fork-lift with Winch/Hoist; Compact Cranes, track rubber over 4,000 pound

capacity, self-erecting cranes; stationary, track or truck (all configurations) Bucket trench machines (over 24 inches wide).

Class 2 - Asphalt Pavers; Automatic Subgrade Machines, self-propelled (CMI-type); Bobcat-type and /or skid steer loader with hoe attachment greater than 7000 lbs.; Boring Machine Operators (more than 48 inches); Bulldozers; Endloaders; Hydro Milling Machine; Kolman-type Loaders (production type-dirt); Lead Greasemen; Maintenance Operators, Class B (Portage and Summit Counties only); Pettibone-Rail Equipment; Power Graders; Power Scrapers; Push Cats; Lighting and Traffic Signal Installation Equipment includes all groups or classifications; Trench Machines (24inch wide and under); Vermeer Type Concrete saw. Material Transfer Equipment (Shuttle buggy) Asphalt; All rotomills,grinders and planers of all types. Horizontal Directional Drill (Over 50,000 ft.lbs.thrust and over)

Class 3 - A-Frames; Air Compressors, on tunnel work (low Pressure); Asphalt Plant Engineers; Bobcat-type and/or skid steer loader with or without attachments; Power Boilers (15 lbs pressure and over); Highway Drills (all types); Rollers, asphalt; Pump Operators (installing or operating well Points); Pumps (4 inch and over discharge); Railroad Tie Inserter/Remover; Rotator (lime-soil Stabilizer), Switch & Tie Tampers (without lifting and aligning device); Locomotives (narrow gage); Mixers, concrete (more than one bag capacity); Mixers, one bag capacity (side loader); Utilities Operators, (small equipment); Welding Machines; Material hoist/elevators. Articulating/straight bed end dumps if assigned (minus $4.00 per hour).

Class 4 -Ballast Re-locator; Backfillers, Batch Plants; Bar and Joint Installing Machines; Boring Machine Operators (48 inch or less); Bull Floats; Burlap and Curing Machines; Concrete Plants (capacity 4 yd and under); Conveyors (highway); Concrete Saws (multiple); Crushers; Deckhands; Farm type tractors, with attachments (highway), except masonry; Finishing Machines; Firemen, Floating Equipment (all types); Fork Lifts (highway); Form Trenchers; Hydro Hammers; Hydro Seeders; Pavement Breakers; Plant Mixers; Post Drivers; Post Hole Diggers (power auger); Power Brush Burners; Power Form Handling Equipment; Road Widening Trenchers; Rollers (brick, grade, macadam); Self-Propelled Power Spreaders; Self-Propelled Sub-Graders; Tractors, pulling sheepsfoot rollers or graders; Steam Firemen; Vibratory Compactors, with integral power.

Class 5 - Compressors (portable, Sewer, Heavy and Highway); Generators; Inboard-Outboard Motor Boat Launches; Masonry Fork Lifts; Oilers/Helpers; Power Driven Heaters; Power Scrubbers; Power Sweepers; Pumps (under 4 inch discharge); Signalmen; Drum Fireman (in Asphalt Plant); Oil Heaters (Asphalt Plant); Tire Repairmen; VAC/ALLS; Fueling and greasing (plus $3.00), compact cranes: track or rubber under 4,000 pounds.

Class 6 - Master Mechanic

Prevailing Wage Rate
Skilled Crafts

Name of Union: Painter Local 841 Zone II

Change # : LCN01-2017fbLoc603Com.

Craft : Painter Effective Date : 11/08/2017 Last Posted : 11/08/2017

Classification	BHR		Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Painter Brush Roll	$21.77		$6.16	$6.37	$0.35	$0.00	$0.00	$0.00	$0.00	$0.00	$34.65	$45.53
Paperhanger	$21.87		$6.16	$6.37	$0.35	$0.00	$0.00	$0.00	$0.00	$0.00	$34.75	$45.69
Spray Painter	$22.27		$6.16	$6.37	$0.35	$0.00	$0.00	$0.00	$0.00	$0.00	$35.15	$46.28
Epoxy Applications Class 3	$22.27		$6.16	$6.37	$0.35	$0.00	$0.00	$0.00	$0.00	$0.00	$35.15	$46.28
Epoxy Applications Class 4	$22.27		$6.16	$6.37	$0.35	$0.00	$0.00	$0.00	$0.00	$0.00	$35.15	$46.28
Apprentice	**Percent**											
1st 6 months	50.00	$10.89	$6.16	$6.37	$0.35	$0.00	$0.00	$0.00	$0.00	$0.00	$23.77	$29.21
2nd 6 months	55.00	$11.97	$6.16	$6.37	$0.35	$0.00	$0.00	$0.00	$0.00	$0.00	$24.85	$30.84
3rd 6 months	60.00	$13.06	$6.16	$6.37	$0.35	$0.00	$0.00	$0.00	$0.00	$0.00	$25.94	$32.47
4th 6 months	65.00	$14.15	$6.16	$6.37	$0.35	$0.00	$0.00	$0.00	$0.00	$0.00	$27.03	$34.11
5th 6 months	70.00	$15.24	$6.16	$6.37	$0.35	$0.00	$0.00	$0.00	$0.00	$0.00	$28.12	$35.74
6th 6 months	75.00	$16.33	$6.16	$6.37	$0.35	$0.00	$0.00	$0.00	$0.00	$0.00	$29.21	$37.37
7th 6 months	80.00	$17.42	$6.16	$6.37	$0.35	$0.00	$0.00	$0.00	$0.00	$0.00	$30.30	$39.00
8th 6 months	90.00	$19.59	$6.16	$6.37	$0.35	$0.00	$0.00	$0.00	$0.00	$0.00	$32.47	$42.27

Special Calculation Note : Apprentice pay based on percentage of above appropriate classification.

Ratio :

3 Journeymen to 1 Apprentice

Jurisdiction (* denotes special jurisdictional note) :

CARROLL, COSHOCTON, HOLMES, STARK, TUSCARAWAS, WAYNE

Special Jurisdictional Note :

Details :

Commercial and industrial work, performed outside the regular work day, the rate of pay shall be $2.00 per hour above the applicable wage scale. This rate of pay is only applicable for eight – (8) hours. Additional hours shall be paid at the rate of time and one – half.

Prevailing Wage Rate
Skilled Crafts

Name of Union: Painter Local 841 Zone II

Change # : LCN01-2017fbLoc603Com.

Craft : Drywall Finisher Effective Date : 11/08/2017 Last Posted : 11/08/2017

Classification	BHR	Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
		H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Painter Drywall Finisher	$22.17	$6.16	$6.37	$0.35	$0.00	$0.00	$0.00	$0.00	$0.00	$35.05	$46.14
Drywall Taping	$22.17	$6.16	$6.37	$0.35	$0.00	$0.00	$0.00	$0.00	$0.00	$35.05	$46.14
Taping and Finishing with Machines	$22.52	$6.16	$6.37	$0.35	$0.00	$0.00	$0.00	$0.00	$0.00	$35.40	$46.66
Wipe Down Man & Taper, Swing Stage, Ladder Jack or Window Jack	$22.82	$6.16	$6.37	$0.35	$0.00	$0.00	$0.00	$0.00	$0.00	$35.70	$47.11
Stilts & Automatic Tools	$22.97	$6.16	$6.37	$0.35	$0.00	$0.00	$0.00	$0.00	$0.00	$35.85	$47.33

Apprentice	Percent											
1st 6 months	50.00	$11.09	$6.16	$6.37	$0.35	$0.00	$0.00	$0.00	$0.00	$0.00	$23.97	$29.51
2nd 6 months	55.00	$12.19	$6.16	$6.37	$0.35	$0.00	$0.00	$0.00	$0.00	$0.00	$25.07	$31.17
3rd 6 months	60.00	$13.30	$6.16	$6.37	$0.35	$0.00	$0.00	$0.00	$0.00	$0.00	$26.18	$32.83
4rd 6 months	70.00	$15.52	$6.16	$6.37	$0.35	$0.00	$0.00	$0.00	$0.00	$0.00	$28.40	$36.16
5th 6 months	80.00	$17.74	$6.16	$6.37	$0.35	$0.00	$0.00	$0.00	$0.00	$0.00	$30.62	$39.48
6th 6 months	90.00	$19.95	$6.16	$6.37	$0.35	$0.00	$0.00	$0.00	$0.00	$0.00	$32.83	$42.81

Special Calculation Note : Apprentice pay based on percentage of above appropriate classification.

Ratio :

Jurisdiction (* denotes special jurisdictional note) :

3 Journeymen to 1 Apprentice	CARROLL, COSHOCTON, HOLMES, STARK, TUSCARAWAS, WAYNE

Special Jurisdictional Note :

Details :

Commercial and industrial work, performed outside the regular work day, the rate of pay shall be $2.00 per hour above the applicable wage scale. This rate of pay is only applicable for eight – (8) hours. Additional hours shall be paid at the rate of time and one – half.

Prevailing Wage Rate
Skilled Crafts

Name of Union: Painter Local 841 Zone II Industrial

Change # : LCN01-2017fbLoc841

Craft : Painter Effective Date : 11/08/2017 Last Posted : 11/08/2017

	BHR		Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Classification												
Painter Brush and Roll	$22.07		$6.16	$6.37	$0.35	$0.00	$0.00	$0.00	$0.00	$0.00	$34.95	$45.99
Painter Spray Painter	$22.60		$6.16	$6.37	$0.35	$0.00	$0.00	$0.00	$0.00	$0.00	$35.48	$46.78
Tank Interior & Exterior	$22.60		$6.16	$6.37	$0.35	$0.00	$0.00	$0.00	$0.00	$0.00	$35.48	$46.78
Sandblasting Steel, Structural Steel & Metallizing	$22.78		$6.16	$6.37	$0.35	$0.00	$0.00	$0.00	$0.00	$0.00	$35.66	$47.05
Epoxy Application Class 3	$22.57		$6.16	$6.37	$0.35	$0.00	$0.00	$0.00	$0.00	$0.00	$35.45	$46.74
Epoxy Application Class 4	$23.07		$6.16	$6.37	$0.35	$0.00	$0.00	$0.00	$0.00	$0.00	$35.95	$47.49
Bridges,, Towers, Poles & Stacks	$22.78		$6.16	$6.37	$0.35	$0.00	$0.00	$0.00	$0.00	$0.00	$35.66	$47.05
Apprentice	**Percent**											
1st 6 Months	50.00	$11.04	$6.16	$6.37	$0.35	$0.00	$0.00	$0.00	$0.00	$0.00	$23.92	$29.43
2nd 6 Months	55.00	$12.14	$6.16	$6.37	$0.35	$0.00	$0.00	$0.00	$0.00	$0.00	$25.02	$31.09
3rd 6 Months	60.00	$13.24	$6.16	$6.37	$0.35	$0.00	$0.00	$0.00	$0.00	$0.00	$26.12	$32.74
4th 6 Months	65.00	$14.35	$6.16	$6.37	$0.35	$0.00	$0.00	$0.00	$0.00	$0.00	$27.23	$34.40
5th 6 Months	70.00	$15.45	$6.16	$6.37	$0.35	$0.00	$0.00	$0.00	$0.00	$0.00	$28.33	$36.05
6th 6 Months	75.00	$16.55	$6.16	$6.37	$0.35	$0.00	$0.00	$0.00	$0.00	$0.00	$29.43	$37.71
7th 6 Months	80.00	$17.66	$6.16	$6.37	$0.35	$0.00	$0.00	$0.00	$0.00	$0.00	$30.54	$39.36

8th 6 Months	90.00	$19.86	$6.16	$6.37	$0.35	$0.00	$0.00	$0.00	$0.00	$0.00	$32.74	$42.67

Special Calculation Note : Apprentice pay based on percentage of above classification.

atio :
3 Journeymen to 1 Apprentice

Jurisdiction (* denotes special jurisdictional note) :
CARROLL, COSHOCTON, HOLMES, STARK, TUSCARAWAS, WAYNE

Special Jurisdictional Note :

Details :
Commercial and industrial work, performed outside the regular work day, the rate of pay shall be $2.00 per hour above the applicable wage scale. This rate of pay is only applicable for eight – (8) hours. Additional hours shall be paid at the rate of time and one – half.

Prevailing Wage Rate
Skilled Crafts

Name of Union: Painter Local 603

Change # : LCN01-2012fbLoc603Com.

Craft : Drywall Finisher Effective Date : 06/06/2012 Last Posted : 06/06/2012

	BHR		Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Classification												
Painter Drywall Finisher	$20.10		$4.96	$5.40	$0.19	$0.00	$0.45	$0.00	$0.00	$0.00	$31.10	$41.15
Drywall Taping	$20.10		$4.96	$5.40	$0.19	$0.00	$0.45	$0.00	$0.00	$0.00	$31.10	$41.15
Taping and Finishing with Automatic Tools	$20.45		$4.96	$5.40	$0.19	$0.00	$0.45	$0.00	$0.00	$0.00	$31.45	$41.67
Apprentice	**Percent**											
1st 6 months	40.00	$8.04	$4.96	$5.40	$0.19	$0.00	$0.45	$0.00	$0.00	$0.00	$19.04	$23.06
2nd 6 months	50.00	$10.05	$4.96	$5.40	$0.19	$0.00	$0.45	$0.00	$0.00	$0.00	$21.05	$26.08
3rd 6 months	60.00	$12.06	$4.96	$5.40	$0.19	$0.00	$0.45	$0.00	$0.00	$0.00	$23.06	$29.09
4rd 6 months	70.00	$14.07	$4.96	$5.40	$0.19	$0.00	$0.45	$0.00	$0.00	$0.00	$25.07	$32.11
5th 6 months	80.00	$16.08	$4.96	$5.40	$0.19	$0.00	$0.45	$0.00	$0.00	$0.00	$27.08	$35.12
6th 6 months	90.00	$18.09	$4.96	$5.40	$0.19	$0.00	$0.45	$0.00	$0.00	$0.00	$29.09	$38.14

Special Calculation Note : Apprentice pay based on percentage of above appropriate classification.

Ratio :

1 Journeymen to 1 Apprentice

Jurisdiction (* denotes special jurisdictional note) :

CARROLL, COSHOCTON, HOLMES, STARK, TUSCARAWAS, WAYNE

Special Jurisdictional Note :

Details :

Journeymen and apprentices using coal tar, vinyl's, epoxies or any product using hot or special thinner, shall be paid an additional $0.50 per hour for (class 3) and an additional $.50 for (class 4) of each classification. This does not apply to water based epoxies.

When concrete block is filled by spray application, Roller men shall be paid $0.25 per hour in addition to the Brush and Roll rate.

Drywall Finisher: both wipe down man and finisher, when using Journeyman's own stilts or automatic tools add .80 per hour worked to the classification above. Drywall Finishers: both wipe down man and taper/finisher, swing stage, ladder jack, or window jack add $.30 per hour worked to the above classification.

Prevailing Wage Rate
Skilled Crafts

Name of Union: Painter Local 603

Change # : LCN01-2012fbLoc603Com.

Craft : Painter Effective Date : 06/12/2012 Last Posted : 06/06/2012

	BHR		Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Classification												
Painter Brush Roll	$19.70		$4.96	$5.40	$0.19	$0.00	$0.45	$0.00	$0.00	$0.00	$30.70	$40.55
Wallcovering Installer	$19.80		$4.96	$5.40	$0.19	$0.00	$0.45	$0.00	$0.00	$0.00	$30.80	$40.70
Spray Gun Operator	$20.20		$4.96	$5.40	$0.19	$0.00	$0.45	$0.00	$0.00	$0.00	$31.20	$41.30
Apprentice	**Percent**											
1st 6 months	45.00	$8.87	$4.96	$5.40	$0.19	$0.00	$0.45	$0.00	$0.00	$0.00	$19.87	$24.30
2nd 6 months	50.00	$9.85	$4.96	$5.40	$0.19	$0.00	$0.45	$0.00	$0.00	$0.00	$20.85	$25.77
3rd 6 months	55.00	$10.84	$4.96	$5.40	$0.19	$0.00	$0.45	$0.00	$0.00	$0.00	$21.83	$27.25
4th 6 months	60.00	$11.82	$4.96	$5.40	$0.19	$0.00	$0.45	$0.00	$0.00	$0.00	$22.82	$28.73
5th 6 months	65.00	$12.81	$4.96	$5.40	$0.19	$0.00	$0.45	$0.00	$0.00	$0.00	$23.80	$30.21
6th 6 months	70.00	$13.79	$4.96	$5.40	$0.19	$0.00	$0.45	$0.00	$0.00	$0.00	$24.79	$31.69
7th 6 months	75.00	$14.77	$4.96	$5.40	$0.19	$0.00	$0.45	$0.00	$0.00	$0.00	$25.77	$33.16
8th 6 months	80.00	$15.76	$4.96	$5.40	$0.19	$0.00	$0.45	$0.00	$0.00	$0.00	$26.76	$34.64

Special Calculation Note : Apprentice pay based on percentage of above appropriate classification.

Ratio :

1 Journeymen to 1 Apprentice

Jurisdiction (* denotes special jurisdictional note) :
CARROLL, COSHOCTON, HOLMES, STARK, TUSCARAWAS, WAYNE

Special Jurisdictional Note :

Details :

Journeymen and apprentices using coal tar, vinyl's, epoxies or any product using hot or special thinner, shall be paid an additional $0.50 per hour for (class 3) and an additional $.50 for (class 4) of each classification. This does not apply to water based epoxies.

When concrete block is filled by spray application, Roller men shall be paid $0.25 per hour in addition to the Brush and Roll rate.

Drywall Finisher: both wipe down man and finisher ($20.95) when using Journeyman's own stilts or automatic tools ($21.45). Drywall Finisher w/Machines both wipe down man and finisher ($21.30) when using Journeyman's own stilts or automatic tools ($21.80) Apprentice pay based on percentage of above appropriate classification.

Prevailing Wage Rate
Skilled Crafts

Name of Union: Painter Local 639

Change # : LCNO1-2015fbLoc639

Craft : Painter Effective Date : 06/10/2015 Last Posted : 06/10/2015

Classification	BHR	Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
		H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Painter Metal Polisher											
Top Helper Class A	$19.09	$3.65	$0.00	$0.00	$0.66	$0.00	$0.00	$0.00	$0.00	$23.40	$32.94
Top Helper Class B	$19.09	$3.65	$0.65	$0.00	$1.03	$0.00	$0.37	$0.00	$0.00	$24.79	$34.33
Top Helper Class C	$19.09	$3.65	$1.00	$0.00	$1.76	$0.00	$0.37	$0.00	$0.00	$25.87	$35.41
Helper Class A	$14.69	$3.65	$0.00	$0.00	$0.51	$0.00	$0.00	$0.00	$0.00	$18.85	$26.19
Helper Class B	$14.69	$3.65	$0.65	$0.00	$0.79	$0.00	$0.28	$0.00	$0.00	$20.06	$27.40
Helper Class C	$14.69	$3.65	$1.00	$0.00	$1.64	$0.00	$0.28	$0.00	$0.00	$21.26	$28.60
New Hire 90 Days	$11.00	$3.65	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$14.65	$20.15

Special Calculation Note : Other is Sick and Personal Time

Ratio :

Jurisdiction (* denotes special jurisdictional note) :
ADAMS, ALLEN, ASHLAND, ASHTABULA, ATHENS, AUGLAIZE, BELMONT, BROWN, BUTLER, CARROLL, CHAMPAIGN, CLARK, CLERMONT, CLINTON, COLUMBIANA, COSHOCTON, CRAWFORD, CUYAHOGA, DARKE, DEFIANCE, DELAWARE, ERIE, FAIRFIELD, FAYETTE, FRANKLIN, FULTON, GALLIA, GEAUGA, GREENE, GUERNSEY, HAMILTON, HANCOCK, HARDIN, HARRISON, HENRY, HIGHLAND, HOCKING, HOLMES, HURON, JACKSON, JEFFERSON, KNOX, LAKE, LAWRENCE, LICKING, LOGAN, LORAIN, LUCAS, MADISON, MAHONING, MARION, MEDINA, MEIGS, MERCER, MIAMI, MONROE, MONTGOMERY, MORGAN, MORROW, MUSKINGUM, NOBLE, OTTAWA, PAULDING, PERRY, PICKAWAY, PIKE, PORTAGE, PREBLE, PUTNAM, RICHLAND, ROSS, SANDUSKY, SCIOTO, SENECA, SHELBY, STARK, SUMMIT, TRUMBULL, TUSCARAWAS, UNION,

VAN WERT, VINTON, WARREN, WASHINGTON,
WAYNE, WILLIAMS, WOOD, WYANDOT

Special Jurisdictional Note :

Details :

Top Helper: Shall perform the responsibilities of a Helper and be responsible for the setup, break down, safety and quality of the company's product.
Helper : Shall be responsible for performing tasks in refinishing, compliance with safety procedures, setting up and breaking down job sites, scaffolding and swing stages and preparing surfaces for refinishing including but not limited to, masking and stripping and cleaning, oxidizing, polishing and scratch removal on various surfaces
.
Class A Workers: Less than 1 Year of Service.
Class B Workers: More than 1 and less than 8 Years of Service.
Class C Workers: More than 8 Years of Service.

Metal Polisher Scope of Work: Polishing, buffing, stripping, coloring, lacquering, spraying, cleaning and maintenance of ornamental and architectural metals, iron, bronze, nickel, aluminum and stainless steel and in mental specialty work, various stone finishes, stone specialty work and any other work pertaining to the finishing of metal, stones, woods, and any window washing/cleaning done in conjunction with this work, using chemicals, solvents, coatings and hand applied lacquer thinner, removing scratches from mirrow finished metals, burnishing of bronze, statuary finishes on exterior and interior surfaces and the use of all tools required to perform such work, including but not limited to polishes, spray equipment and scaffolding.

Swing State Rate: All work on scaffold 4 sections or higher, including any boom lifts and swing stage scaffolds including the rigging and derigging of hanging/suspended swing stage systems and rappelling/bolson chair work, ADD $1.50 per hour.

Prevailing Wage Rate
Skilled Crafts

Name of Union: Painter Local 603 Industrial

Change # : LCN01-2012fbLoc603Ind.

Craft : Painter Effective Date : 06/12/2012 Last Posted : 06/06/2012

Classification	BHR		Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Painter Brush Roll	$20.00		$4.96	$5.40	$0.19	$0.00	$0.45	$0.00	$0.00	$0.00	$31.00	$41.00
Tanks & Spray Painter	$20.53		$4.96	$5.40	$0.19	$0.00	$0.45	$0.00	$0.00	$0.00	$31.53	$41.80
Bridges, Towers, Poles, Stacks	$20.71		$4.96	$5.40	$0.19	$0.00	$0.45	$0.00	$0.00	$0.00	$31.71	$42.07
Sandblasting, Metallizing & Structural Steel	$20.71		$4.96	$5.40	$0.19	$0.00	$0.45	$0.00	$0.00	$0.00	$31.71	$42.07
Apprentice	**Percent**											
1st 6 months	45.00	$9.00	$4.96	$5.40	$0.19	$0.00	$0.45	$0.00	$0.00	$0.00	$20.00	$24.50
2nd 6 months	50.00	$10.00	$4.96	$5.40	$0.19	$0.00	$0.45	$0.00	$0.00	$0.00	$21.00	$26.00
3rd 6 months	55.00	$11.00	$4.96	$5.40	$0.19	$0.00	$0.45	$0.00	$0.00	$0.00	$22.00	$27.50
4th 6 months	60.00	$12.00	$4.96	$5.40	$0.19	$0.00	$0.45	$0.00	$0.00	$0.00	$23.00	$29.00
5th 6 months	65.00	$13.00	$4.96	$5.40	$0.19	$0.00	$0.45	$0.00	$0.00	$0.00	$24.00	$30.50
6th 6 months	70.00	$14.00	$4.96	$5.40	$0.19	$0.00	$0.45	$0.00	$0.00	$0.00	$25.00	$32.00
7th 6 months	75.00	$15.00	$4.96	$5.40	$0.19	$0.00	$0.45	$0.00	$0.00	$0.00	$26.00	$33.50
8th 6 months	80.00	$16.00	$4.96	$5.40	$0.19	$0.00	$0.45	$0.00	$0.00	$0.00	$27.00	$35.00

Special Calculation Note : Apprentice pay based on percentage of above appropriate classification.

Ratio :

Jurisdiction (* denotes special jurisdictional note) :

1 Journeymen to 1 Apprentice	CARROLL, COSHOCTON, HOLMES, STARK, TUSCARAWAS, WAYNE

Special Jurisdictional Note :

Details :

Journeymen and apprentices using coal tar, vinyl's, epoxies or any product using hot or special thinner, shall be paid an additional $0.50 per hour for (class 3) and an additional $.50 for (class 4) of each classification. This does not apply to water based epoxies.

When concrete block is filled by spray application, Roller men shall be paid $0.25 per hour in addition to the Brush and Roll rate.

Drywall Finisher: both wipe down man and finisher ($20.95) when using Journeyman's own stilts or automatic tools ($21.45). Drywall Finisher w/Machines both wipe down man and finisher ($21.30) when using Journeyman's own stilts or automatic tools ($21.80) Apprentice pay based on percentage of above appropriate classification.

Prevailing Wage Rate
Skilled Crafts

Name of Union: Painter Local 639 (A) Sign

Change # : CN01-2009Loc639A

Craft : Painter Effective Date : 03/06/2009 Last Posted : 03/06/2009

	BHR		Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Classification												
Painter Sign Erector	$19.98		$4.46	$1.00	$0.25	$1.68	$0.00	$0.00			$27.37	$37.36
Serviceman	$19.98		$4.46	$1.00	$0.25	$1.68	$0.00	$0.00			$27.37	$37.36
Metal Sign Fabricator	$19.98		$4.46	$1.00	$0.25	$1.68	$0.00	$0.00			$27.37	$37.36
Neon Bender Pattern Maker	$19.98		$4.46	$1.00	$0.25	$1.68	$0.00	$0.00			$27.37	$37.36
Computer Operator	$18.98		$4.46	$1.00	$0.25	$1.61	$0.00	$0.00			$26.30	$35.79
Router	$18.98		$4.46	$1.00	$0.25	$1.61	$0.00	$0.00			$26.30	$35.79
Plastic Wood Fabricator	$18.98		$4.46	$1.00	$0.25	$1.61	$0.00	$0.00			$26.30	$35.79
Vinyl Applicator	$18.98		$4.46	$1.00	$0.25	$1.61	$0.00	$0.00			$26.30	$35.79
Apprentice For Sign Service, Metal,Neon,Pattern	**Percent**											
1000 hrs	50.00	$9.99	$4.46	$1.00	$0.25	$1.03	$0.00	$0.00			$16.73	$21.73
2000 hrs	55.00	$10.99	$4.46	$1.00	$0.25	$0.37	$0.00	$0.00			$17.07	$22.56
3000 hrs	60.00	$11.99	$4.46	$1.00	$0.25	$0.37	$0.00	$0.00			$18.07	$24.06
4000 hrs	65.00	$12.99	$4.46	$1.00	$0.25	$0.37	$0.00	$0.00			$19.07	$25.56
5000 hrs	70.00	$13.99	$4.46	$1.00	$0.25	$0.37	$0.00	$0.00			$20.07	$27.06
6000 hrs	85.00	$16.98	$4.46	$1.00	$0.25	$0.37	$0.00	$0.00			$23.06	$31.55
7000 hrs	90.00	$17.98	$4.46	$1.00	$0.25	$0.37	$0.00	$0.00			$24.06	$33.05

Special Calculation Note : Apprentice Rates For: Computer Operator, Router, Plastic-Wood Fabricator Vinyl Application

1000 hrs 50% plus ($4.46 h&w)+($1.00 pension)+($.25 apprentice training) + vacation $0.99
2000 hrs 55% plus ($4.46 h&w)+($1.00 pension)+($.25 apprentice training) + vacation $0.37
3000 hrs 65% plus ($4.46 h&w)+($1.00 pension)+($.25 apprentice training) + vacation $0.37

4000 hrs 50% plus ($4.46 h&w)+($1.00 pension)+($.25 apprentice training) + vacation $0.37
5000 hrs 70% plus ($4.46 h&w)+($1.00 pension)+($.25 apprentice training) + vacation $0.37
6000 hrs 85% plus ($4.46 h&w)+($1.00 pension)+($.25 apprentice training) + vacation $0.37
7000 hrs 90% plus ($4.46 h&w)+($1.00 pension)+($.25 apprentice training) + vacation $0.37

Ratio :

Jurisdiction (* denotes special jurisdictional note) :
ASHLAND, ASHTABULA, CUYAHOGA, ERIE, GEAUGA, LAKE, LORAIN, MEDINA, PORTAGE, RICHLAND, STARK, SUMMIT

Special Jurisdictional Note :

Details :
Sign and display work shall include but not limited: to the making and installation of all signs and servicing of the same, lettering and pictorial work of any kind, including vinyl signs and vinyl substrates and the preparing for the finishing of same, be it by hand, brush, roller,spray, mechanical or computer aided and by any other method or process pertaining to same: they shall have control of all branches, methods and processes of screen process work: tube bending and display work such as creating, building and finishing of all display matter and its related operations used for advertising purposes, including all lettering whether it be done by hand, mechanical or computer aided or by any other method or process pertaining to same: the construction, erection and maintenance of all billboards and all communication advertising.

Prevailing Wage Rate
Skilled Crafts

Name of Union: Painter Local 639 Zone 2 Sign

Change # : LCN01-2016fbLoc639

Craft : Painter Effective Date : 08/03/2016 Last Posted : 08/03/2016

Classification	BHR	Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
		H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Painter Sign Journeyman Tech/Team Leader Class A	$21.25	$1.33	$0.14	$0.00	$0.00	$0.00	$0.57	$0.00	$0.00	$23.29	$33.92
Painter Sign Journeyman Tech/Team Leader Class B	$21.25	$1.33	$0.14	$0.00	$0.41	$0.00	$0.57	$0.00	$0.00	$23.70	$34.32
Painter Sign Journeyman Tech/Team Leader Class C	$21.25	$1.33	$0.14	$0.00	$0.82	$0.00	$0.57	$0.00	$0.00	$24.11	$34.74
Painter Sign Journeyman Tech/Team Leader Class D	$21.25	$1.33	$0.14	$0.00	$1.23	$0.00	$0.57	$0.00	$0.00	$24.52	$35.14
Sign Journeyman Class A	$20.98	$1.33	$0.14	$0.00	$0.00	$0.00	$0.56	$0.00	$0.00	$23.01	$33.50
Sign Journeyman Class B	$20.98	$1.33	$0.14	$0.00	$0.40	$0.00	$0.56	$0.00	$0.00	$23.41	$33.90
Sign Journeyman Class C	$20.98	$1.33	$0.14	$0.00	$0.81	$0.00	$0.56	$0.00	$0.00	$23.82	$34.31
Sign Journeyman Class D	$20.98	$1.33	$0.14	$0.00	$1.21	$0.00	$0.56	$0.00	$0.00	$24.22	$34.71
Tech Sign Fabrication/ Erector Class A	$15.90	$1.33	$0.14	$0.00	$0.00	$0.00	$0.43	$0.00	$0.00	$17.80	$25.75
Tech Sign Fabrication/ Erector Class B	$15.90	$1.33	$0.14	$0.00	$0.31	$0.00	$0.43	$0.00	$0.00	$18.11	$26.06
Tech Sign Fabrication/ Erector Class C	$15.90	$1.33	$0.14	$0.00	$0.61	$0.00	$0.43	$0.00	$0.00	$18.41	$26.36
Tech Sign Fabrication/ Erector	$15.90	$1.33	$0.14	$0.00	$0.92	$0.00	$0.43	$0.00	$0.00	$18.72	$26.67

Class D										

Special Calculation Note : Other is for paid holidays.

Ratio :

Jurisdiction (* denotes special jurisdictional note) :
ADAMS, ALLEN, AUGLAIZE, BROWN, BUTLER, CARROLL, CHAMPAIGN, CLARK, CLERMONT, CLINTON, COLUMBIANA, COSHOCTON, CRAWFORD, DARKE, DEFIANCE, DELAWARE, ERIE, FAIRFIELD, FAYETTE, FRANKLIN, FULTON, GREENE, HAMILTON, HANCOCK, HARDIN, HENRY, HIGHLAND, HOLMES, HURON, JACKSON, KNOX, LICKING, LOGAN, LORAIN, LUCAS, MADISON, MAHONING, MARION, MERCER, MIAMI, MONTGOMERY, MORROW, MUSKINGUM, OTTAWA, PAULDING, PERRY, PICKAWAY, PIKE, PREBLE, PUTNAM, ROSS, SANDUSKY, SCIOTO, SENECA, SHELBY, STARK, TRUMBULL, TUSCARAWAS, UNION, VAN WERT, WARREN, WAYNE, WILLIAMS, WOOD, WYANDOT

Special Jurisdictional Note :

Details :
Class A: less that 1 year.
Class B: 1-3 years.
Class C; 3-10 years.
Class D: More than 10 years.

Prevailing Wage Rate
Skilled Crafts

Name of Union: Painter Local 639 (Cleveland Area) Sign

Change # : CN01-2006Loc639Cleve

Craft : Painter Effective Date : 01/03/2006 Last Posted : 01/03/2006

	BHR		Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Classification												
Painter Sign	$20.20		$3.13	$3.25	$0.20	$1.96	$0.00	$0.00			$28.74	$38.84
Apprentice	Percent											
1000 hrs	40.00	$8.08	$3.13	$3.25	$0.20	$1.07	$0.00	$0.00			$15.73	$19.77
2000 hrs	50.00	$10.10	$3.13	$3.25	$0.20	$1.22	$0.00	$0.00			$17.90	$22.95
3000 hrs	60.00	$12.12	$3.13	$3.25	$0.20	$1.37	$0.00	$0.00			$20.07	$26.13
4000 hrs	70.00	$14.14	$3.13	$3.25	$0.20	$1.51	$0.00	$0.00			$22.23	$29.30
5000 hrs	75.00	$15.15	$3.13	$3.25	$0.20	$1.59	$0.00	$0.00			$23.32	$30.89
6000 hrs	80.00	$16.16	$3.13	$3.25	$0.20	$1.66	$0.00	$0.00			$24.40	$32.48
7000 hrs	85.00	$17.17	$3.13	$3.25	$0.20	$1.74	$0.00	$0.00			$25.49	$34.07
8000 hrs	90.00	$18.18	$3.13	$3.25	$0.20	$1.81	$0.00	$0.00			$26.57	$35.66

Special Calculation Note : No special calculations for this skilled craft wage rate are required at this time.

Ratio :

Jurisdiction (* denotes special jurisdictional note) :
ALLEN, ASHLAND, ASHTABULA, AUGLAIZE, BELMONT, CARROLL, CHAMPAIGN, COLUMBIANA, COSHOCTON, CRAWFORD, CUYAHOGA, DEFIANCE, ERIE, FULTON, GEAUGA, GUERNSEY, HANCOCK, HARDIN, HARRISON, HENRY, HOLMES, HURON, JEFFERSON, KNOX, LAKE, LOGAN, LORAIN, LUCAS, MAHONING, MARION, MEDINA,

MERCER, MONROE, MORROW, NOBLE, OTTAWA, PAULDING, PIKE, PORTAGE, PUTNAM, RICHLAND, SANDUSKY, SENECA, SHELBY, STARK, SUMMIT, TRUMBULL, TUSCARAWAS, VAN WERT, WASHINGTON, WAYNE, WILLIAMS, WOOD, WYANDOT

Special Jurisdictional Note :

Details :

Prevailing Wage Rate
Skilled Crafts

Name of Union: Painter Local 639 (D) Sign

Change # : CN01-2005Loc639D

Craft : Painter Effective Date : 12/12/2005 Last Posted : 12/12/2005

Classification	BHR		Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Painter Sign Erector	$15.25		$3.65	$1.45	$0.10	$1.34	$0.00	$0.00			$21.79	$29.41
Sign Fabricator	$15.25		$3.65	$1.45	$0.10	$1.34	$0.00	$0.00			$21.79	$29.41
Serviceman	$15.25		$3.65	$1.45	$0.10	$1.34	$0.00	$0.00			$21.79	$29.41
Apprentice	**Percent**											
0-6 Months	60.00	$9.15	$3.65	$1.45	$0.10	$0.94	$0.00	$0.00			$15.29	$19.87
6-12 Months	65.00	$9.91	$3.65	$1.45	$0.10	$0.99	$0.00	$0.00			$16.10	$21.06
12-18 Months	70.00	$10.67	$3.65	$1.45	$0.10	$1.04	$0.00	$0.00			$16.91	$22.25
18-24 Months	75.00	$11.44	$3.65	$1.45	$0.10	$1.09	$0.00	$0.00			$17.73	$23.45
24-30 Months	80.00	$12.20	$3.65	$1.45	$0.10	$1.14	$0.00	$0.00			$18.54	$24.64
30-36 Months	85.00	$12.96	$3.65	$1.45	$0.10	$1.19	$0.00	$0.00			$19.35	$25.83
36-42 Months	90.00	$13.73	$3.65	$1.45	$0.10	$1.24	$0.00	$0.00			$20.16	$27.03
42-48 Months	95.00	$14.49	$3.65	$1.45	$0.10	$1.29	$0.00	$0.00			$20.98	$28.22

Special Calculation Note : Add .75 cents increase per hour for high pay over 40 feet.

Ratio :

Jurisdiction (* denotes special jurisdictional note) :

3 Journeymen to 1 Apprentice	CARROLL, COSHOCTON, HOLMES, KNOX, STARK, TUSCARAWAS, WAYNE

Special Jurisdictional Note :

Details :

Prevailing Wage Rate
Skilled Crafts

Name of Union: Plumber Pipefitter Local 94

Change # : LCN01-2017fbLoc94

Craft : Plumber/Pipefitter Effective Date : 07/26/2017 Last Posted : 07/26/2017

Classification	BHR		Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Plumber Pipefitter	$35.23		$7.23	$5.24	$0.72	$0.00	$4.80	$0.17	$0.00	$0.00	$53.39	$71.00
Apprentice Hired Before 05-01-2017												
1st 6 Months	$14.09		$7.23	$0.00	$0.72	$0.00	$1.76	$0.17	$0.00	$0.00	$23.97	$31.01
2nd 6 Months	$15.85		$7.23	$0.00	$0.72	$0.00	$1.76	$0.17	$0.00	$0.00	$25.73	$33.66
3 rd 6 months	$17.62		$7.23	$0.50	$0.72	$0.00	$1.76	$0.17	$0.00	$0.00	$28.00	$36.81
4th 6 Months	$19.38		$7.23	$0.50	$0.72	$0.00	$1.76	$0.17	$0.00	$0.00	$29.76	$39.45
5th 6 Months	$21.14		$7.23	$0.50	$0.72	$0.00	$1.76	$0.17	$0.00	$0.00	$31.52	$42.09
6th 6 months	$22.90		$7.23	$0.50	$0.72	$0.00	$1.76	$0.17	$0.00	$0.00	$33.28	$44.73
7th 6 [illegible]nths	$26.42		$7.23	$0.50	$0.72	$0.00	$1.76	$0.17	$0.00	$0.00	$36.80	$50.01
[illegible] Months	$28.18		$7.23	$0.50	$0.72	$0.00	$1.76	$0.17	$0.00	$0.00	$38.56	$52.65
9th 6 Months	$29.95		$7.23	$0.50	$0.72	$0.00	$1.76	$0.17	$0.00	$0.00	$40.33	$55.31
10th 6 Months	$31.71		$7.23	$0.50	$0.72	$0.00	$1.76	$0.17	$0.00	$0.00	$42.09	$57.95
Apprentice If Hired After 5-01-2017	**Percent**											
1st Year	40.00	$14.09	$7.23	$0.24	$0.72	$0.00	$2.40	$0.17	$0.00	$0.00	$24.85	$31.90
2nd Yeat	50.00	$17.61	$7.23	$0.74	$0.72	$0.00	$2.40	$0.17	$0.00	$0.00	$28.87	$37.68
3rd Year	60.00	$21.14	$7.23	$0.74	$0.72	$0.00	$2.40	$0.17	$0.00	$0.00	$32.40	$42.97
4th Year	70.00	$24.66	$7.23	$1.30	$0.72	$0.00	$3.60	$0.17	$0.00	$0.00	$37.68	$50.01
5th Year	80.00	$28.18	$7.23	$1.31	$0.72	$0.00	$3.60	$0.17	$0.00	$0.00	$41.21	$55.31

Special Calculation Note : Other is $0.07 for Industry and $0.10 is for International Training Fund.

Ratio :
1 Journeymen to 2 Apprentice
4 Journeymen to 3 Apprentice
6 Journeymen to 4 Apprentice
9 Journeymen to 5 Apprentice

3 Journeyman to 1 Apprentice Thereafter

Jurisdiction (* denotes special jurisdictional note) :
CARROLL*, STARK, WAYNE

Special Jurisdictional Note : In Carroll County the following townships are included: Ross, Monroe, Union, Lee, Orange, Perry and London.

[illegible]ils :

Prevailing Wage Rate
Skilled Crafts

Name of Union: Roofer Local 88

Change # : LCN01-2017fbLoc88

Craft : Roofer Effective Date : 07/26/2017 Last Posted : 07/27/2017

Classification	BHR		Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Roofer	$25.30		$8.52	$7.69	$0.13	$0.00	$0.40	$0.12	$0.00	$0.00	$42.16	$54.81
HELPERS												
1st year Helper - 500 1st 6 months	$12.00		$2.25	$0.00	$0.13	$0.00	$0.40	$0.12	$0.00	$0.00	$14.90	$20.90
1st year Helper - 500 w/12 months	$12.65		$8.52	$7.69	$0.13	$0.00	$0.40	$0.12	$0.00	$0.00	$29.51	$35.84
2nd year Helper - w/12 months	$14.17		$8.52	$7.69	$0.13	$0.00	$0.40	$0.12	$0.00	$0.00	$31.03	$38.11
3rd year Helper - w/12 months	$15.69		$8.52	$7.69	$0.13	$0.00	$0.40	$0.12	$0.00	$0.00	$32.55	$40.39
4th year Helper - w/12 months	$17.20		$8.52	$7.69	$0.13	$0.00	$0.40	$0.12	$0.00	$0.00	$34.06	$42.66
5th year Helper - w/12 months	$18.72		$8.52	$7.69	$0.13	$0.00	$0.40	$0.12	$0.00	$0.00	$35.58	$44.94
6th year Helper	$20.24		$8.52	$7.69	$0.13	$0.00	$0.40	$0.12	$0.00	$0.00	$37.10	$47.22
Apprentice	Percent											
1st 6 months w/500 hrs	50.00	$12.65	$8.52	$7.69	$0.13	$0.00	$0.40	$0.12	$0.00	$0.00	$29.51	$35.84
2nd 6 months w/500 hrs	56.00	$14.17	$8.52	$7.69	$0.13	$0.00	$0.40	$0.12	$0.00	$0.00	$31.03	$38.11
3rd 6 months w/500 hrs	62.00	$15.69	$8.52	$7.69	$0.13	$0.00	$0.40	$0.12	$0.00	$0.00	$32.55	$40.39
4th 6 months w/500 hrs	68.00	$17.20	$8.52	$7.69	$0.13	$0.00	$0.40	$0.12	$0.00	$0.00	$34.06	$42.67
5th 6 months w/500 hrs	74.00	$18.72	$8.52	$7.69	$0.13	$0.00	$0.40	$0.12	$0.00	$0.00	$35.58	$44.94
6th 6 months w/500 hrs	80.00	$20.24	$8.52	$7.69	$0.13	$0.00	$0.40	$0.12	$0.00	$0.00	$37.10	$47.22
7th 6 months w/500 hrs	86.00	$21.76	$8.52	$7.69	$0.13	$0.00	$0.40	$0.12	$0.00	$0.00	$38.62	$49.50
8th 6 months w/500 hrs	92.00	$23.28	$8.52	$7.69	$0.13	$0.00	$0.40	$0.12	$0.00	$0.00	$40.14	$51.77

Special Calculation Note : Roofers working in any form of coal tar pitch, whether hot or cold, installing and/or removing will be paid $.25 more per hour. Other $0.12 is for C.I.D.B.

Ratio :
No helper shall be used on any one job unless 1 Journeymen, and 1 Apprentices are working on said job .One
(1) Journeymen to One (1) Apprentice to One (1) Helper

Jurisdiction (* denotes special jurisdictional note) :
ASHLAND, CARROLL, COSHOCTON, CRAWFORD, HOLMES, HURON, LORAIN*, MEDINA, PORTAGE, RICHLAND, STARK, SUMMIT, TUSCARAWAS, WAYNE

Special Jurisdictional Note : In Lorain County (South of the Turnpike)

Details :

Prevailing Wage Rate
Skilled Crafts

Name of Union: Sheet Metal Local 33 (Akron)

Change # : LCN01-2018fbLoc33Akron

Craft : Sheet Metal Worker Effective Date : 06/04/2018 Last Posted : 05/25/2018

	BHR		Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Classification												
Sheet Metal Worker	$30.57		$7.65	$12.89	$1.21	$0.00	$6.00	$0.00	$0.00	$0.00	$58.32	$73.60
1st year	45.00	$13.76	$7.65	$3.47	$0.17	$0.00	$0.00	$0.00	$0.00	$0.00	$25.05	$31.92
2nd year	50.00	$15.29	$7.65	$4.62	$1.21	$0.00	$3.00	$0.00	$0.00	$0.00	$31.77	$39.41
3rd year	55.00	$16.81	$7.65	$5.00	$1.21	$0.00	$3.00	$0.00	$0.00	$0.00	$33.67	$42.08
4th year	65.00	$19.87	$7.65	$5.77	$1.21	$0.00	$3.00	$0.00	$0.00	$0.00	$37.50	$47.44
5th year	80.00	$24.46	$7.65	$6.93	$1.21	$0.00	$3.00	$0.00	$0.00	$0.00	$43.25	$55.47

Special Calculation Note : No special calculations for this skilled craft wage rate are required at this time.

Ratio :

1 Journeymen to 1 Apprentice
2 Journeymen to 1 Apprentice
3 Journeymen to 2 Apprentice
4 Journeymen to 2 Apprentice
5-7 Journeymen to 3 Apprentice
8-10 Journeymen to 4 Apprentice
11-13 Journeymen to 5 Apprentice
14, 15 Journeymen to 6 Apprentice
and maintaining a three to one apprentice ratio thereafter.

Jurisdiction (* denotes special jurisdictional note) :

ASHLAND, CARROLL, COSHOCTON, CRAWFORD, HOLMES, MEDINA, PORTAGE, RICHLAND, STARK, SUMMIT, TUSCARAWAS, WAYNE

Special Jurisdictional Note :

Details :

Scope of Work: This Agreement covers the rates of pay and conditions of employment of all employees of the Employer engaged in, but not limited to, the a) manufacture, fabrication, assembling, handling, erection, installation, dismantling, conditioning, adjustment, alteration, repairing and servicing of all ferrous or non-ferrous metal work and all other materials used in lieu thereof and of all HVAC systems, air-veyor systems, exhaust systems, and air handling systems regardless of material used, including the setting of all equipment and all reinforcements in connection therewith; (b) all lagging over insulation and all duct-lining; (c) testing, servicing, and balancing of all air-handling equipment and duct work; (d) the preparation of all shop and field sketches, whether manually drawn or computer assisted, used in fabrication and erection, including those taken from original architectural and engineering drawings or sketches, and (e) metal roofing; and (f) all other work included in the jurisdictional claims of Sheet Metal Worker's International Association.

Prevailing Wage Rate
Skilled Crafts

Name of Union: Sheet Metal Local 33 (Akron) Decking

Change # : CN01-2009Loc33(Akron)Deck

Craft : Sheet Metal Worker Effective Date : 09/24/2009 Last Posted : 09/24/2009

	BHR		Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Classification												
Sheet Metal Worker Decking & Siding	$20.06		$6.31	$6.35	$0.38	$0.00	$0.00	$0.98			$34.08	$44.11
Decking & Siding Specialty Trainees	**Percent**											
1st 30 days	64.25	$12.89	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00			$12.89	$19.33
2nd thru 6th months	64.25	$12.89	$6.31	$6.35	$0.00	$0.00	$0.00	$0.00			$25.55	$31.99
7th thru 12th months	64.28	$12.89	$6.31	$6.35	$0.38	$0.00	$0.00	$0.98			$26.91	$33.36
2nd year	78.56	$15.76	$6.31	$6.35	$0.38	$0.00	$0.00	$0.98			$29.78	$37.66

Special Calculation Note : No special calculations for this skilled craft wage rate are required at this time.

Ratio :

Jurisdiction (* denotes special jurisdictional note) :

3 Journeymen To 1 Apprentice	ASHLAND, CARROLL, COSHOCTON, CRAWFORD, HOLMES, MEDINA, PORTAGE, RICHLAND, STARK, SUMMIT, TUSCARAWAS, WAYNE

Special Jurisdictional Note :

Details :

Work but not limited to:Exterior application of manufactured and/or job site fabricated metal decking, siding and exterior appurtenances thereto. The erection of pre-engineered metal buildings, pre-manufactured gas stations and appurtenances thereto. The installation of metal roofs and appurtenances. The erection and/or job site fabrication of draft or fire curtains and appurtenances thereto.

Prevailing Wage Rate
Skilled Crafts

Name of Union: Sprinkler Fitter Local 669

Change # : LCN02-2018fbLoc669

Craft : Sprinkler Fitter Effective Date : 04/04/2018 Last Posted : 04/04/2018

	BHR	Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
		H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Classification											
Sprinkler Fitter	$37.78	$9.67	$6.40	$0.52	$0.00	$5.12	$0.00	$0.00	$0.00	$59.49	$78.38
Indentured Between April 1, 2010-March 31, 2013											
45%	$17.00	$7.75	$0.00	$0.52	$0.00	$0.69	$0.00	$0.00	$0.00	$25.96	$34.46
50%	$18.89	$7.75	$0.00	$0.52	$0.00	$0.74	$0.00	$0.00	$0.00	$27.90	$37.35
55%	$20.78	$9.67	$6.40	$0.52	$0.00	$0.53	$0.00	$0.00	$0.00	$37.90	$48.29
60%	$22.67	$9.67	$6.40	$0.52	$0.00	$0.58	$0.00	$0.00	$0.00	$39.84	$51.18
65%	$24.56	$9.67	$6.40	$0.52	$0.00	$1.13	$0.00	$0.00	$0.00	$42.28	$54.56
70%	$26.45	$9.67	$6.40	$0.52	$0.00	$1.18	$0.00	$0.00	$0.00	$44.22	$57.45
75%	$28.34	$9.67	$6.40	$0.52	$0.00	$1.23	$0.00	$0.00	$0.00	$46.16	$60.33
80%	$30.22	$9.67	$6.40	$0.52	$0.00	$1.28	$0.00	$0.00	$0.00	$48.09	$63.20
85%	$32.11	$9.67	$6.40	$0.52	$0.00	$1.32	$0.00	$0.00	$0.00	$50.02	$66.07
90%	$34.00	$9.67	$6.40	$0.52	$0.00	$1.37	$0.00	$0.00	$0.00	$51.96	$68.96
Apprentice Indentured after April 1, 2013	**Percent**										
CLASS 1	45.00	$17.00	$7.75	$0.00	$0.52	$0.00	$0.00	$0.00	$0.00	$0.00	$25.27	$33.77
CLASS 2	50.00	$18.89	$7.75	$0.00	$0.52	$0.00	$0.00	$0.00	$0.00	$0.00	$27.16	$36.61
CLASS 3	55.00	$20.78	$9.67	$6.40	$0.52	$0.00	$0.65	$0.00	$0.00	$0.00	$38.02	$48.41
CLASS 4	60.00	$22.67	$9.67	$6.40	$0.52	$0.00	$0.65	$0.00	$0.00	$0.00	$39.91	$51.24
CLASS 5	65.00	$24.56	$9.67	$6.40	$0.52	$0.00	$0.90	$0.00	$0.00	$0.00	$42.05	$54.33
CLASS 6	70.00	$26.45	$9.67	$6.40	$0.52	$0.00	$0.90	$0.00	$0.00	$0.00	$43.94	$57.16
CLASS 7	75.00	$28.33	$9.67	$6.40	$0.52	$0.00	$0.90	$0.00	$0.00	$0.00	$45.83	$59.99
CLASS 8	80.00	$30.22	$9.67	$6.40	$0.52	$0.00	$0.90	$0.00	$0.00	$0.00	$47.71	$62.83
CLASS 9	85.00	$32.11	$9.67	$6.40	$0.52	$0.00	$0.90	$0.00	$0.00	$0.00	$49.60	$65.66
CLASS 10	90.00	$34.00	$9.67	$6.40	$0.52	$0.00	$0.90	$0.00	$0.00	$0.00	$51.49	$68.49

Special Calculation Note : No special calculations for this skilled craft wage rate are required at this time.

Ratio :

1 Journeyman to 1 Apprentice

Jurisdiction (* denotes special jurisdictional note) :

ADAMS, ALLEN, ASHLAND, ASHTABULA, ATHENS, AUGLAIZE, BELMONT, BROWN, BUTLER, CARROLL, CHAMPAIGN, CLARK, CLERMONT, CLINTON, COLUMBIANA, COSHOCTON, CRAWFORD, DARKE, DEFIANCE, DELAWARE, ERIE, FAIRFIELD, FAYETTE, FRANKLIN, FULTON, GALLIA, GREENE, GUERNSEY, HAMILTON, HANCOCK, HARDIN, HARRISON, HENRY, HIGHLAND, HOCKING, HOLMES, HURON, JACKSON, JEFFERSON, KNOX, LAWRENCE, LICKING, LOGAN, LUCAS, MADISON, MAHONING, MARION, MEDINA, MEIGS, MERCER, MIAMI, MONROE, MONTGOMERY, MORGAN, MORROW, MUSKINGUM, NOBLE, OTTAWA, PAULDING, PERRY, PICKAWAY, PIKE, PORTAGE, PREBLE, PUTNAM, RICHLAND, ROSS, SANDUSKY, SCIOTO, SENECA, SHELBY, STARK, SUMMIT, TRUMBULL, TUSCARAWAS, UNION, VAN WERT, VINTON, WARREN, WASHINGTON, WAYNE, WILLIAMS, WOOD, WYANDOT

Special Jurisdictional Note :

Details :

Sprinkler Fitter work shall consist of the installation,dismantling,maintenance,repairs,adjustments,and corrections of all fire protection and fire control systems including the unloading,handling by hand,power equipment and installation of all piping or tubing,appurtenances and equipment pertaining thereto,including both overhead and underground water mains,fire hydrants and hydrant mains,standpipes and hose connections to sprinkler systems used in connection with sprinkler and alarm systems. Also all tanks and pumps connected thereto,also included shall be CO-2 and Cardox Systems, Dry Chemical Systems,Foam Systems and all other fire protection systems.

Prevailing Wage Rate
Skilled Crafts

Name of Union: Truck Driver Bldg & HevHwy Class 1
Locals 20,40,92,92b,100,175,284,438,377,637,908,957

Change # : LCON1-2017fbBldgHevHwy

Craft : Truck Driver Effective Date : 07/05/2017 Last Posted : 07/05/2017

Classification	BHR		Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Truck Driver CLASS 1 4 wheel service, dump, and batch trucks, Oil Distributor Asphalt Distributor-Tandems	$26.49		$7.00	$7.30	$0.20	$0.00	$0.00	$0.00	$0.00	$0.00	$40.99	$54.24
Apprentice	**Percent**											
First 6 months	80.00	$21.19	$7.00	$7.30	$0.20	$0.00	$0.00	$0.00	$0.00	$0.00	$35.69	$46.29
7-12 months	85.00	$22.52	$7.00	$7.30	$0.20	$0.00	$0.00	$0.00	$0.00	$0.00	$37.02	$48.27
13-18 months	90.00	$23.84	$7.00	$7.30	$0.20	$0.00	$0.00	$0.00	$0.00	$0.00	$38.34	$50.26
19-24 months	95.00	$25.17	$7.00	$7.30	$0.20	$0.00	$0.00	$0.00	$0.00	$0.00	$39.67	$52.25
25-30 months	100.00	$26.49	$7.00	$7.30	$0.20	$0.00	$0.00	$0.00	$0.00	$0.00	$40.99	$54.24

Special Calculation Note : No special calculations for this skilled craft wage rate are required at this time.

Ratio :

Jurisdiction (* denotes special jurisdictional note) :

3 Journeymen to 1 Apprentice per company/project

ADAMS, ALLEN, ASHLAND, ASHTABULA, ATHENS, AUGLAIZE, BELMONT, BROWN, BUTLER, CARROLL, CHAMPAIGN, CLARK, CLERMONT, CLINTON, COLUMBIANA, COSHOCTON, CRAWFORD, DARKE, DEFIANCE, DELAWARE, ERIE, FAIRFIELD, FAYETTE, FRANKLIN, FULTON, GALLIA, GREENE, GUERNSEY, HAMILTON, HANCOCK, HARDIN, HARRISON, HENRY, HIGHLAND, HOCKING, HOLMES, HURON, JACKSON, JEFFERSON, KNOX, LAWRENCE, LICKING, LOGAN, LORAIN, LUCAS, MADISON, MAHONING, MARION, MEDINA, MEIGS, MERCER, MIAMI, MONROE, MONTGOMERY, MORGAN, MORROW, MUSKINGUM, NOBLE, OTTAWA, PAULDING, PERRY, PICKAWAY, PIKE, PORTAGE, PREBLE, PUTNAM, RICHLAND, ROSS, SANDUSKY, SCIOTO, SENECA, SHELBY, STARK, SUMMIT, TRUMBULL, TUSCARAWAS, UNION, VAN WERT, VINTON, WARREN, WASHINGTON, WAYNE, WILLIAMS, WOOD, WYANDOT

Special Jurisdictional Note :

Details :

** Asphalt - Oil spray bar man when operating from cab shall receive $0.20 cents per hour above their Basic Hourly Rate.

Prevailing Wage Rate
Skilled Crafts

Name of Union: Truck Driver Bldg & HevHwy Class 2
Locals 20,40,92,92b,100,175,284,438,377,637,908,957

Change # : CN1-2017-fbBldgHevHwy

Craft : Truck Driver Effective Date : 07/05/2017 Last Posted : 07/05/2017

Classification	BHR		Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Truck Driver CLASS 2 Tractor Trailer-Semi Tractor Trucks-Pole Trailers-Ready Mix Trucks-Fuel Trucks-Asphalt-Oil Spray bar men- 5 Axle & Over -Belly Dumps-End Dumps-Articulated Dump Trucks- Low boys-Heavy duty Equipment(irrespective of load carried) when used exclusively for transportation-Truck Mechanics (when needed)	$26.91		$7.00	$7.30	$0.20	$0.00	$0.00	$0.00	$0.00	$0.00	$41.41	$54.87
Apprentice	**Percent**											
First 6 months	80.00	$21.53	$7.00	$7.30	$0.20	$0.00	$0.00	$0.00	$0.00	$0.00	$36.03	$46.79
7-12 months	85.00	$22.87	$7.00	$7.30	$0.20	$0.00	$0.00	$0.00	$0.00	$0.00	$37.37	$48.81
13-18 months	90.00	$24.22	$7.00	$7.30	$0.20	$0.00	$0.00	$0.00	$0.00	$0.00	$38.72	$50.83
19-24 months	95.00	$25.56	$7.00	$7.30	$0.20	$0.00	$0.00	$0.00	$0.00	$0.00	$40.06	$52.85
25-30 months	100.00	$26.91	$7.00	$7.30	$0.20	$0.00	$0.00	$0.00	$0.00	$0.00	$41.41	$54.87

Special Calculation Note : No special calculations for this skilled craft wage rate are required at this time.

Ratio :

Jurisdiction (* denotes special jurisdictional note) :

3 Journeymen to 1 Apprentice
per company/project

ADAMS, ALLEN, ASHLAND, ASHTABULA, ATHENS, AUGLAIZE, BELMONT, BROWN, BUTLER, CARROLL, CHAMPAIGN, CLARK, CLERMONT, CLINTON, COLUMBIANA, COSHOCTON, CRAWFORD, DARKE, DEFIANCE, DELAWARE, ERIE, FAIRFIELD, FAYETTE, FRANKLIN, FULTON, GALLIA, GREENE, GUERNSEY, HAMILTON, HANCOCK, HARDIN, HARRISON, HENRY, HIGHLAND, HOCKING, HOLMES, HURON, JACKSON, JEFFERSON, KNOX, LAWRENCE, LICKING, LOGAN, LORAIN, LUCAS, MADISON, MAHONING, MARION, MEDINA, MEIGS, MERCER, MIAMI, MONROE, MONTGOMERY, MORGAN, MORROW, MUSKINGUM, NOBLE, OTTAWA, PAULDING, PERRY, PICKAWAY, PIKE, PORTAGE, PREBLE, PUTNAM, RICHLAND, ROSS, SANDUSKY, SCIOTO, SENECA, SHELBY, STARK, SUMMIT, TRUMBULL, TUSCARAWAS, UNION, VAN WERT, VINTON, WARREN, WASHINGTON, WAYNE, WILLIAMS, WOOD, WYANDOT

Special Jurisdictional Note :

Details :

** Asphalt - Oil spray bar man when operating from cab shall receive $0.20 cents per hour above their Basic Hourly Rate.

Appendix B: Project Labor Agreement (PLA)

PROJECT LABOR AGREEMENT

FOR THE

CITY OF CANTON WRF – SLUDGE PROCESSING MODIFICATIONS PROJECT – CONTRACT 27

ENTERED INTO BETWEEN

CITY OF CANTON

AND

EAST CENTRAL OHIO BUILDING AND CONSTRUCTION TRADES COUNCIL AFL-CIO

AND

SIGNATORY LOCAL UNIONS

Effective _____

CONTENTS

ARTICLE I

INTENT AND DURATION

Section 1. Intent And Duration. This Project Labor Agreement (the "Agreement") is entered into between the City of Canton (collectively the "Owner"); the East Central Ohio Building and Construction Trades Council, AFL-CIO ("ECOB & CTC" or "Council"); and the Signatory Unions (the "Unions"), and applies exclusively to the construction work within the scope of this Agreement to be performed on the Canton WRF – Sludge Processing Modifications Project (the "Project"). The purpose of this Agreement is to promote efficiency and cost-savings in the construction and refurbishment that is a part of the Project and to provide for the peaceful settlement of any and all labor disputes and grievances without strikes or lockouts, thereby promoting the public interest in assuring the timely and economical completion of the Project. This Agreement shall expire and be of no further force or effect upon the completion of the Project.

Upon execution of this Agreement by all parties, all construction, refurbishing and renovation work covered by this Agreement on the Project shall be contracted exclusively to Contractors, of whatever tier, who agree to execute and be bound by the terms of this Agreement. The Unions agree that Contractors may execute the Agreement, or the Letter of Assent attached as Appendix I, for purposes of performing such work. The Owner (or its permitted designee) shall monitor compliance with this Agreement by all contractors and subcontractors. For purposes of the Agreement, the term "Contractor" shall be deemed to include all construction contractors and subcontractors of whatever tier engaged in on-site construction, refurbishment and renovation work on the Project. The Owner, the Unions and all signatory Contractors agree to abide by the terms and conditions contained in the Agreement. This Agreement represents the complete understanding of all parties, and no Contractor is or will be required to sign any other agreement with a signatory union as a condition of performing work coming within the scope of this Agreement. No practice, understanding or agreement between a Contractor and a Union, which conflicts with any provisions in this Agreement, will be binding on any other party unless endorsed in writing by the Owner.

Section 2. Limitation Of Agreement To Project. The Unions agree that this

Agreement will be made available to, and will fully apply to, any successful bidder for work on the Project, without regard to whether that successful bidder performs work at other sites on either a union or a non-union basis, and without regard to whether employees of such bidder are or are not members of any union. The Unions further agree that this Agreement applies only to this Project. Nothing in this agreement is intended to, or shall, interfere with, or negate, any existing contractual relationship or collective bargaining agreement between the Union and any contractor or subcontractor that may execute this Agreement.

ARTICLE II
PURPOSE

Section 1. Purpose. The parties to this Agreement understand and acknowledge that the timely construction of the Project is critical to the economic stability and development of the City of Canton and the welfare of Canton residents, and is consistent with the City's proposed Comprehensive Plan. The current belt filter presses at the City's Water Reclamation Facility are not consistently functioning at levels appropriate for sludge processing. The replacement of these current belt filter presses is, therefore, urgent and necessary. The existing presses will be replaced with a dewatering system that uses currently available technology. This dewatering system will either involve a centrifuge system, a screw press system or a rotary drum thickener system. The cost of this Project is approximately $6.7 million dollars. Because of the nature of this Project, it must be let out for bid in the fourth quarter of calendar year 2017 in order for work to begin as soon as possible thereafter. The parties signatory to this Agreement accordingly pledge their complete good faith and trust to work towards an on-time and efficient completion of the Project.

Section 2. Time Is Of The Essence. The parties to this Agreement understand and agree that time is of the essence for this Project. The parties understand and agree that the Owner has a critical need for timely completion of the Project and that timely completion of the Project is therefore vital. The parties understand and agree that timely completion of the Project will require the use of substantial numbers of employees from construction and supporting crafts possessing skills and qualifications that are essential to the Project. The Unions pledge that they have members who are competent, skilled, and qualified to perform the required construction work. The

parties also understand that on-budget completion of the Project is most critical; it is therefore essential that construction work on the Project be done in an efficient, economical manner with optimum productivity and with no delays. In recognition of those special needs of the Project, the Unions signatory hereto and their members agree not to initiate, authorize, sanction, participate in or condone, or permit their members to engage in, any strike, sympathy strike, jurisdictional strike, recognitional strike, slowdown, sabotage, work to rule, sickout, sit down, picketing of any type (including informational picketing), handbilling, boycott, interruption of work or any disruptive activity that interferes with or interrupts in any way work on the Project or other operations of the City of Canton. Contractors agree not to engage in any lockouts.

Section 3. Nothing in this Article II is intended to reliever or excuse the Owner, or an Employer, from fully and fairly participating in any pre-job conference required under this Agreement. Provided further, nothing in this Article II is intended to deny any contractor or subcontractor the opportunity to fully and fairly participate in the bid process for work under this Agreement.

ARTICLE III

BENEFITS OF THE AGREEMENT

Section 1. Benefits Of The Agreement. This Agreement is intended to foster the achievement of a timely and on-budget completion of the Project by, among other things:

(a) reducing and/or eliminating the tension and potential disagreements that might otherwise exist between Union and non-union workers on the Project;

(b) avoiding the costly delays of strikes, sympathy strikes, jurisdictional strikes, slowdowns, walkouts, picketing, handbilling and any other disruptions or interference with work, and promoting labor harmony and peace for the duration of the Project;

(c) standardizing terms and conditions governing the employment of labor on the Project;

(d) permitting flexibility in work scheduling and shift hours and times;

(e) achieving negotiated adjustments as to work rules and staffing requirements from those which otherwise might obtain;

(f) providing comprehensive and standardized mechanisms for the settlement of work disputes;

(g) ensuring a reliable source of skilled and experienced labor; and

(h) furthering public policy objectives, to the extent lawful, as to improved employment opportunities for minorities, women and the economically disadvantaged in the construction industry. Mindful of the economic condition and unemployment rate in Stark County, the Owner anticipates and expects that all construction workers and employees on this Project will be residents of Stark County. In view of the very technical and specialized work that is inherent in the construction industry, all parties acknowledge that this expectation by the Owner is a goal, not a mandate. To this end, all Contractors working under this Agreement pledge that they will make a good-faith effort to reach this goal expressed by the Owner.

ARTICLE IV

SCOPE OF AGREEMENT

Section 1. The Work. This Agreement is specifically defined and limited to onsite construction and renovation work required to construct the Project.

Section 2. Exclusions From Scope. Items specifically excluded from the scope of this Agreement, even if performed in connection with the Project, include the following:

(a) Work of non-manual employees, including but not limited to, superintendents, supervisors, staff engineers, inspectors, quality control and quality assurance personnel, timekeepers, mail carriers, clerks, office workers, including messengers, guards, safety personnel, emergency medical and first aid technicians, and other professional, engineering, administrative, supervisory and management employees.

(b) Equipment and machinery owned or controlled and operated by the Owner.

(c) All off-site manufacture, fabrication or handling of materials, equipment or machinery (except at dedicated lay-down or storage areas and except as provided in Article IV, Section 10), and all deliveries of any type to and from the Project site (except on-site pouring of concrete).

(d) All employees of the Owner, the Construction Supervisor, design team or any environmental, engineering or other consultant when such employees do not perform labor coming within the scope of this Agreement.

(e) Any work performed on or near or leading to or onto the site of work on the Project and undertaken by state, county, city or other governmental bodies, or their contractors; or by public utilities or their contractors.

(f) Off-site maintenance of leased equipment and on-site supervision of all such maintenance work.

(g) Work by employees of a manufacturer or vendor necessary to maintain such manufacturer's or vendor's warranty or guarantee, or work performed by supervisors or technicians employed by the manufacturer or vendor to oversee the testing of equipment once installed to insure that the equipment is fully operational.

(h) Laboratory work for specialty testing or inspections not ordinarily done by the signatory local unions.

(i) All work done by employees of any State agency, authority or entity or employees of any municipality or other public employer.

The Unions agree that there shall be no interference with or disruption of work, of those contractors, employers, and employees exempted from coverage of this Agreement by subparagraph (a) through (i) above.

Section 3. Contract Award and Consent to Agreement.

(a) The Owner, and/or Contractors, as appropriate, have the absolute right to award contracts or subcontracts on the Project notwithstanding the existence or nonexistence of any agreements between such Contractor and any Union party provided only that such Contractor is willing, ready and able to execute and comply with this Agreement or a Letter of Assent thereto, should such Contractor be awarded work covered by this Agreement.

(b) All subcontractors of a Contractor, of whatever tier, who have been awarded contracts of work covered by this Agreement, on or after the effective date of this Agreement, shall also be required to accept and to

be bound by the terms and conditions of this Agreement, and shall evidence their acceptance by the execution of this Agreement or a Letter of Assent thereto, prior to the commencement of work. A copy of this Agreement or Letter of Assent executed by each Contractor shall be immediately provided to the Union upon execution.

Section 4. Stand-Alone Agreement. This Agreement is a stand-alone Agreement. While this Agreement expressly does not incorporate any local area collective bargaining agreements, such local area collective bargaining agreements may be referenced for the limited purposes as hereinafter set forth in this Agreement. However, to the extent, if any, that any provisions of this Agreement conflict with any provision of a local area collective bargaining agreement, the provisions of this Agreement shall control, except for all work performed under the NTL Articles of Agreement, the National Stack/Chimney Agreement, the National Cooling Tower Agreement, all instrument calibration work and loop checking shall be performed under the terms of the UA/IBEW Joint National Agreement for Instrument and Control Systems Technicians, and the National Agreement of the International Union of Elevator Constructors, with the exception of Articles VII, VIII and X of this Agreement, which shall apply to such work.

Section 5. Craft Jurisdiction. This Agreement shall recognize the traditional craft jurisdictions of the signatory unions. Any and all jurisdictional disputes shall be settled in accordance with Article VIII below. While this Agreement is a stand-alone Agreement, the Agreement will utilize the local area collective bargaining agreements of signatory locals, not state-wide agreements or other special project agreements, as a reference to define the signatory local unions' craft jurisdiction. Again, jurisdictional disputes shall be settled in accordance with Article VIII.

Section 6. Subcontracting. The Owner agrees that neither it nor any of its contractors or subcontractors will subcontract any work covered by this Agreement to be done on the Project except to a person, firm or corporation who is or agrees to become party to this Agreement. Any contractor or subcontractor working on the Project shall, as a condition to working on said Project, become signatory to and perform all work under the terms of this Agreement. Contractors who are signatory to local collective bargaining agreements shall be bound by the terms of their respective

local collective bargaining agreements on subcontracting to the extent such terms are consistent with Article IV, Section 2 of this Agreement. Disputes concerning compliance with such local subcontracting provisions for this Project shall be subject to all of the dispute resolution provisions of this Agreement.

Section 7. Security. All employees covered by this Agreement in the employ of the Contractors shall remain members in the applicable signatory Union during the term of this Agreement, and all workers hereinafter employed by the Contractors shall become members of the applicable signatory Union seven (7) days after the date of their employment and shall remain members of the Union during the term of this Agreement. (This clause shall be applied to the extent permitted by law). A Contractor shall not discharge any employee for non-membership in the Union if: (a) he has reasonable grounds for believing that such membership was not available to the employee on the same terms and conditions generally applicable to other members, or (b) he has reasonable grounds for believing that membership was denied or terminated for reasons other than the failure of the employee to tender the periodic dues and initiation fee uniformly required as a condition of acquiring or retaining membership.

Section 8. Liability. It is understood that the liability of the Contractor and the liability of the separate Unions under this Agreement shall be several and not joint. The Unions agree that this Agreement does not have the effect of creating any joint employer status between or among the Owner, Construction Supervisor and/or any Contractor, and neither the Owner nor Construction Supervisor shall assume any liabilities of the Contractors.

Section 9. Abatement of Agreement. As areas of covered work on the Project are accepted by the Owner, this Agreement shall have no further force or effect on such areas except where the Contractor is directed by the Owner to engage in repairs or punch list modifications.

Section 10. Miscellaneous. Notwithstanding any other provision of this Agreement, this Agreement applies and is limited to the recognized and accepted historical definition of demolition and new construction work under the direction of and performed by the contractor(s), of whatever tier who have contracts awarded for such work on the project. Such work shall include site preparation work and dedicated off-site

work except for the contractors and subcontractors specifically excluded in the agreement. Any off-site prefabrication of any building materials, systems and/or components traditionally performed on site shall be performed by the appropriate craft signatory to this agreement and approved by the Owner.

ARTICLE V

LABOR/MANAGEMENT COOPERATION

JOINT ADMINISTRATIVE COMMITTEE

Section 1. The parties to this Agreement shall establish a Project Joint Administrative Committee ("Committee"). This Committee will be a two-person committee comprised of one member each appointed by the Owner (or its designee) and the Unions, with an alternate appointee Union member available to replace the regular appointee when a problem or grievance concerns the regular appointee's Union. Each member of the Committee shall designate an alternate who shall serve in the absence of the member for any purpose contemplated by this Agreement.

Section 2. The Committee shall meet at least quarterly, or more often if special circumstances warrant, to discuss the administration of the Agreement, the progress of the Project, labor/management problems that may arise, and any other relevant matters. Any need for interpretation which might arise from the application of the terms and conditions of the Agreement shall be referred directly to the Committee for resolution.

ARTICLE VI

UNION RECOGNITION AND EMPLOYMENT

Section 1. Pre-Hire Recognition. Each Contractor and subcontractor recognizes the Unions as the sole and exclusive bargaining representatives of all craft and trade employees within their respective jurisdictions working on the Project under the Agreement.

Section 2. Contractor's Right of Selection. Each Contractor shall have the right to determine the competency of all employees, the number of employees required and shall have the sole responsibility for selecting employees to be laid off. To the extent any training or vendor education is required to fill any position, said training shall be undertaken at no cost or expense to Owner.

Section 3. Union Referral. For local Unions having a job referral system, each Contractor agrees to comply with such system, and the referral system shall be used exclusively by such Contractor, except as modified by this Article. Such job referral system will be operated in a non-discriminatory manner and in full compliance with Federal, state, and local laws and regulations requiring equal employment

opportunities and nondiscrimination, and referrals shall not be affected in any way by the rules, regulations, bylaws, constitutional provisions or any other aspects or obligations of union membership, policies or requirements. The Union shall indemnify and hold each Contractor harmless with respect to any claim arising out of how the Union operates and administers its referral system. All hiring procedures, including related practices affecting apprenticeship and training, will be operated so as to facilitate the ability of the contractors to meet any and all equal employment opportunity/affirmative action obligations. The Contractor may reject any referral and request another, different referral; provided, however, the Contractor shall furnish, upon request from the Union, a written explanation for the rejection.

Section 4. Lack of Job Referral System. In the event that a signatory Local Union does not have a job referral system as set forth in Section 3 above, the Contractor shall give the Union a forty-eight (48) hour opportunity to refer applicants. The Contractor shall notify the Union of employees hired from any source other than referral by the Union.

Section 5. Unavailability of Union Referrals. In the event that local Unions are unable to fill any requisitions for qualified employees within forty-eight hours (48) after such requisition is made by the Contractor (Saturdays, Sundays, and Holidays excepted), the Contractor may employ applicants from any other available source. The Contractor shall inform the Union of the name, address and telephone number of any applicants hired from other sources and refer the applicant for the Local Union for dispatch to the Project.

Section 6. Union Best Efforts. The Local Unions will exert their utmost efforts to recruit sufficient numbers of skilled craft workers to fulfill the manpower requirements of each Contractor, including calls to local unions in other geographic areas when its referral lists have been exhausted. The parties to this Agreement support the development of increased numbers of skilled construction workers from the residents of the area of the Project. Toward that end, the Unions agree to encourage the referral and utilization, to the extent permitted by law and the hiring hall procedures, of qualified residents as journeymen, apprentices and trainees on the Project.

ARTICLE VII

GRIEVANCE ARBITRATION PROCEDURE

Section 1. This Agreement is intended to provide close cooperation between management and labor. Each of the Unions will assign a representative to this Project for the purpose of completing the construction of the Project economically, efficiently, continuously, and without interruptions, delays, or work stoppages.

Section 2. The Contractors, Unions, and the employees, collectively and individually, realize the importance to all parties to maintain continuous and uninterrupted performance of the work of the Project, and agree to resolve disputes in accordance with the grievance-arbitration provisions set forth in this Article.

Section 3. Any question or dispute arising out of and during the term of this Agreement (other than trade jurisdictional disputes) shall be considered a grievance and subject to resolution under the following procedures:

Step 1. (a) When any employee subject to the provisions of this Agreement feels he or she is aggrieved by a violation of this Agreement, he or she, through his or her local union business representative or job steward, shall, within five (5) working days after the occurrence of the violation, give notice to the work-site representative of the involved Contractor stating the provision(s) alleged to have been violated. The business representative of the local union or the job steward and the work-site representative of the involved Contractor shall meet and endeavor to adjust the matter within three (3) working days after timely notice has been given. The representative of the Contractor shall keep the meeting minutes and shall respond to the Union representative in writing at the conclusion of the meeting but not later than twenty-four (24) hours thereafter. If they fail to resolve the matter within the prescribed period, the Local Union may, within forty-eight (48) hours thereafter, pursue Step 2 of the Grievance Procedure, provided the grievance is reduced to writing, setting forth the relevant information concerning the alleged grievance, including a short description hereof, the date on which the grievance occurred, and the provisions of the

Agreement alleged to have been violated.

(a) Should the Local Union(s) or the Project Contractor or any Contractor have a dispute with the other party and if, after conferring, a settlement is not reached within three (3) working days, the dispute may be reduced to writing and proceed to Step 2 in the same manner as outlined herein for the adjustment of an employee complaint.

Step 2. The International Union Representative and the involved Contractor shall meet within seven (7) working days of the referral of a dispute to this second step to arrive at a satisfactory settlement thereof. Meeting minutes shall be kept by the Contractor. If the parties fail to reach an agreement, the dispute may be appealed by the Union, in writing, in accordance with the provisions of Step 3.

Step 3. (a) If the grievance has been submitted but not adjusted under Step 2, either party may request in writing, within seven (7) calendar days thereafter, that the grievance be submitted to an Arbitrator mutually agreed upon by them. The Contractor and the involved Union shall attempt mutually to select an arbitrator, but if they are unable to do so, they shall request the Federal Mediation and Conciliation Services (FMCS) to provide them with a list of arbitrators from which the Arbitrator shall be selected. The rules of FMCS shall govern the conduct of the arbitration hearing. The decision of the Arbitrator shall be final and binding on all parties. The fee and expenses of such Arbitration shall be borne equally be the Contractor and the involved Local Union(s).

Section 4. Failure of the grieving party to adhere to the time limits established herein shall render the grievance null and void. Failure of the Contractor to adhere to the time limits established herein shall result in the grievance being sustained. The time limits established herein may be extended only by written consent of the parties involved at the particular step where the extension is agreed upon. The Arbitrator shall have the authority to make decisions only on issues presented to him or her, and he or she shall

not have authority to change, amend, add to or detract from any of the provisions of this Agreement.

Section 5. The Owner shall be notified of all actions at Steps 2 and 3 and shall, upon their request, be permitted to participate in all proceedings at these steps.

ARTICLE VIII

JURISDICTIONAL DISPUTES

Section 1. The assignment of work will be the responsibility of the Contractor performing the work involved and such work assignments will be in accordance with decisions issued under the Plan for the Settlement of Jurisdictional Disputes in the Construction Industry (the "Plan"), or any successor Plan, adopted by the National Building and Construction Trades Department.

Section 2. All jurisdictional disputes on this Project, between or among Building and Construction Trades Unions and employers, parties to this Agreement, shall be settled and adjusted according to the present Plan established by the Building and Construction Trades Department or any other plan or method of procedure that may be adopted in the future by the Building and Construction Trades Department. Decisions rendered shall be final, binding and conclusive on the Contractors and Unions parties to this Agreement.

Section 3. All jurisdictional disputes shall be resolved without the occurrence of any strike, work stoppage, or slow-down of any nature, and the Contractor's assignment shall be adhered to until the dispute is resolved. Individuals violating this section shall be subject to immediate discharge.

Section 4. Each Contractor will conduct a pre job conference with the appropriate Council prior to commencing work. The Owner will be advised in advance of all such conferences and may participate in the conference.

ARTICLE IX

MANAGEMENT'S RIGHTS

Section 1. Exclusive Owner - Workforce. Except as otherwise provided in this Agreement, the Owner (or its designee) and the Contractors retain the authority for the management of their operations and workforces.

Section 2. Materials, Design, Machinery, Equipment. There shall be no limitation or restriction by a signatory Union upon a Contractor's choice of materials or

design, nor, regardless of source or location, upon the full use and utilization of equipment, machinery packaging, pre-cast, pre-fabricated, pre-finish, or pre-assembled materials, tools or other labor saving devices. The on-site installation or application of all items shall be performed by the craft having jurisdiction of such work; provided, however, that installation of specialty items may be performed by employees employed under this Agreement who may be directed by other personnel in a supervisory role, in circumstances requiring special knowledge of the particular items.

Section 3. New Technology, Equipment. The use of new technology, equipment, machinery, tools and/or labor saving devices and methods of performing work may be initiated by any Contractor from time to time during the Project. The Union agrees that it will not in any way restrict the implementation of such new devices or work methods.

Section 4. Disputes. If there is any disagreement between any Contractor and the Union concerning the manner or implementation of such device or method of work, the implementation shall proceed as directed by the Contractor, and the Union shall have the right to grieve and/or arbitrate the dispute as set forth in Article VII of this Agreement.

ARTICLE X

WORK STOPPAGES

Section 1. No Strikes or Work Disruptions. There shall be no strike, sympathy strike, jurisdictional strike, recognitional strike, slowdown, sabotage, work to rule, sickout, sit down, picketing of any type (including informational picketing), handbilling, boycott, interruption of work or any disruptive activity that interferes with or interrupts in any way work on the Project. The applicable local union shall not sanction, aid or abet, encourage or continue any work stoppage, strike, picketing or other disruptive activity which violates this Article and shall undertake all reasonable means to prevent or to terminate any such activity. No employee shall engage in activity which violates this Article. Any employee who participates in or encourages any activity which violates this Article shall be subject to disciplinary action, including discharge, and if justifiably discharged for the above reasons, shall not be eligible for rehire on the same project for a period of not less than ninety (90) days. Further, if the Local Union is unable to provide qualified replacements for those employees who

are in violation of this Article by the beginning of the next shift, the Employer is free to hire from any source.

Section 2. Union Responsibilities. The Local Union shall not be liable for acts of employees for which it has no responsibility. The principal officers of the Local Union will immediately instruct, order and use their best efforts to cause the members of the Local Union they represent to cease any violations of this Article. If it complies with this obligation, the Local Union shall not be responsible for unauthorized acts of employees it represents.

ARTICLE XI
WAGES AND BENEFITS

Section 1(A). Wages. All employees covered by this Agreement shall be classified in accordance with work performed and paid 100% of the wages and 100% of the benefits as established in the respective Craft's Collective Bargaining Agreement and any subsequent modifications thereto. The Contractor, upon request, shall provide the Unions and Owner with substantiation that wages and benefits are being paid on the Project. The Unions shall provide the Owner, and any Contractor or subcontractor that is party to this Agreement, with wage, fringe benefit and dues reporting forms.

Section 1(B). Wage Premiums and Additives. The Council and the signatory unions agree that no PLA-specific wage increases, premiums or additives appearing in any local collective bargaining agreement shall have any application to the wage rates appearing in Section 1(A) above.

Section 2. Payment of Benefits/Contributions. Each Contractor will also pay all required contributions in the amounts required by Section 1 of this Article to the established employee benefit funds that accrue to the direct benefit of the employees (such as pension and annuity, health and welfare, vacation, apprenticeship, training funds). With respect to contributions required in this Section to Employer-Union jointly trusted funds, the Contractor adopts and agrees to be bound by the written terms of the legally established trust agreement specifying the detailed basis on which payments are to be made into, and benefits paid out of, such Trust Funds. The Contractor authorizes the parties to such Trust Funds to appoint Trustees and successor Trustees to administer the Trust Funds and hereby ratifies and accepts the

Trustees so appointed as if made by Contractor.

Section 3. Non-Affiliated Labor Organizations. The Contractor shall deduct from each employee's wages all uniform dues and working assessments set forth in the Employee's Local Collective Bargaining Agreement. If a labor organization is not affiliated with the Council, and supplies its members or referrals for work on the Project, such labor organization shall pay to the Council the dues and assessments it would owe the Council if affiliated, for all periods during which the labor organization has members or referrals working on the Project. Any disputes under this paragraph shall be resolved exclusively between the labor organization and the Council by using the grievance procedure appearing in Article VII, as provided herein. All grievances shall be reduced to writing within thirty (30) days of the date on which the aggrieved party discovered the dispute. The grievance shall be initiated at Article VII, Section 3, Step 3.

ARTICLE XII
LOCAL UNION NEGOTIATIONS DURING
THE PENDENCY OF THE AGREEMENT

Section 1. All parties to this Agreement understand and acknowledge that some crafts who will be working on the Project are covered by local collective bargaining agreements that will expire prior to the projected completion of the Project. All parties understand and agree that irrespective of whether such local collective bargaining agreement negotiations are successful or unsuccessful, there shall be no strike, sympathy strike, jurisdictional strike, recognitional strike, slowdown, sabotage, work to rule, sickout, sit down, picketing of any type (including informational picketing), handbilling, boycott, interruption of work or any disruptive activity that interferes with or interrupts in any way work on the Project by any Union involved in such local negotiations, or by any of its members, nor shall there be any lockout by a Contractor on the Project affecting such union or its members during the course of such negotiations. Irrespective of the status of any such local collective bargaining agreement negotiations, the affected Union and all of its members will observe and fully comply with the provisions of this Agreement. Should any Local Union fail or refuse to provide and/or refer qualified employees for work on the Project during an economic strike, any affected Contractor shall be permitted to utilize the procedures appearing in Article VI, Section 5

of this Agreement.

Section 2. Wage/Benefit Increases. Should a craft covered by this Agreement negotiate an increase in wages or an increase in benefits with any Contractor to become effective during the term of the Project, those wage and/or benefit increases shall be paid by the affected Contractor, as of the effective date of those increases, to those employees in that craft performing work covered by this Agreement.

ARTICLE XIII

HOURS OF WORK, OVERTIME, SHIFTS AND HOLIDAY

Section 1. Work Day and Work Week. Except as provided in Section 4, the first shift shall consist of eight (8) or ten (10) hours per day between the hours of 6:00 a.m. and 5:30 p.m., plus one-half (1/2) hour unpaid for lunch, approximately mid-way through the shift. Forty (40) hours per week shall constitute a regular week's work, whether consisting of five (5) eight (8) eight hours days, or four (4) ten (10) hour days. The work week will start on Monday and conclude on Sunday. A uniform starting time will be established for all crafts on each project or segment of the work. Nothing herein shall be construed as guaranteeing any employee eight (8) or ten (10) hours per day or forty (40) hours per week. The Union(s) shall be informed of the work starting time set by the contractor at the pre job conference which may be changed thereafter upon three (3) days' notice to the Union(s) and the employees. A second shift, if used, shall consist of eight hours between 3:00 p.m. and 1:00 a.m.; a third shift, if used, shall begin between 10:00 p.m. and 1:00 a.m. For purposes of Section 3, the third shift shall be considered as part of the prior day's work.

Section 2. Starting Times. Employees shall be at their place of work at the starting time and shall remain at their place of work (as designated by the Contractor) performing their assigned functions until quitting time, which is defined as the scheduled end of the shift. The parties reaffirm their policy of a fair day's work for a fair day's wage. There shall be no pay for time not worked unless the employee is otherwise engaged at the direction of the Contractor.

Section 3. Overtime. Overtime shall be defined as all hours worked in excess of forty (40) hours in a work week or, for 8 hour shifts, in excess of eight (8) hours per day; or for 10 (ten) hour shifts for work in excess of 10 hours per day; such work and work performed on Saturdays shall be paid at one and one-half times the straight time rate of pay. However, in scheduled four (4) day/ten hour shift work weeks, Friday may be scheduled as a "makeup" day at straight time to make up for a day lost (Monday through Thursday) due to inclement weather. In addition, if a "make-up" day is scheduled, all employees directed to work on such day will be guaranteed a minimum of four (4) hours work or pay. In any week in which employees on the Project are scheduled on four/ten hour shifts, an employee whose first day of work on the Project

begins on Wednesday or later day of the schedule shall be paid, during the first week of his employment only, time-and-one-half for all hours worked in excess of eight in a day or each day he works during said week. Work on Sundays and holidays shall be at double time. There shall be no restriction on any contractor's scheduling of overtime or the non-discriminatory designation of employees who will work. The contractor shall have the right to schedule work so as to minimize overtime. There shall be no pyramiding of overtime pay under any circumstances.

Section 4. Shifts.

(a) Shift work may be performed at the option of the Contractor(s) upon three (3) days' prior notice to the Union and shall continue for a period of not less than five (5) working days. Saturdays and Sundays, if worked, may be used for establishing the five (5) day minimum work shift. If two shifts are worked, each shall consist of eight (8) hours of continuous work exclusive of a one--half (½) hour non-paid lunch period. Any third shift shall consist of seven (7) hours of continuous work exclusive of one-half (½) hour non-paid lunch period for eight (8) hours pay. A premium of $.25 per hour shall be paid for work on the second shift and $.50 per hour for work on the third shift.

(b) The Contractor may establish a work week of four (4) consecutive ten (10) hour work days (exclusive of one-half (½) hour unpaid lunch, approximately midway through the shift) between Monday through Thursday.

Section 5. Minimum Pay. An employee who reports for work at the regular starting time and for whom no work is provided shall receive pay equivalent to two (2) hours at the applicable hourly rate, provided the employee at the employer's discretion remains available for work. Any employee who reports for work and for whom work is provided shall be paid for actual time worked but not less than two (2) hours. It will not be a violation of this agreement when the employer considers it necessary to shut down to avoid the possible loss of human life, because of an emergency situation that could endanger the life and safety of an employee. In such cases, employees will be compensated only for the actual time worked. In the case of a situation described above where the employer requests employees to remain available for work, the employees will be compensation for such time. If a project is shut down because of weather, employees, who report for work, shall be paid actual

time worked but not less than two (2) hours. Procedures for prior notification of work cancellation shall be determined at the pre-job conference. The provisions of this section are not applicable where the employee voluntarily quits or lays off.

Section 6. Holidays. Holidays shall be New Year's Day, Good Friday, Memorial Day, Independence Day, Labor Day, Veteran's Day, Thanksgiving Day, the Day after Thanksgiving Day, and Christmas Day. A holiday falling on Saturday shall be observed on the preceding Friday. A holiday falling on Sunday shall be observed on the following Monday.

Section 7. Meal Period. The Contractor will schedule a meal period of not more than one-half hour duration at the work location at approximately the mid-point of the scheduled work shift (4 hours in a five day work week, 5 hours in a four-day work week), consistent with Section 1; provided, however, that the Contractor may, for efficiency of the operation, establish a schedule which coordinates the meal periods of two or more crafts. If an employee is required to work through his meal period, he shall be compensated for the time worked at the applicable overtime rate and the employee shall, when work permits, eat his lunch "on the fly".

Section 8. No Organized Work Breaks. There will be one (1) break during the first four (4) hours of a shift which shall be taken at the employee's work station. Individual nonalcoholic beverage containers will be permitted at the employee's work station.

Section 9. Helmets to Hardhats.

(a) The Employers and the Unions recognize a desire to facilitate the entry into the building and construction trades of veterans who are interested in careers in*the building and construction industry. The Employers and Unions agree to utilize the services of the Center for Military Recruitment, Assessment and Veterans Employment (hereinafter "Center") and the Center's "Helmets to Hardhats" program to serve as a resource for preliminary orientation, assessment of construction aptitude, referral to apprenticeship programs or hiring halls, counseling and mentoring, support network, employment opportunities and other needs as identified by the parties.

(b) The Unions and Employers agree to coordinate with the Center to create

and maintain an integrated database of veterans interested in working on this Project and of apprenticeship and employment opportunities for this Project. To the extent permitted by law, the Unions will give credit to such veterans for bona fide, provable past experience.

ARTICLE XIV

APPRENTICES

Section 1. Need For. The parties recognize the need to maintain continuing support of programs designed to develop adequate numbers of competent workers in the construction industry. The Contractor(s) will accordingly employ apprentices in their respective crafts to perform work on the Project within the apprentice's capabilities.

Section 2. Ratios. The Union agrees to cooperate with the Contractor in furnishing qualified apprentices as requested and if available. Apprentices shall perform the work of their craft in accordance with the ratios and terms in their governing collective bargaining agreements. To the extent requested by Owner, the Contractor(s) may use the maximum number of apprentices permitted by local collective bargaining agreements.

ARTICLE XV

DRUG AND ALCOHOL POLICY

Section 1. Drug and Alcohol Policy. All parties understand and agree that a drug and alcohol policy, approved by the Council, will be in force for all work performed under the Agreement. The drug and alcohol policy will prohibit the use, sale, transfer, purchase and/or possession of a controlled substance, alcohol and/or firearms while on the Project's premises and will require testing of employees. The drug and alcohol policy, attached hereto as Appendix 2, is incorporated into and made part of this Agreement and is implemented for all Contractors and employees working on the Project.

ARTICLE XVI

NON-DISCRIMINATION

Section 1. Policy. It is the continuing policy of the Owner, the Contractors and the Unions that the provisions of this Agreement shall be applied without discrimination because of age, race, sex, color, religion, creed, national origin, sexual orientation or any other basis prohibited by applicable law.

ARTICLE XVII

SOLE AND COMPLETE AGREEMENT

Section 1. The parties agree that this Agreement constitutes the sole and complete agreement between them governing the rates of pay and working conditions of the construction employees working on the Project. This Agreement settles all demands and issues on the matters subject to collective bargaining and that it shall not be modified or supplemented in any way except by written agreement executed by the Owner and all parties.

ARTICLE XVIII

SEPARABILITY AND SAVINGS CLAUSE

Section 1. Intent of Parties. If any article or section of this Agreement shall be held invalid by law or by a tribunal of competent jurisdiction, or if compliance with or enforcement of any article should be restrained pending a final determination as to its validity, the remainder of this Agreement shall not be affected and shall remain in full force and effect. In the event that any article or section is held invalid, the parties hereto shall, upon the request of the Unions, enter into collective bargaining negotiations for the purpose of arriving at a mutually satisfactory replacement for such article during the period of invalidity or restraint. If the Owner and the Council cannot agree on a mutually satisfactory replacement, either party shall be permitted to submit its demand to formal interest arbitration.

Section 2. Force of Agreement. The parties recognize the right of the Owner to withdraw, at its absolute discretion, the utilization of this Agreement as part of any bid specification should a court of competent jurisdiction issue any order which could result, temporarily or permanently, in delay of the bidding, awarding, and/or construction work on the Project. Notwithstanding such an action by the Owner, or such court order, the parties agree that the Agreement shall remain in full force and effect on the Project, to the maximum extent legally possible. It is hereby agreed that this Agreement covers all of the signatory local unions listed below.

Section 3. Delegation. The Owner, in its sole and absolute discretion has the right to delegate its duties hereunder to a representative and/or designee who may be either an employee of Owner or a third party with whom Owner has contracted for contractor services.

OWNER
CITY OF CANTON

Director of Public Service

EAST CENTRAL OHIO BUILDING & CONSTRUCTION TRADES COUNCIL, AFL-CIO

Dave Kuver

PRESIDENT

APPROVED AS TO FORM

CANTON LAW DIRECTOR

BRICKLAYERS LOCAL 6

By: Justin M. Gartrell

Name: Justin M. Gartrell

Title: Field Rep

Date: 5-11-17

ELECTRICIANS LOCAL NO. 540

By: Philip D. Williams

Name: Philip D. Williams

Title: Bus. Mngr/Finan-Secy

Date: 5/3/17

GENERAL TRUCK DRIVERS & HELPERS UNION LOCAL NO. 92

By: Warren Brustoski

Name: Warren Brustoski

Title: Business Agent

Date: 5-5-17

GLAZIERS LOCAL NO. 1162

By:_____

Name:_____

Title:_____

Date: _____

HEAT & FROST INSULATORS AND ASBESTOS WORKERS LOCAL NO. 84

By:_____

Name:_____

Title:_____

Date: _____

INDIANA/KENTUCKY/OHIO REGIONAL COUNCIL OF CARPENTERS

By: Aaron Wright

Name: AARON WRIGHT

Title: REPRESENTATIVE

Date: 5/11/17

IRONWORKERS LOCAL NO. 550

By: _____

Name: William Sherer Jr

Title: BM

Date: 5-3-17

LABORERS LOCAL NO. 1015

By: _____

Name: Jake Craston Jr

Title: Business Manager

Date: 5/5/17

OPERATIVE PLASTERERS' AND CEMENT MASONS LOCAL NO. 109

By: _____

Name: Greg Daniels

Title: Bus. Mgr. + Fin. Sec.

Date: 5-4-17

PAINTERS LOCAL NO. 603

By:_____

Name:_____

Title:_____

Date: _____

PLUMBERS, PIPEFITTERS AND REFRIGERATION LOCAL NO. 94

By: Dave Kirven

Name: DAVE KIRVEN

Title: BUSINESS MGR

Date: 5-2-2017

ROOFERS, LOCAL UNION NO. 88

By: BARBARA A. DIXON

Name: Barbara A. Dixon

Title: ~~BUSINESS~~ AGENT

Date: 5/11/2017

SHEET METAL WORKERS LOCAL NO. 33

By: _____

Name: JEOFFREY DUPUIS

Title: BUSINESS AGENT

Date: 5/3/17

SPRINKLER FITTERS LOCAL NO. 669

By: _____

Name: _____

Title: _____

Date: _____

APPENDIX 1

LETTER OF ASSENT TO THE PROJECT LABOR AGREEMENT

FOR THE CITY OF CANTON WRF – SLUDGE PROCESSING MODIFICATIONS PROJECT

Pursuant to Article I, Section 1 of the Project Labor Agreement (the "Agreement") for the City of Canton WRF – Sludge Processing Modifications Project, the undersigned party hereby agrees that it will comply with and be bound by all of the terms and conditions of the Agreement and agrees to all approved amendments or revisions thereto.

This Letter of Assent shall ONLY apply to the above-referenced Project and shall remain in effect for the duration of the above-referenced Project, after which this understanding will automatically terminate without further notice.

For the Contractor (or Subcontractor of whatever tier):

Name of Contractor/Subcontractor: _____

Name and Signature of Authorized Person:

(Print Name) _____

(Title) _____

(Signature) _____

(Phone #) _____

(Date) _____

APPENDIX 2

EMPLOYEE DRUG AND ALCOHOL TESTING POLICY

SPECIFICATIONS

The Owner is committed to providing a safe workplace for the workers assigned the Project, promoting high standards of employment health, and fostering productivity that satisfies its quality expectations. Consistent with the intent and spirit of this commitment, the Owner and ECOB & CTC have established a substance abuse testing specification for the Project with the goal of maintaining a work environment that is free from the effects of the use of illegal drugs and alcohol. The Owner will implement the terms of this policy.

This specification is not intended as a substitute for the Contractors' complete written substance abuse policy. Normally, such policies include other important features, including, but not limited to, an employee education and awareness Program, a supervisor training program and an employee assistance program.

The policy for this Project requires that any construction employee entering the project site will comply with the substance abuse testing requirements as outlined in this section. The Owner reserves the right to amend this specification upon written notice to the Contractor and the Unions on the Project. The parties to this agreement shall recognize the Drug Free Work Site Program as implemented through participating Unions and/or Contractors as administered by the contractor, or for contractors who are not signatory to agreements with signatory unions belonging to ECOB & CTC, and their core employees, an equivalent program that meets the specifications, contractual requirements, and testing requirements as set forth in this Appendix 1.

CONTRACTUAL REQUIREMENTS

All Contractors must have and enforce a written Substance Abuse Program incorporating the testing requirements, term, and conditions set forth in this specification. This specification is applicable to all employees, current and prospective, in order to be eligible to perform work at the Project. The Contractors must comply with the specification. Supplies, vendors, and visitors are subject to confirmation of their abstinence from the possession or use of substances indicated in this specification. A copy of each contractor's substance abuse program must be

submitted to the Owner for approval prior to commencement of any work on the Project site.

The substance abuse program must apply to all employees working on the Project and subcontractors' of any of tier working on the Project site. This includes workers, new hires, replacement workers, and supervisory personnel. No employee or prospective employee of a Contractor shall be permitted to work on the Project site unless such employee has submitted to testing by this specification and unless the results of such testing are negative as hereinafter defined. The Contractor must provide the Owner with a Monthly Summary Report of the Substance Abuse Program compliance.

All Contractors must train their respective employees in methods that will allow them to recognize substance abusers. Supervisory Employees of the Owner or its subcontractor shall be trained to take action, and to confront a substance abuser in a manner consistent with generally accepted safety-training procedures.

The cost of implementing the Substance Abuse program shall be borne by each respective Contractor affected by this specification.

Suppliers, vendors, and visitors must become signatory to the terms of this specification and their abstinence from substance abuse, and their continued avoidance of violations of the specification at the project site. Furthermore, in the event of an incident and/or accident occurrences involving suppliers, vendors, and/or visitors, the same agrees to submit to the substance abuse testing when requested. Refusal to comply would be grounds to have the supplier, vendor, or visitor permanently barred from the Project site by regulators.

TESTING REQUIREMENTS

The Project requires:

- Post-offer/Pre-engagement drug and alcohol testing.
- Testing for reasonable suspicion of illegal drug use or alcohol use.
- Post accident and post incident drug and alcohol testing upon reasonable suspicion.
- Drug testing following discovery of illegal or unauthorized drugs or paraphernalia as creating reasonable suspicion.

All Prime Contractors must perform post-offer/pre-engagement, and post

accident/incident testing upon reasonable suspicion, as follows:

a. All drug testing must be conducted by a National Institute of Drug Abuse (NIDA) certified laboratory with test results interpreted by a licensed medical review officer (MRO).
b. The initial screen tests for alcohol shall be performed by using either a saliva test or breathalyzer test comparable to the type used by state or local law enforcement officials. Furthermore, alcohol confirmatory tests shall be performed by using either blood alcohol test or a Breathalyzer test comparable to the type used by state or local law enforcement officials.
c. Evidence of the negative test results of individual employees required by this specification shall be furnished to the Owner prior to the commencement of work by the individual employee and promptly after performance of any subsequent testing required by this specification. Acceptable negative test result format.
    - A certificate signed by the testing laboratory, setting forth the nature and results of performed; or
    - An identification card signed by the respective Prime Contractor and issued to the individual employee, setting forth as reported on a certificate issued by the testing laboratory. The name of the testing laboratory shall also appear on the identification card; provided the affected employee authorizes the issuance of such identification card.

COMPLIANCE PROCEDURE

The Owner reserves the right to audit any substance abuse program required by this specification to verify compliance results within twenty-four (24) hours of notification of the intent to audit. The Owner shall have free right of access to all relevant records of the Prime Contractor and their subcontractors and supplies for this purpose, provided such record disclosures are within the scope of the States guidelines pertaining to confidentiality of employee records.

The Contractor's pre-engagement employees who receive a positive test result shall immediately leave the Project Site. Transportation of employees receiving the positive test result is the direct responsibility of the employing Prime Contractor, including employees of its subcontractors. Furthermore, pre-engagement employees

receiving a positive test shall not be permitted to return to the Project Site earlier than 90 days from the date of the positive test. At this time the employee may begin the process outlined by this specification again.

DEFINITIONS/ CONFIDENTIALITY/RULES- DISCIPLANARY ACTIONS- GRIEVANCE PROCEDURES

1. DEFINITIONS:

(a) Company Premises - the term "Company Premises" as used in this policy includes all property, facilities, land, building, structures, automobiles, trucks and other vehicles owned, leased or used by the Contractor on the Project. Construction job sites for which the Contractor has responsibility are included.

(b) Prohibited Items & Substances - Prohibited substances include illegal drugs (including controlled substances, look alike drugs and designer drugs, alcoholic beverages, and drug paraphernalia in the possession of or being used by an employee on the job.

(c) Employee - Individuals, who perform work for the Contractor, including, but not limited to management, supervision, engineering, craft workers and clerical personnel.

(d) Accident - Any event resulting in injury to a person or property to which an employee, or contractor/contractor's employee, contributed as a direct or indirect cause.

(e) Incident - An event which has all the attributes of an accident, except that no harm was caused to person or property.

(f) Reasonable Cause - Reasonable cause shall be defined as tardiness, excessive absenteeism, and erratic behavior such as noticeable imbalance, incoherence, and disorientation.

2. CONFIDENTIALITY

(a) All parties to this policy and program have only the interests of employees in mind; therefore, encourage any employee with a substance abuse problem to come forward and voluntarily accept our assistance in dealing with the illness. An employee assistance program will provide guidance and direction for you during your recovery period. If you volunteer for help, the Contractor

will make every reasonable effort to return you to work upon your recovery. The Contractor will also take action to assure that your illness is handled in a confidential manner.

(b) All actions taken under this policy and program will be confidential and disclosed only to those with a "need to know."

(c) When a test is required, the specimen will be identified with a code number, not by name, to insure confidentiality of the donor. Each specimen container will be properly label and made tamper proof. The donor must witness this procedure.

(d) Unless an initial positive result is confirmed as positive, it shall be deemed negative and reported by the laboratory as such.

(e) The handling and transportation of each specimen will be properly documented through the strict chain of custody procedures.

3. RULES - all employees must report to work in a physical condition that will enable them to perform their jobs in a safe and efficient manner. Employees shall not:

(a) Use, possess, dispense or receive prohibited substances on or at the Project job site; or

(b) Report to work at or on the Project with any measurable amount of prohibited substances in their system.

4. DISCIPLINE - When the Contractor has reasonable cause to believe an employee is under the influence of a prohibited substance, for reasons of safety, the employee may be suspended until test results are available. If no test results are received after three (3) working days, the employee, if available, shall return to work with back pay. If the test results prove negative, the employee shall be reinstated with back pay. In all other cases:

(a) Applicants testing positive for drug use will not be hired.

(b) Employees who have not voluntarily come forward, and who test positive for a drug use, will be terminated.

(c) Employees who refuse to cooperate with testing procedures will be terminated.

(d) Employees found in possession of drugs or drug paraphernalia will be terminated.

(e) Employees found under the influence of alcohol while on duty, or while operating a company vehicle, will be subject to termination.

5. PRESCRIPTION DRUGS - Employees using a prescribed medication which, in their physician's opinion, may impair the performance of their duties, either mental or motor functions, must immediately inform the supervisor of such prescription drug use if instructed by their physician to do so. For the safety of all employees, the Contractor will consult with you and your physician to determine if a reassignment of duties is necessary. The Contractor will attempt to accommodate your needs by making an appropriate reassignment. However, if a reassignment is not possible, you will be placed on temporary medical leave until released as fit for duty by the prescribing physician.

Appendix C: Project Manual and Technical Specifications

ARCADIS Design & Consultancy for natural and built assets

City of Canton

City Hall, 218 Cleveland Ave, S.W., Canton, OH 44702

Set No. _____

Project Manual

Volume 1 of 1

Canton Water Reclamation Facility

Sludge Processing Modifications

Contract No. 27

May 2018

Prepared By:

Arcadis U.S., Inc.

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Akron, OH 44308
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STATE OF OHIO DAVID A. FRANK 53268 REGISTERED PROFESSIONAL ENGINEER

STATE OF OHIO Daniel James Ocharzak #E-69071 REGISTERED PROFESSIONAL ENGINEER

AK000343.B002

CITY OF CANTON, OHIO
SLUDGE PROCESSING MODIFICATIONS
CONTRACT NO. 27

SEALS AND CERTIFICATIONS

ENGINEER: Arcadis U.S., Inc.

David A. Frank, PE License No. OH – 53268 	The seal and signature to the left applies to the following Specifications Divisions and Sections of this Project Manual: • Division 01 • Division 02 • Division 09 • Division 10 • Division 22 • Division 40 • Division 43 • Division 46
Daniel J. Ocharzak, PE License No. OH – 69071 	The seal and signature to the left applies to the following Specifications Divisions and Sections of this Project Manual: • Division 23

John P. Sidoti, PE License No. OH – 71807  	The seal and signature to the left applies to the following Specifications Divisions and Sections of this Project Manual: • Division 26 • Division 40
Matthew A. Palte, PE License No. OH - 68671  	The seal and signature to the left applies to the following Specifications Divisions and Sections of this Project Manual: • Division 03 • Division 05 • Division 41

Engineer's seal and signature does not apply to the documents that comprise Division 00, Bidding and Contracting Requirements.

It is a violation of applicable laws and regulations governing professional licensing and registration for any person, unless acting under the direction of the licensed and registered design professional(s) indicated above, to alter in any way the Specifications in this Project Manual.

+ + END OF SEALS AND CERTIFICATIONS + +

TABLE OF CONTENTS

VOLUME 1 OF 1

+ + END OF TABLE OF CONTENTS + +

SECTION 01 11 13

SUMMARY OF WORK

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. This Section includes the following Articles:

Article	Title
1.1	Section Includes
1.2	Location and Description of Work
1.3	Work by OWNER
1.4	Sequence and Progress of Work
1.5	CONTRACTOR's Use of Site
1.6	Easements and Rights-of-Way
1.7	Salvage of Materials and Equipment
1.8	Partial Utilization by OWNER

1.2 LOCATION AND DESCRIPTION OF WORK

A. The Work is located at the Water Reclamation Facility of the City of Canton, OH at 3530 Central Ave SE, Canton, OH 44707.

B. The Work to be performed under this Contract includes, but is not limited to, constructing the Work described below and all related appurtenances. The Work includes, but is not limited to, the following:
   1. Decommissioning, removal and disposal of three existing 2-belt belt filter presses and appurtenances. Assistance in removing one portable, rental 3-belt belt filter press.
   2. Installation and commissioning of three new centrifuges and ancillary systems.
   3. Modifications to existing process piping and electrical equipment to accommodate the new centrifuges.
   4. Modifications to the existing biofilter system and associated ductwork.
   5. All other work described within the Contract Documents.

C. Contracting Method: The Project shall be constructed under one prime Contract.

1.3 WORK BY OWNER

A. OWNER will perform the following in connection with the Work:
   1. Operate all existing valves, gates, pumps, equipment, and appurtenances that will affect OWNER's operation, unless otherwise specified or indicated.

1.4 SEQUENCE AND PROGRESS OF WORK

A. Requirements for sequencing and coordinating with OWNER's operations, including maintenance of facility operations during construction, and requirements for tie-ins and shutdowns, are in Section 01 14 16, Coordination with Owner's Operations.

1.5 CONTRACTOR'S USE OF SITE

A. CONTRACTOR's use of the Site shall be confined to the areas shown.

B. Move stored materials and equipment that interfere with operations of OWNER, other contractors, and others performing work for OWNER.

C. Limits on CONTRACTOR's use of the Site are:
   1. Contractor's use of site shall be limited to the areas shown on the Contract Drawings.
   2. Do not use the Site for operations other than those required for the Project.

1.6 EASEMENTS AND RIGHTS-OF-WAY

A. General:
   1. Easements and rights-of-way required for the permanent improvements included in the Work will be provided by OWNER in accordance with the General Conditions and Supplementary Conditions.
   2. Confine construction operations within OWNER's property.
   3. Use care in placing construction tools, equipment, excavated materials, and materials and equipment to be incorporated into the Work to avoid damaging property and interfering with traffic.
   4. Do not enter private property outside the construction limits without permission from the owner of the property.

1.7 SALVAGE OF MATERIALS AND EQUIPMENT

A. Existing materials and equipment removed and not shown or specified to be reused in the Work will become CONTRACTOR's property, except the following items that shall remain OWNER's property:

   1. Polymer Blending Unit No. 3 – contractor to remove and relocate PBU to location on plant site as directed by OWNER.

B. Existing materials and equipment removed by CONTRACTOR shall not be reused in the Work, except where specified or indicated.

C. Removal, Storage, Handling, Reinstallation:

1. Carefully remove in manner to prevent damage all materials and equipment shown or indicated to be salvaged and reused or to remain property of OWNER.
2. Store and protect salvaged items shown or indicated to be used in the Work.
3. Replace in-kind or with new items those items of materials and equipment damaged during removal, storage, or handling through CONTRACTOR's actions, negligence, or improper procedures.

D. CONTRACTOR may furnish and install new items, with ENGINEER's approval, instead of those specified or indicated to be salvaged and reused, in which case such removed items will become CONTRACTOR's property.

1.8 PARTIAL UTILIZATION BY OWNER

A. Owner may begin using the facility for the purpose of the dewatering waste activated sludge from the membrane bioreactors prior to complete of the work to maintain dewatering requirements at the WRF.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 14 16

COORDINATION WITH OWNER'S OPERATIONS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. This Section includes requirements for coordinating with OWNER's operations during the Project and includes requirements for tie-ins and shutdowns necessary to complete the Work without impact on OWNER's operations except as allowed in this Section.
   2. CONTRACTOR shall provide all labor, materials, equipment, tools, and incidentals shown, specified, and required to coordinate with OWNER's operations during the Work in accordance with this Section.

B. Coordination:
   1. Review construction procedures under other Specifications sections and coordinate Work that will be performed with or before the Work specified in this Section.

C. Related Sections:
   1. Section 01 11 13, Summary of Work.
   2. Section 01 73 29, Cutting and Patching.
   3. Section 01 73 24, Connections to Existing Facilities.

D. Except for shutdowns specified in this Section, perform the Work such that OWNER's facilities remain in continuous satisfactory operation during the Project. Schedule and conduct the Work such that the Work does not: impede OWNER's production or processes, create potential hazards to operating equipment and personnel, reduce the quality of the facility's products or effluent, cause odors or other nuisances, or affect the public health, safety, and convenience.

E. Work not specifically covered in this Section or in referenced Sections may, in general, be completed, within the Contract Times, at any time during regular working hours in accordance with the Contract Documents, subject to the requirements in this Section.

F. As a substitute to the procedures specified in this Section, CONTRACTOR may propose providing additional temporary facilities that can eliminate or mitigate a constraint without additional cost to OWNER, provided such additional temporary facilities: do not present hazards to the public, personnel, structures, and equipment; that such additional temporary facilities do not adversely affect OWNER's ability to comply with Laws and Regulations, permits, and operating

requirements; that such temporary facilities do not generate or foster the generation of odors and other nuisances; and that requirements of the Contract Documents are fulfilled.

G. Coordinate shutdowns with OWNER and ENGINEER. When possible, combine multiple tie-ins into a single shutdown to reduce impacts on OWNER's operations and processes.

H. Operation of Existing Systems and Equipment during the Work:
   1. Do not shut off or disconnect existing operating systems or equipment, unless accepted by ENGINEER in writing.
   2. Operation of existing systems and equipment will be by OWNER unless otherwise specified or indicated.

I. Bypassing:
   1. Diversion of flows around treatment processes is not allowed.

1.2 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Substitute Sequence Submittal: When deviation from specified sequence or procedures is proposed, furnish submittal explaining in detail the proposed sequence or procedures and associated effects, including evidence that OWNER's operations will not be adversely affected, to an extent greater than originally contemplated in the Contract Documents, by proposed substitution. List benefits of proposed substitution, including benefits to Progress Schedule. Submit in accordance with Section 01 25 00, Substitution Procedures, and other requirements of the Contract Documents regarding substitution requests.

B. Informational Submittals: Submit the following:
   1. Shutdown Planning Submittal:
      a. For each shutdown, submit an inventory of labor, materials, and equipment required to perform the shutdown and tie-in tasks, an estimate of time required to accomplish the complete shutdown including time for OWNER to take down and start up existing equipment, systems, or conduits, and written description of steps required to complete the Work associated with the shutdown.
      b. Furnish submittal to ENGINEER not less than 30 days prior to proposed shutdown start date. Do not start shutdown until obtaining ENGINEER's acceptance of shutdown planning submittal.
   2. Shutdown Notification: After ENGINEER's acceptance of shutdown planning submittal and prior to starting the shutdown, submit written notification to OWNER and ENGINEER of date and time each shutdown is to start. Submit notification not less than 72 hours in advance of each shutdown.

1.3 GENERAL CONSTRAINTS

A. Indicated in the Contract Documents are the sequence and shutdown durations, where applicable, for OWNER'S equipment, systems, and conduits (including piping and ducting) that are to be taken out of service temporarily for the Work. New materials, equipment, and systems may be used by OWNER after the specified field quality controls and testing are successfully completed and the materials or equipment are Substantially Complete in accordance with the Contract Documents.

B. The following constraints apply to coordination with OWNER's operations:
   1. Operational Access: OWNER'S personnel shall have access to equipment and areas of the facility that remain in operation. The Sludge Handling Building belt filter presses are operated 24 hours a day, 7 days a week.
   2. Temporary Partitions and Enclosures: Provide temporary partitions and enclosures necessary to maintain dust-free, heated, and ventilated spaces in areas of the facility that are adjacent to the Work and that must be kept operational. Comply with Section 01 51 05, Temporary Utilities.
   3. Schedule and perform equipment and system start-ups for Monday through Thursday. Equipment and systems shall not be placed into operation on Friday, Saturday, and Sunday without prior approval of OWNER, unless specifically indicated otherwise in the Contract Documents.
   4. Dead End Valves or Conduits: Provide blind flanges, watertight bulkheads, or valve at temporary and permanent terminuses of conduits, including piping and ducting. Blind flanges and bulkheads shall be suitable for the service and braced and blocked, as required, or otherwise restrained as directed by ENGINEER. Temporary valves shall be suitable for their associated service. Where valve is provided at permanent terminus of conduit, including piping or ducting, also provide on downstream side of valve a blind flange with drain/flushing connection.
   5. Rental Belt Filter Press (BFP) Connections: Provide cable, hose/tubing and piping necessary to reroute connections to Rental BFP to maintain its operation while Work proceeds.

1.4 SEQUENCE OF WORK

A. Perform the Work in the indicated sequence. Certain phases or stages of the Work may require working 24-hour days or work during hours outside of regular working hours. Work may be accelerated from a later stage to an earlier stage if OWNER's operations are not adversely affected by proposed sequence change, with ENGINEER's acceptance. Stages specified in this Article 1.4 are sequence-dependent.

B. Stage 1 - Submittals and Material Procurement: Issue purchase order to centrifuge manufacturer within 2 weeks of Notice to Proceed; Centrifuge submittals to be provided to Engineer for review within 6 weeks of purchase order. Complete all Submittals and procure all materials and equipment to complete the Work prior to

mobilizing on the project site. One exception may be, with OWNER consent and confirmed shipping date, the receipt on Project site of third centrifuge.

C. Stage 2 - Demolition and Ancillary Systems Installation: Complete the following Work items prior to removing Belt Filter Press (BFP) No. 1 from operation.
   1. Provide temporary piping to reroute and maintain in service drains connecting to both the 10-inch cast iron drain oriented east-west beneath BFP No. 1 and the 12-inch drain flowing south from connection with 10-inch drain. Then demolish the 10-inch and 12-inch drains. Work on new 12-inch and smaller drains may proceed.
   2. After Step C.1, proceed with dismantling and removing BFP No. 1 and associated systems. Removal of BFP No. 1 components through roll-up door will be limited by location and proximity of the Rental BFP and its polymer tote. Coordinate temporary capping or plugging of utilities serving BFP No. 1 which serve other BFPs so as not to maintain their operation. Demolish BFP No. 1 containment dikes, curbs and concrete fill.
   3. Install new polymer blending units (PBUs) and Packaged Booster Water Pumping Station. Complete water supply piping to all three PBUs and polymer solution piping to near Centrifuge Nos. 1 and 2. Complete flush water (utility water) piping to near Centrifuge Nos. 1 and 2. (Piping serving Centrifuge No. 3 may also be installed, to the extent possible, at Contractor's discretion.)
   4. Proceed with electrical, instrumentation and control Work. Complete setting of Centrifuge No. 1 Control Panel and RIO-RTU-SH and conduit and wiring to those panels.
   5. Receive onsite Centrifuge No. 1 within 24 weeks after shop drawing approval.

D. Stage 3a - BFP No. 2 Removal and Centrifuge No. 1 Installation: <u>Centrifuge No. 1 shall be fully operational within 6 weeks of removal of BFP No. 2.</u>
   1. Complete all Work possible to support and begin staging the installation of Centrifuge No. 1 prior to removing BFP No. 2.
   2. Remove BFP No. 2, its associated systems, containment dikes, curbs and concrete fill. Complete cored holes and floor repairs.
   3. Construct Platform serving Centrifuge Nos 1 and 2. Install Centrifuge No. 1.
   4. Provide Operator Training on new equipment.
   5. Complete all Work to make Centrifuge No. 1 fully operational. Start-up and successfully operate Centrifuge No. 1 continuously for one week (7 contiguous days) prior to proceeding with Stage 3b.

E. Stage 3b - Centrifuge No. 2 Installation: Complete all Work to make Centrifuge No. 2 fully operational. Start-up and successfully operate Centrifuge No. 2 continuously for one week (7 contiguous days) prior to proceeding with Stage 3b. Centrifuge No. 1 shall continue to operate successfully during this same period for successful completion of Stage 3b.

F. Stage 4 – Centrifuge No. 3 Installation

1. Assist City Rental BFP agent in disconnecting piping and power to the skid, move the skid outside of Sludge Handling Building and load onto agent's truck. Agent will provide guidance on material handling.
2. Remove BFP No. 3 and associated systems. Containment dikes, curbs and concrete fill.
3. Complete all Work to make Centrifuge No. 3 fully operational. Start-up and successfully operate Centrifuge No. 3 continuously for one week (7 contiguous days) for successful completion of Stage 4.
4. Complete all other Work not previously completed.

1.5 TIE-INS

A. The CONTRACTOR shall perform tie-ins as necessary to complete the Work.

1.6 SHUTDOWNS

A. General:
   1. Terminology: A "shutdown" is when a portion of the normal operation of OWNER's facility, whether equipment, systems, conduit (including piping and ducting), has to be temporarily suspended or taken out of service to perform the Work.
   2. Work that may interrupt normal operations shall be accomplished at times convenient to OWNER unless otherwise indicated in the Contract Documents.
   3. Furnish at the Site, in close proximity to the shutdown and tie-in work areas, tools, materials, equipment, spare parts, both temporary and permanent, necessary to successfully perform the shutdown. Complete to the extent possible, prefabrication of piping and other assemblies prior to commencing the associated shutdown. Demonstrate to ENGINEER's satisfaction that CONTRACTOR has complied with such requirements before commencing the shutdown.
   4. If CONTRACTOR's operations cause an unscheduled interruption of OWNER's operations, immediately re-establish satisfactory operation for OWNER.
   5. Unscheduled shutdowns or interruptions of continued safe and satisfactory operation of OWNER's facilities that result in fines or penalties by authorities having jurisdiction shall be paid solely by CONTRACTOR if, in ENGINEER's opinion, CONTRACTOR did not comply with requirements of the Contract Documents, or was negligent in the Work, or did not exercise proper precautions in performing the Work and complying with applicable permits, Laws, and Regulations.
   6. Work requiring service interruptions for tie-ins shall be performed during scheduled shutdowns.
   7. Coordinate requirements for temporary, short-term shutdowns of smaller piping, conduits, equipment, and systems with ENGINEER and OWNER. Where necessary, obtain ENGINEER's interpretation or clarification before proceeding.

B. Shutdowns of Electrical Systems:
   1. Comply with Laws and Regulations, including the National Electric Code.
   2. CONTRACTOR shall lock out and tag circuit breakers and switches operated by OWNER and shall verify that affected cables and wires are de-energized to ground potential before shutdown Work is started.
   3. Upon completion of shutdown Work, remove the locks and tags and notify ENGINEER that facilities are available for use.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 GENERAL

A. In addition to requirements of this Section, comply with Section 01 73 29, Cutting and Patching, and Section 01 73 24, Connections to Existing Facilities, and other Contract Documents applicable to Work associated with shutdowns, tie-ins, temporary pumping (where applicable), and similar work.

+ + END OF SECTION + +

SECTION 01 14 19

USE OF SITE

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. This Section includes requirements for use of the Site during the Project, and includes requirements for use of existing facilities, as applicable.
   2. CONTRACTOR shall provide all labor, materials, equipment, tools, and incidentals shown, specified, and required to comply with restrictions on CONTRACTOR's use of the Site and other areas.
   3. Comply with requirements of the General Conditions, as may be modified by the Supplementary Conditions, regarding the CONTRACTOR's use of the Site and other areas.

1.2 USE OF PREMISES

A. Limit use of premises at the Site to work areas shown or indicated on the Drawings and as specified in this Section. Do not disturb portions of the Site beyond areas of the Work.
   1. Limits:
      a. Confine construction operations to the areas shown on the drawings.
      b. Confine storage of materials and equipment, and locations of temporary facilities to areas shown on the drawings.
   2. Access to Site, Access Roads, and Parking Areas: Refer to Section 01 55 13, Access Roads and Parking Areas.

B. Use of Existing Buildings and Structures: Obtain OWNER's written permission for each proposed use of existing buildings and structures.
   1. Use of Existing Utilities, Sanitary Facilities, and First-aid Facilities: Refer Section 01 51 05, Temporary Utilities.
   2. Use of Existing Elevators:
      a. CONTRACTOR may use OWNER's freight elevators as approved by owner for moving materials and equipment during construction. Elevators shall be available to OWNER at all times unless otherwise arranged with OWNER and ENGINEER. Do not load elevator beyond posted capacity.
   3 Use of Existing Hoisting Equipment and Access to Work Areas for Loading:
      a. CONTRACTOR may use OWNER's existing hoisting equipment as approved by OWNER.
      b. Hoisting equipment shall be available to OWNER at all times unless otherwise arranged with OWNER and ENGINEER. Do not load hoisting equipment beyond posted capacity.

C. Promptly repair damage to premises caused by construction operations. Upon completion of the Work, restore premises to specified condition; if condition is not specified, restore to pre-construction condition.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 21 00

ALLOWANCES

PART 1 – GENERAL

1.1 SCOPE

A. Scope:
   1. This Section includes administrative and procedural requirements governing the following types of allowances:
      a. Cash allowances.
      b. Contingency allowances.

B. Authorization of Allowances:
   1. Work that will be paid under an allowance will be authorized in OWNER's written instruction to CONTRACTOR using the form included with this Section or other written allowance authorization issued by OWNER.
   2. Do not perform Work under an allowance without written authorization of OWNER.

1.2 CASH ALLOWANCES

A. General:
   1. Cash allowances are stipulated amounts for anticipated purchase of materials, equipment, or services.
   2. In addition to this Section, refer to the General Conditions, as may be modified by the Supplementary Conditions; and individual Specification Sections for CONTRACTOR's costs to be covered by cash allowances, and CONTRACTOR's costs, including overhead and profit, to be included elsewhere in the Contract Price.

B. Timing:
   1. At earliest practical date after the Contract Times commence running, notify ENGINEER of date when final selection and purchase of each material, equipment, or service item described by a cash allowance must be completed to avoid delaying the Work.

C. Selection of Materials, Equipment or Services Included in Cash Allowance:
   1. Consult with ENGINEER in selecting Suppliers and obtain proposals for price and time from selected suppliers. Submit proposals to ENGINEER along with recommendations relevant to furnishing and installing products or providing services covered in the cash allowance.
   2. Purchase materials, equipment, or services from Suppliers selected by ENGINEER or OWNER.

D. Documentation:
   1. Proposals:
      a. Prior to selection of Supplier by ENGINEER, submit proposals from prospective suppliers as indicated in above.
      b. For each allowance, submit to ENGINEER a Change Proposal to adjust Contract Price for difference between specified cash allowance amount and actual cost. Prepare Change Proposals in accordance with the General Conditions and Supplementary Conditions and Section 01 26 00, Contract Modification Procedures, except that payment within limit of a cash allowance shall exclude cost of bond and insurance premiums.
   2. When applying for payment for materials or equipment furnished under a cash allowance, submit with the Application for Payment invoices or delivery slips as evidence of actual costs and quantities of materials or equipment furnished and used in fulfilling each cash allowance.

E. Prepare unused materials, or equipment furnished under a cash allowance, for storage by OWNER, when not economically practical to return for credit. Deliver to storage space at the Site designated by OWNER.

1.3 CONTINGENCY ALLOWANCE

A. Contingency allowances are stipulated amounts available as reserve for sole use by OWNER to cover unanticipated costs.

B. When authorization of Work under contingency allowance is contemplated by OWNER for a defined scope, submit Change Proposal to ENGINEER. Prepare Change Proposal in accordance with the General Conditions and Supplementary Conditions and Section 01 26 00, Contract Modification Procedures, except that payments within limit of contingency allowance shall exclude cost of bond and insurance premiums.

1.4 SCHEDULE OF ALLOWANCES

A. Cash Allowances:
   1. Section 40 61 13, Process Control Systems General Provisions: Include the lump sum price of $120,000 for I&C equipment, programming, and configuration services.

B. Contingency Allowances:
   1. Schedule of Contingency Allowances: Include the following allowances for use in accordance with OWNER's instructions:

Contract and Bid/Payment Item No.	Allowance Name	Include Contingency Allowance Amount Of
General Contract / Item No. 5	General Contingency	$100,000

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 ATTACHMENTS

A. The documents listed below, and attached following this Section's "End of Section" designation, are part of this Specification Section.
   1. Allowance Authorization Form (one page).

+ + END OF SECTION + +

ALLOWANCE AUTHORIZATION

Project: _____ Authorization Number: _____

_____ From: _____

To: _____ Date: _____

_____ Engineer Project No.: _____

Re: _____ Contract For: _____

You are authorized to perform the following item(s) of Work and to adjust the Contract allowance amount accordingly:

1. [*Allowance Title*] / [*Title of Change*]:

THIS IS NOT A CHANGE ORDER AND DOES NOT INCREASE OR DECREASE THE CONTRACT PRICE

Original Allowance	$ _____
Allowance Expenditures prior to this Authorization	$ _____
Allowance Balance prior to this Authorization	$ _____
Allowance will be decreased by this Authorization	$
New Allowance Balance	$

RECOMMENDED BY

ARCADIS U.S., Inc.
Engineer

By Date

OWNER APPROVAL

Owner

By Date

CONTRACTOR ACCEPTANCE

Contractor

By Date

☐ Attachments

Copies: ☐ Owner ☐ Contractor ☐ Consultants ☐ _____ ☐ _____ ☐ _____ ☐ File

SECTION 01 22 13

MEASUREMENT AND PAYMENT

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. The items listed starting with Article 1.5 of this Section refer to and are the same pay items listed in the Bid Form and constitute all pay items for completing the Work.
   2. No direct or separate payment will be made for providing miscellaneous temporary or accessory works, plant or facility services, CONTRACTOR's or ENGINEER's field offices, layout surveys, Project signs, sanitary requirements, testing, safety provisions and safety devices, submittals and record drawings, water supplies, power and fuel, maintenance of traffic, removal of waste, security, coordination with OWNER's operations, information technology (including hardware, software, and services) required during construction, bonds, insurance, or other requirements of the General Conditions, Supplementary Conditions, Division 01 Specifications, and other requirements of the Contract Documents.
   3. Compensation for all services, items, materials, and equipment shall be included in prices stipulated for the unit price pay items listed in this Section and included in the Contract.

B. Each unit price shall include an amount considered by CONTRACTOR to be adequate to cover CONTRACTOR's overhead and profit for each separately identified item.

1.2 ENGINEER'S ESTIMATE OF QUANTITIES

A. ENGINEER's estimated quantities for items of Unit Price Work, as included in the Contract, are approximate only and are included solely for purpose of comparing Bids and pricing. OWNER does not expressly or by implication agree that nature of materials encountered below the ground surface, or actual quantities of material encountered or required, will correspond with the quantities included in the Contract at the time of award and reserves right to increase or decrease quantities, and to eliminate quantities, as OWNER may deem necessary. Unless indicated otherwise in the Supplementary Conditions, CONTRACTOR or OWNER will not be entitled to adjustment in price of Unit Price Work items as a result of change in estimated quantity and agree to accept the unit prices accepted in the Bid as complete and total compensation for additions caused by changes or alterations in the Unit Price Work directed by OWNER.

1.3 ADJUSTMENT OF UNIT PRICES FOR INCREASE OR DECREASE OF ESTIMATED QUANTITIES

A. Increases or decreases in the quantity of an item of Unit Price Work will be determined by comparing total payable quantity of Unit Price Work with ENGINEER's estimated quantity indicated in the Contract Documents.

B. Provisions, if any, regarding adjustment of unit prices due to variations in actual quantities from the estimated quantities awarded with the Contract, are in the Supplementary Conditions.
   1. ENGINEER's review for possible unit price cost adjustment, when provision for such adjustment is indicated in the Supplementary Conditions, will be at a time ENGINEER deems reasonable and proper.
   2. Payment for Unit Price Work item that has an as-awarded computed total value of less than the percent (indicated in the Supplementary Conditions) of the sum of the as-awarded total Contract Price will be made at the unit price in the Contract, regardless of an increase or decrease in quantity.

1.4 RELATED PROVISIONS

A. Payments to CONTRACTOR: Refer to General Conditions, Supplementary Conditions, Agreement, and Section 01 29 76, Progress Payment Procedures.

B. Changes in Contract Price: Refer to General Conditions, Supplementary Conditions, and Section 01 26 00, Contract Modification Procedures.

C. Schedule of Values: Refer to General Conditions, Supplementary Conditions, and Section 01 29 73, Schedule of Values.

1.5 BID ITEMS

A. Item 1 – General and Mechanical Construction:
   1. Measurement and Payment: Lump sum payment for Item 1 will be full compensation for completing the Work, as shown or indicated under this Contract.

B. Item 2 – Structural Construction:
   1. Measurement and Payment: Lump sum payment for Item 2 will be full compensation for completing the Work, as shown or indicated under this Contract.

C. Item 3 – Heating and Ventilation:
   1. Measurement and Payment: Lump sum payment for Item 3 will be full compensation for completing the Work, as shown or indicated under this Contract.

D. Item 4 – Electrical and Instrumentation/Controls:
   1. Measurement and Payment: Lump sum payment for Item 4 will be full compensation for completing the Work, as shown or indicated under this Contract.

E. Item 5 Contingency Allowance:
   1. Measurement: Section 01 21 00, Allowances, includes a stipulated amount available as reserve for sole use by the OWNER to cover unanticipated costs.
   2. Payment: Payment for Work authorized under Item 5 will be full compensation for providing all Work authorized under the contingency allowance, complete as shown, indicated, or directed by the ENGINEER. Work authorized under the contingency allowance may be included in subsequent Application(s) for Payment, as applicable, following authorization of and performance of contingency allowance Work.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 25 00

SUBSTITUTION PROCEDURES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope: Section includes:
   1. Administrative and procedural requirements for selecting materials and equipment for the Project.
   2. Procedural requirements for substitutions of materials and equipment.
   3. Procedural requirements for substitute construction methods or procedures, when construction methods or procedures are specified.

B. A proposed substitute will not be accepted for review if:
   1. Approval would require changes in design concept or a substantial revision of the Contract Documents.
   2. Approval would delay completion of the Work or the work of other contractors.
   3. Substitution request is indicated or implied on a Shop Drawing or other submittal, or on a request for interpretation or clarification, and is not accompanied by CONTRACTOR's formal and complete request for substitution.

C. If proposed substitute is not approved, CONTRACTOR shall provide the specified materials, equipment, method, or procedure, as applicable.

D. Approval of a substitute does not relieve CONTRACTOR from requirement for submitting Shop Drawings and other submittals in accordance with the Contract Documents.

E. ENGINEER and OWNER have the right to rely upon the completeness and accuracy of the information included in CONTRACTOR's request for approval of a substitute, and CONTRACTOR accepts full responsibility for the completeness and accuracy thereof.

F. When approved substitute is defective or fail to perform in accordance with the Contract Documents, responsibility for remedying the defect or failure resides solely with CONTRACTOR and Supplier.

1.2 SUBSTITUTE MATERIALS AND EQUIPMENT

A. Requests for approval of substitute items of materials or equipment will be considered within a period of 60 days after the Effective Date of the Contract. After the end of specified period, substitution requests will be considered only in case of

unavailability of a specified item of material or equipment or other conditions beyond CONTRACTOR's control.

B. Procedure:
   1. Submit requests for substitution in accordance with requirements for furnishing submittals, as indicated in Section 01 33 00, Submittal Procedures.
   2. Submit separate request for each proposed substitute.
   3. Submit request for substitution using forms attached to this Section. Complete all information requested on each form, and enclose with the forms supplementary information as required. In addition to requirements of the General Conditions and information required on substitution request forms, include with each substitute request the following:
      a. Identification of the materials and equipment (as applicable), including manufacturer's name and address.
      b. Manufacturer's literature with description of the materials and equipment, performance and test data, and reference standards with which materials and equipment comply.
      c. Samples, when appropriate.
      d. Name and address of similar projects on which the materials and equipment were used, date of installation, and names and contact information (including telephone number) for the facility operations and maintenance manager.

1.3 SUBSTITUTE CONSTRUCTION METHODS OR PROCEDURES

A. The provisions of the General Conditions, as may be modified by the Supplementary Conditions, regarding substitute items of materials and equipment are hereby extended to apply to substitute construction methods or procedures.

B. Procedure:
   1. Submit requests for substitution in accordance with requirements for furnishing submittals, as indicated in Section 01 33 00, Submittal Procedures.
   2. Submit separate request for each proposed substitute.
   3. Submit request for substitution using forms attached to this Section. Complete all information requested on each form, and enclose with the forms supplementary information as required. In addition to requirements of the General Conditions and information required on substitution request forms, include with each substitute request the following:
      a. Detailed description of proposed method or procedure.
      b. Itemized comparison of the proposed substitution with the specified method or procedure.
      c. Drawings illustrating method or procedure.
      d. Other data required by ENGINEER to establish that proposed substitution is equivalent to specified method or procedure.

1.4 CONTRACTOR'S REPRESENTATIONS

A. In submitting request for substitution, CONTRACTOR represents that:
   1. CONTRACTOR has read and fully understands the provisions regarding substitutes as indicated in the General Conditions, as may be modified by the Supplementary Conditions.
   2. Substitution request is complete and includes all information required by the Contract Documents.
   3. CONTRACTOR certifications required by the General Conditions, as may be modified by the Supplementary Conditions, are valid and made with CONTRACTOR's full knowledge, information, and belief.
   4. CONTRACTOR will provide the same or better guarantees or warranties for proposed substitute as for the specified materials, equipment, methods, or procedures, as applicable.
   5. CONTRACTOR waives all Claims for additional costs or extension of time related to proposed substitute that subsequently may become apparent.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 ATTACHMENTS

A. The documents listed below, and attached following this Section's "End of Section" designation, are part of this Specification Section.
   1. Substitution Request Form (two pages).
   2. Product Substitution Checklist (one page).

+ + END OF SECTION + +

SUBSTITUTION REQUEST

Project: _____ Substitution Request Number: _____

_____ From: _____

To: _____ Date: _____

_____ Engineer Project. No._____

Re: _____ Contract For: _____

Specification Title: _____ Description: _____

Section: _____ Page: _____ Article/Paragraph: _____

Proposed Substitute: _____

Manufacturer: _____ Address: _____ Phone: _____

Trade Name: _____ Model No.: _____

Installer: _____ Address: _____ Phone: _____

History: ☐ New product ☐ 1 to 4 years old ☐ 5 to 10 years old ☐ More than 10 years old

Differences between proposed substitute and specified item: _____

_____

_____

☐ Point-by-point comparative data attached — REQUIRED BY THE CONTRACT DOCUMENTS

Reason for not providing specified item: _____

_____

Similar Installation:

Project: _____ Engineer: _____

Address: _____ Owner: _____

_____ Date Installed: _____

Proposed substitution affects other parts of Work: ☐ No ☐ Yes; explain _____

_____

Savings to Owner for accepting substitute: ($)
(attach detailed, itemized estimate)

_____ _____

Proposed substitute changes Contract Time: ☐ No ☐ Yes [Add] [Deduct] _____ days.
(clarify whether change is to Substantial Completion, Milestone, or time for readiness for final payment)

Supporting Data Attached: ☐ Drawings ☐ Product Data ☐ Samples ☐ Tests ☐ Reports ☐ _____

SUBSTITUTION REQUEST
(Continued)

☐ Substitute product, method, or procedure is subject to payment of licensing fee or royalty (check if "yes" and attach information)

☐ Substitute product, method, or procedure is patented or copyrighted (check if "yes" and attach information)

The undersigned certifies:

- Representations in the General Conditions and in Section 01 25 00, Substitution Procedures, regarding substitutions are valid.
- Same or better warranty and guarantee will be furnished for proposed substitution as for specified item.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed substitute will have no adverse effect on other trades and will not affect or delay Progress Schedule.
- Cost data as stated above is complete. Claims for additional costs or time related to accepted substitution which may subsequently become apparent are waived.
- Proposed substitute does not affect dimensions and functional clearances.
- Payment will be made for Engineer's review and changes, if any, to the design and Contract Documents, and construction costs caused by the substitute.
- Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Submitted by: _____

Signed by: _____

Firm: _____

Address: _____

_____

Telephone: _____

Attachments: ☐

ENGINEER'S REVIEW AND ACCEPTANCE (OR NON-ACCEPTANCE) WILL BE DOCUMENTED IN A FIELD ORDER OR CHANGE ORDER, AS APPROPRIATE. _____

Additional Comments: ☐ Contractor ☐ Subcontractor ☐ Supplier ☐ Manufacturer ☐ Engineer ☐ Other:

Adapted from CSI Form No. 13.0B, 2004 edition

PRODUCT SUBSTITUTION CHECKLIST

Date: _____ Re: _____

Engineer Proj No.: _____ Manufacturer's Project No.: _____

Filing No.: _____ Contract For: _____

Item Equivalence:

☐ Is the submitted item equivalent to the specified item? _____

☐ Does it serve the same function? _____

☐ Does it have the same dimensions? _____

☐ Does it have the same appearance? _____

☐ Will it last as long? _____

☐ Does it comply with the same codes, and standards and performance requirements? _____

☐ Has the item been used locally, and where are the projects? _____

_____

☐ Has a problem occurred with the item, and what was the remedy? _____

_____

Effect on the Project:

☐ Will the substitute affect other aspects of the construction? _____

☐ Are any details affected and are changes required? _____

☐ What is the cost of the changes? _____

☐ Who pays for the required changes? _____

☐ Are Contract Times affected? _____

_____

Effect on the Warranty:

☐ How does the proposed warranty differ from the specified warranty? _____

_____

☐ Does the manufacturer have a track record of standing behind the warranty? _____

_____

Adapted from CSI Form No. 20.3, 1998 edition

SECTION 01 26 00

CONTRACT MODIFICATION PROCEDURES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope.
   1. This Section expands upon provisions of the General Conditions, as may be modified by the Supplementary Conditions, and includes:
      a. Requests for interpretation.
      b. Written clarifications.
      c. Minor changes in the Work and Field Orders.
      d. Work Change Directives.
      e. Proposal Requests.
      f. Change Proposals.
      g. Change Orders.

B. Submit Contract modification documents to ENGINEER, addressed to the contact person and contact information indicated in Section 01 33 00, Submittal Procedures, and in accordance with Section 01 31 26, Electronic Communication Protocols.

C. Retain at CONTRACTOR's office and at the Site complete copy of each Contract modification document and related documents, and ENGINEER's response.

1.2 REQUESTS FOR INTERPRETATION

A. General.
   1. Transmit written requests for interpretation to ENGINEER. CONTRACTOR and OWNER may prepare and transmit requests for interpretation.
   2. Prepare and transmit request for interpretation to obtain clarifications or interpretations of the Contract Documents. Report conflicts, errors, ambiguities, and discrepancies in the Contract Documents by requesting an interpretation.
   3. Do not transmit request for interpretation when other form of communication is appropriate, such as CONTRACTOR's submittals, requests for approvals of substitutes, notices, ordinary correspondence, or other form of communication. Improperly prepared or inappropriate requests for interpretation will be returned without response or action by ENGINEER.
   4. Do not submit request for interpretation or clarification when:
      a. answer may be obtained by observations at the Site; or
      b. required information is clearly indicated in the Contract Documents; or

c. required information is included in industry standards referenced in the Contract Documents or Supplier's instructions that are consistent with the Contract Documents; or
d. are reasonably inferable from any of foregoing.

5. CONTRACTOR shall have sole financial responsibility for requests for interpretations or clarifications that are submitted late, out of sequence, or that are unnecessary.

B. Procedure.

1. Transmit requests for interpretation in accordance with Section 01 31 26, Electronic Communication Protocols, and requirements of this Section. Include with each request for interpretation a separate letter of transmittal.
2. ENGINEER will provide timely review of requests for interpretation. Allow sufficient time for review and response.
3. ENGINEER will maintain log of requests for interpretation. Upon request, copy of log will be transmitted to requestor.
4. ENGINEER's response to requests for interpretation will be transmitted in accordance with Section 01 31 26, Electronic Communication Protocols, and requirements of this Section. Each response to a request for interpretation will include a separate letter of transmittal.
5. ENGINEER's written response to each request for interpretation will be distributed to:
   a. CONTRACTOR.
   b. OWNER.
   c. ENGINEER.
   d. RESIDENT PROJECT REPRESENTATIVE
6. If ENGINEER requests additional information to make an interpretation, entity requesting the interpretation shall transmit the information requested within ten days, unless ENGINEER allows additional time, via correspondence referring to request for interpretation number.
7. Interpretations that One or Both Parties Believes Entails a Change to the Contract:
   a. If CONTRACTOR or OWNER believes that a change in the Contract Price or Contract Times or other change to the Contract is required as a result of ENGINEER's interpretation, so advise ENGINEER in writing before proceeding with the Work associated with the request for interpretation.
   b. If, after this initial communication, either OWNER or CONTRACTOR believes that change in Contract Price, Contract Times, both, or other relief with respect to the terms of the Contract is necessary, recourse shall be in accordance with the Contract Documents.

C. Preparation of Requests for Interpretation:

1. Prepare each request for interpretation on the "Request for Interpretation" form included with this Section, or other form acceptable to ENGINEER.

2. Number each request for interpretation as follows: Numbering system shall be the Contract number and designation followed by a hyphen and three-digit sequential number. Example: First request for interpretation on the general contract for project titled, "Contract A15" would be, "RFI No. A15-GC-001".
3. In space provided on form, describe the interpretation requested. Provide additional sheets as necessary. Include text and sketches as required in sufficient detail to describe the the need for an interpretation.
4. When applicable, request for interpretation shall include CONTRACTOR's recommended resolution.

1.3 WRITTEN CLARIFICATIONS

A. General:
1. Written clarifications, when required, will be initiated and issued by ENGINEER.
2. Written clarifications do not change the Contract Price or Contract Times, and do not alter the Contract Documents.
3. Written clarifications will be issued as correspondence or using clarification notice form, with additional information as required.

B. Procedure.
1. ENGINEER's written clarifications will be transmitted in accordance with Section 01 31 26, Electronic Communication Protocols, and requirements of this Section.
2. Each written clarification will be distributed to:
   a. CONTRACTOR.
   b. OWNER.
   c. Resident Project Representative (RPR).
   d. ENGINEER.
3. Written Clarifications that One or Both Parties Believes Entails a Change to the Contract:
   a. If CONTRACTOR or OWNER believes that a change in the Contract Price or Contract Times or other change to the Contract is required as a result of ENGINEER's written clarification, so advise ENGINEER in writing before proceeding with the Work associated with the written clarification.
   b. If, after this initial communication, either OWNER or CONTRACTOR believes that change in Contract Price, Contract Times, both, or other relief with respect to the terms of the Contract is necessary, recourse shall be in accordance with the Contract Documents.
4. If ENGINEER's written clarification is unclear, prepare and transmit a request for interpretation.

1.4 MINOR CHANGES IN THE WORK AND FIELD ORDERS

A. General:

1. Field Orders, when required, will be initiated and issued by ENGINEER.
2. Field Orders authorize minor variations in the Work but do not change the Contract Price or Contract Times.
3. Field Orders will be in the form of Engineers Joint Contract Documents Committee document EJCDC® C-942, "Field Order".
4. ENGINEER will maintain a log of Field Orders issued.

B. Procedure.
1. Field Orders will be transmitted in accordance with Section 01 31 26, Electronic Communication Protocols, and requirements of this Section. Each Field Order will include a separate letter of transmittal.
2. Each Field Order will be distributed to:
   a. CONTRACTOR.
   b. OWNER.
   c. ENGINEER.
   d. RESIDENT PROJECT REPRESENTATIVE
3. Field Orders that One or Both Parties Believes Entails a Change to the Contract Price or Contract Times:
   a. If CONTRACTOR or OWNER believes that a change in the Contract Price or Contract Times or other change to the Contract is required as a result of a Field Order, so advise ENGINEER in writing before proceeding with the Work associated with the Field Order.
   b. If, after this initial communication, CONTRACTOR believes that change in Contract Price, Contract Times, both, or other relief with respect to the terms of the Contract is necessary, recourse shall be in accordance with the Contract Documents.
4. If the Field Order is unclear, submit request for interpretation.

1.5 WORK CHANGE DIRECTIVES

A. General:
1. Work Change Directives, when required, order additions, deletions, or revisions to the Work.
2. Work Change Directives do not change the Contract Price or Contract Times but are evidence that the parties to the Contract expect that the change ordered or documented by the Work Change Directive will be incorporated in subsequently issued Change Order following agreement by the parties as to the Work Change Directive's effect, if any, on the Contract Price or Contract Times.
3. Work Change Directives will be in the form of EJCDC® C-940, "Work Change Directive".

B. Procedure.
1. Work Change Directives signed by OWNER and ENGINEER will be transmitted in accordance with Section 01 31 26, Electronic Communication

Protocols, and requirements of this Section. Each Work Change Directive will include a separate letter of transmittal. CONTRACTOR shall print three originals of Work Change Directive for CONTRACTOR's signature.

2. CONTRACTOR shall promptly sign each original Work Change Directive and, within five days of receipt, return all originals to ENGINEER.
3. Original, signed Work Change Directives will be distributed as follows:
   a. CONTRACTOR: One original.
   b. OWNER: One original.
   c. ENGINEER: One original.
4. One copy of each Work Change Directive will be distributed to:
   d. RESIDENT PROJECT REPRESENTATIVE
5. Documentation of Costs:
   a. When basis of payment for Work ordered under a Work Change Directive will be paid as Cost of the Work, or when otherwise required by ENGINEER, document for the Work performed under each separate Work Change Directive, for each day, the following:
      1) Number and labor classifications of workers employed and hours worked.
      2) Construction equipment used including manufacturer, model, and year of manufacture, and number of hours such equipment was onsite and used for the Work under the Work Change Directive.
      3) Consumables and similar materials used.
      4) Receipts, bills, or invoices for and descriptions of materials and equipment incorporated into the Work.
      5) Invoices and labor and equipment breakdowns for Subcontractors and Suppliers.
      6) Other information required by OWNER or ENGINEER,
   b. Submit such information in a format acceptable to ENGINEER.
   c. Transmit such documentation to ENGINEER as a Change Proposal.

1.6 PROPOSAL REQUESTS

A. General:
   1. Proposal Requests may be initiated by ENGINEER or OWNER.
   2. Proposal Requests are for requesting the effect on the Contract Price and the Contract Times and other information relative to contemplated changes in the Work. Proposal Requests do not authorize changes or variations in the Work, and do not change the Contract Price or Contract Times or terms of the Contract.
   3. Proposal Requests will be furnished using the "Proposal Request" form included with this Section.

B. Procedure.
   1. Proposal Requests will be transmitted in accordance with Section 01 31 26, Electronic Communication Protocols, and requirements of this Section. Each Proposal Requests will include a separate letter of transmittal.

2. Each signed Proposal Request will be transmitted to:
    a. CONTRACTOR.
    b. OWNER.
    c. ENGINEER.
    d. RESIDENT PROJECT REPRESENTATIVE
3. Transmit request for interpretation to clarify conflicts, errors, ambiguities, and discrepancies in Proposal Request.
4. Upon receipt of Proposal Request, CONTRACTOR shall prepare and transmit to ENGINEER a Change Proposal, in accordance with the Contract Documents, for the proposed Work described in the Proposal Request.

1.7 CHANGE PROPOSALS

A. General.
1. Prepare and transmit written Change Proposal to ENGINEER in response to each Proposal Request; or when CONTRACTOR believes a change in the Contract Price or Contract Times or other change to the terms of the Contract is required; or to appeal an initial decision by ENGINEER concerning the requirements of the Contract Documents or relating to the acceptability of the Work under the Contract Documents; contest a set-off against payment due; or seek other relief under the Contract.

B. Procedure.
1. Prepare and transmit Change Proposals within time limits indicated in the General Conditions, as may be modified by the Supplementary Conditions.
2. Transmit Change Proposals in accordance with Section 01 31 26, Electronic Communication Protocols, and requirements of this Section. Include with each Change Proposal all required supporting documentation and a separate letter of transmittal.
3. ENGINEER's Review and Requests for Additional Information:
    a. ENGINEER will review and act on each Change Proposal in accordance with, and within the time limits indicated in, the General Conditions, as may be modified by the Supplementary Conditions.
    b. When, ENGINEER requests additional information to render a decision, submit required information within five days of receipt of ENGINEER's request, unless ENGINEER allows more time. Submit the required information via correspondence that refers to the specific Change Proposal number.
    c. OWNER shall transmit to ENGINEER such comments, if any, that OWNER has on the Change Proposal, within 10 days of OWNER's receipt of the Change Proposal.
    d. ENGINEER will render a written decision on the Change Proposal.
    e. ENGINEER's response to Change Proposals will be transmitted in accordance with Section 01 31 26, Electronic Communication Protocols, and requirements of this Section, the General Conditions, and the Supplementary Conditions.

4. ENGINEER's response to each Change Proposal will be distributed to:
    a. CONTRACTOR.
    b. OWNER.
    c. ENGINEER.
5. If Change Proposal is recommended for approval by ENGINEER and is approved by OWNER, a Change Order will be issued or, when applicable, an appropriate use of contingency allowance will be authorized by OWNER.
6. If parties do not agree on terms for the change, OWNER or CONTRACTOR may file a Claim against the other, in accordance with the General Conditions, as may be modified by the Supplementary Conditions.

C. Preparation of Change Proposals:
1. Each Change Proposal shall be submitted on the "Change Proposal" form included with this Section, or other form acceptable to ENGINEER.
2. Number each Change Proposal as follows: Numbering system shall be the Contract number and designation followed by a hyphen and three-digit sequential number. Example: First Change Proposal for the general contract for project named "Contract A15" would be, " Change Proposal No. A15-GC-001".
3. In space provided on Change Proposal form:
    a. Describe scope of each proposed change. Include text and sketches on additional sheets as required to provide detail sufficient for ENGINEER's review and response. If a change item is submitted in response to Proposal Request, write in as scope, "In accordance with Proposal Request No." followed by the Proposal Request number. Submit written clarifications, if any, to scope of change.
    b. Submit justification for each proposed change. If change is in response to proposal request, write in as justification, "In accordance with Proposal Request No." followed by the proposal request number.
    c. List the total change in the Contract Price and Contract Times for each separate change item included in the Change Proposal.
4. Unless otherwise directed by ENGINEER, attach to the Change Proposal detailed breakdowns of pricing (Cost of the Work and CONTRACTOR's fee) including:
    a. List of Work tasks to accomplish the change.
    b. For each task, labor cost breakdown including labor classification, total hours per labor classification, and hourly cost rate for each labor classification.
    c. Construction equipment and machinery to be used, including manufacturer, model, and year of manufacture, and number of hours for each.
    d. Detailed breakdown of cost of materials and equipment to be incorporated into the Work, including quantities, unit costs, and total cost, with Supplier's written quotations.
    e. Breakdowns of the Cost of the Work and fee for Subcontractors, including labor, construction equipment and machinery, and materials

and equipment incorporated into the Work, other costs, and Subcontractor fees (e.g., overhead and profit).

f. Breakdown of other costs eligible, in accordance with the General Conditions and the Supplementary Conditions under "Cost of the Work" provisions.

g. Other information required by ENGINEER.

h. CONTRACTOR's fees applied to eligible CONTRACTOR costs and eligible Subcontractor costs.

1.8 CHANGE ORDERS

A. General:

1. Change Orders will be recommended by ENGINEER (when required by the General Conditions), and will be signed by OWNER and CONTRACTOR, to authorize additions, deletions, or revisions to the Work, or changes to the Contract Price or Contract Times.
2. Change Orders will be in the form of EJCDC® C-941, "Change Order".

B. Procedure.

1. Change Orders for signature by CONTRACTOR will be transmitted in accordance with Section 01 31 26, Electronic Communication Protocols, and requirements of this Section. Each Change Order will include a separate letter of transmittal. CONTRACTOR shall print three originals of Change Order for CONTRACTOR's signature.
2. CONTRACTOR shall promptly sign each original Change Order and, within five days of receipt, return all originals to ENGINEER.
3. ENGINEER will sign each original Change Order and forward them to OWNER.
4. After approval and signature by OWNER, original Change Orders will be distributed as indicated below.
5. Original, signed Change Orders will be distributed as follows:
   a. CONTRACTOR: One original.
   b. OWNER: One original.
   c. ENGINEER: One original.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 ATTACHMENTS

A. The forms listed below, following this Section's "End of Section" designation, are part of this Specifications Section:
   1. Request for Interpretation form (one page).
   2. Proposal Request form (one page).
   3. Change Proposal form (one page).

+ + END OF SECTION + +

REQUEST FOR INTERPRETATION

Owner: _____

Project Name: _____

Contractor: _____ RFI No. _____

Date Transmitted: _____ Date Received: _____

Date Response Requested: _____ Date Response Transmitted: _____

Subject: _____

Specification Section and Paragraph: _____

_____

Drawing References: _____

INTERPRETATION REQUESTED:

Signature: _____ Date: _____

ENGINEER'S RESPONSE:

Signature: _____ Date: _____

PROPOSAL REQUEST

Owner: _____
Project Name: _____

Proposal Request No.: _____ Date: _____

Contract Name and No.: _____

Contractor: _____

Other Contracts Involved in Proposed Change: _____
_____

TO CONTRACTOR: Please submit a complete Change Proposal for the proposed modifications described below. If the associated Change Proposal is approved, a Change Order or allowance authorization will be issued to authorize adjustment so the scope of the Work. This Proposal Request is not a Change Order, Work Change Directive, Field Order, or an authorization to proceed with the proposed Work described below.

SCOPE OF PROPOSED WORK:

1. *Item*:
2. *Item*:
3. *Item*:

Proposal requested by: _____

Signature of Requestor: _____

CHANGE PROPOSAL

Owner: _____
Project Name: _____

Change Proposal No.: _____ Date: _____

Submitted in Response to Proposal Request No.: _____

Contract Name and No.: _____
Contractor: _____

Subject: _____
_____

The following changes to the Contract are proposed:

SCOPE OF WORK: *(attach and list supporting information as required)*

1. *Item*:
2. *Item*:

JUSTIFICATION:

1. *Item*:
2. *Item*:

CHANGES IN CONTRACT PRICE AND CONTRACT TIMES:

We propose that the Contract Price and Contract Times be changed as follows:

For Contract Price, attach detailed cost breakdowns for Contractor and Subcontractors, Supplier quotations, and other information required.

For the Contract Times, state increase, decrease, or no change to Contract Times for Substantial Completion, readiness for final payment, and Milestones, if any. If increase or decrease, state specific number of days for changes to the Contract Times.

Description	Amount	Contract Times (days)	
		Substantial	Final
1. Item	$0.00	0	0
2. Item	$0.00	0	0
Total This Change Proposal	**$0.00**	**0**	**0**

Changes to Milestones, if any: _____

Contractor represents that supporting data attached to this Change Proposal are accurate and complete. The requested time or price adjustment indicated in this Change Proposal is the entire adjustment to which Contractor believes it is entitled as a result of the proposed change(s) indicated herein.

Change Proposal by: _____

Signature of Proposer:_____

SECTION 01 29 73

SCHEDULE OF VALUES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall prepare and submit to ENGINEER for acceptance a Schedule of Values that allocates cost to each item of the Work. Schedule of Value list of line items shall correspond to each aspect of the Work, establishing in detail the portion of the Contract Price allocated to each major component of the Work.
   2. Upon request of ENGINEER, support values with data that substantiate their correctness.
   3. Submit preliminary Schedule of Values to ENGINEER for initial review. CONTRACTOR shall incorporate ENGINEER's comments into the Schedule of Values and resubmit to ENGINEER. ENGINEER may require corrections and re-submittals until Schedule of Values is acceptable.
   4. Schedule of Values may be used as a basis for negotiating price of changes, if any, in the Work.
   5. Schedule of Values and the Progress Schedule updates specified in Section 01 32 16, Progress Schedule, will be basis for preparing each Application for Payment.

1.2 SUBMITTALS

A. Informational Submittals: Submit the following:
   1. Submit to ENGINEER Schedule of Values in the form and quantity required in Section 01 33 00, Submittal Procedures, and in accordance with Section 01 31 26, Electronic Communication Protocols.
   2. Content of Schedule of Values submittals shall be in accordance with Article 1.3 of this Section.
   3. Timing of Submittals:
      a. Submit preliminary Schedule of Values within time limit indicated in the General Conditions.
      b. Submittal of the Schedule of Values for acceptance by ENGINEER shall be in accordance with the General Conditions. ENGINEER will not accept Applications for Payment without an acceptable Schedule of Values.
      c. When required by ENGINEER, promptly submit updated Schedule of Values to include cost breakdowns for changes in the Contract Price.

1.3 SCHEDULE OF VALUES FORMAT AND CONTENT

A. Organization and Major Elements of Schedule of Values
   1. Prepare Schedule of Values on the "progress estimate" or "continuation sheets", as applicable, of the Application for Payment form indicated in Section 01 29 76, Progress Payment Procedures.
   2. Organization in Accordance with Specification Sections:
      a. Within each work area, organize the Schedule of Values by the various Specifications Section numbers and titles included in the Contract Documents.
      b. Label each row in the Schedule of Values with the appropriate Specifications Section number. Include an amount for each row in the Schedule of Values.
      c. List sub-items of major products or systems, as appropriate or when requested by ENGINEER.
   3. Include in Schedule of Values unit price payment items with their associated quantity. Provide in the Schedule of Values detailed breakdown of unit prices when required by ENGINEER.

B. Requirements for preliminary Schedule of Values and Schedule of Values are:
   1. Subcontracted Work:
      a. Schedule of Values shall show division of Work between CONTRACTOR and Subcontractors.
      b. Line items for Work to be done by Subcontractor shall include the word, "(SUBCONTRACTED)".
   2. Apportionment between Materials and Equipment, and Installation:
      a. Schedule of Values shall include breakdown of costs for materials and equipment, installation, and other costs used in preparing the Bid by CONTRACTOR and each Subcontractor.
      b. List purchase and delivery costs for materials and equipment for which CONTRACTOR may apply for payment as stored materials.
   3. Sum of individual values shown on the Schedule of Values shall equal the total of associated payment item. Sum of payment item totals in the Schedule of Values shall equal the Contract Price.
   4. Overhead and Profit: Include in each line item a directly proportional amount of CONTRACTOR's overhead and profit. Do not include overhead and profit as separate item(s).
   5. Include separate line item for each allowance, and for each unit price item.
   6. Include a line item for bonds and Insurance Costs, in amount not exceeding 2.0 percent of the Contract Price. This amount may be applied for in the first Application for Payment.
   7. Include relevant items for the General Conditions, permits (when applicable), construction Progress Schedule, and other items required by ENGINEER. Include such items in Applications for Payment on payment schedule acceptable to ENGINEER

8. Line items for Site maintenance such as dust control, snow removal, compliance with storm water pollution prevention plans and permits, spill prevention control and countermeasures plans, and for construction photographic documentation; temporary utilities and temporary facilities, field offices, temporary controls, field engineering, and similar Work shall be included in the Schedule of Values and proportioned in Applications for Payment throughout duration of the Work.
9. Mobilization and Demobilization:
    a. Include separate line items under each appropriate payment item for mobilization and demobilization. Document for ENGINEER the activities included in mobilization and demobilization line items.
    b. Mobilization will be limited to 2 percent of the Contract Price, and will be paid in 2 payments, each of 50 percent of total amount for mobilization.
    c. Demobilization shall be not less than one percent of the Contract Price and shall be included with the Application for Payment following Substantial Completion, or other schedule acceptable to ENGINEER.
10. Costs for Shop Drawings, Samples, and other submittals; operations and maintenance manuals; field testing; and training of operations and maintenance personnel shall be as follows, unless otherwise accepted by ENGINEER:
    a. Up to eight percent of cost (including all associated overhead and profit) of each equipment item, exclusive of transportation and installation costs associated with that item, may be allocated to preparation of Shop Drawings, Samples ,and other submittals and may be included in the Application for Payment following ENGINEER's approval of Shop Drawings (and acceptance of other submittals, as applicable) required for fabricating or purchasing for that item for the Work.
    b. Up to three percent of total cost of each item (including all associated overhead and profit), including materials and equipment, and installation, may be apportioned to testing and included in the Application for Payment following ENGINEER's acceptance of the associated written field testing report(s).
    c. Up to a total of four percent of equipment cost (including all associated overhead and profit), exclusive of transportation and installation costs, may be apportioned to operations and maintenance manuals and training of operations and maintenance personnel, which may be included in the Application for Payment following completion of training for that item.
11. Project Record Documents:
    a. Include in the Schedule of Values a line item with appropriate value for Project record documents.
    b. If adequate record documents are maintained, up to 50 percent of the value of the record documents line item will be eligible for payment, spread evenly over those progress payments in which construction at the Site is performed.
    c. Remainder of Project record documents line item will be eligible for payment when complete record documents are submitted in accordance

with the Contract Documents. If record documents submitted are unsatisfactory to ENGINEER, amount may be reduced via set-offs in accordance with the Contract Documents.

12. Schedule of Values shall include an itemized list of Work by work area, as applicable, for Work included in Section 01 14 16, Coordination with Owner's Operations.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 29 76

PROGRESS PAYMENT PROCEDURES

PART 1 – GENERAL

1.1 PROGRESS PAYMENTS

A. Scope:
   1. CONTRACTOR's requests for payment shall be in accordance with the Agreement, General Conditions and Supplementary Conditions, and the Specifications.
   2. Form: Applications for Payment shall be in the form of Engineers Joint Contract Documents Committee (EJCDC) document EJCDC® C-620, "Contractor's Application for Payment", 2013 edition or later.

B. Procedure:
   1. Review with Resident Project Representative (RPR) quantities and the Work proposed for inclusion in each progress payment. Application for Payment shall cover only the Work and quantities recommended by the RPR.
   2. Submit to ENGINEER four printed originals, each with CONTRACTOR's original, "wet" signature, of each complete Application for Payment and other documents to accompany the Application for Payment.
   3. ENGINEER will act on request for payment in accordance with the General Conditions and Supplementary Conditions.

C. Each request for progress payment shall include:
   1. Completed Application for Payment form, including summary/signature page, progress estimate sheets, and stored materials summary. Progress estimate sheets shall have the same level of detail as the Schedule of Values.
   2. Documentation for Stored Materials and Equipment:
      a. For materials and equipment not incorporated in the Work but suitably stored, submit documentation in accordance with the General Conditions and Supplementary Conditions.
      b. Legibly indicate on invoice or bill of sale the specific materials or equipment included in the payment request and corresponding bid/payment item number for each.
   3. For Payment on the Basis of Cost of the Work.
      a. When Work included in an Application for Payment will be compensated on the basis of Cost of the Work, whether when the entire Contract is compensated on the basis of Cost of the Work or when the Application for Payment includes Change Order Work to be compensated on the basis of Cost of the Work, the Application for Payment shall include documentation of the costs, including not less than the following:
         1) Number and labor classifications of workers employed and hours worked.

2) Construction equipment used including manufacturer, model, and year of manufacture, and number of hours such equipment was onsite and used for the Work compensated on the basis of Cost of the Work.
3) Consumables and similar materials used.
4) Receipts, bills, or invoices for and descriptions of materials and equipment incorporated into the Work.
5) Invoices and labor and equipment breakdowns for Subcontractors and Suppliers.
6) Invoices for other expenses included in the Application for Payment, such as travel and subsistence expenses, costs for bonds and insurance, and all other costs and expenses for which compensation is sought in the subject Application for Payment on the basis of Cost of the Work.
7) Other information required by OWNER or ENGINEER,

b. Costs for which progress payment is requested on the basis of Cost of the Work and for which documentation acceptable to ENINEER is not submitted will not be eligible for payment.

5. Listing of Subcontractors and Suppliers:
   a. In accordance with the General Conditions, submit not less than monthly updated listing of all Subcontractors and Suppliers known to CONTRACTOR, whether or not such entities have a contract directly with CONTRACTOR.
   b. Submit complete information using the form attached to this Section.
6. Allowance Work:
   a. For payment requests that include payment for Work under an allowance, include with the progress payment request copy of OWNER's authorization of the associated allowance Work, in accordance with Section 01 21 00, Allowances.
7. Partial Release or Reduction of Retainage:
   a. For each Application for Payment where CONTRACTOR requests partial release or reduction of retainage in any amount (other than request for final payment), submit with associated progress payment request consent of surety to partial release or reduction of retainage, duly completed by CONTRACTOR and surety.
   b. Acceptable form includes AIA® G707A™, "Consent of Surety to Reduction in or Partial Release of Retainage", 1994 or later edition, or other form acceptable to OWNER.
   c. For payment requests that include reduction in or payment of retainage in an amount greater than that required by the Contract Documents, obtain OWNER's concurrence for partial release or reduction in retainage prior to submitting such Application for Payment.

D. Final Payment:
   1. Requirements for request for final payment are in the General Conditions, as may be modified by the Supplementary Conditions, and Section 01 77 19, Closeout Requirements.

1.2 PAYMENT FOR STORED MATERIALS AND EQUIPMENT

A. Restrictions:
   1. Provisions of the General Conditions, as may be modified by the Supplementary Conditions, notwithstanding, only the following items of materials and equipment will be eligible for payment when suitably stored, prior to incorporation into the Work:
      a. Centrifuges

B. Observation of Stored Materials and Equipment Prior to Application for Payment:
   1. General:
      a. Prior to materials or equipment suitably stored but not yet incorporated into the Work can be eligible for payment, ENGINEER or Resident Project Representative (RPR) shall visit the storage location and verify the extent, condition, and storage environment of the stored items.
      b. When the same material or equipment item is stored for more than two months, such visits to storage location shall be not less than once every two months.
   2. Cost Responsibility for Observations:
      a. When storage location is less than 20 miles from the Site or less than 20 miles from ENGINEER's office, CONTRACTOR is not responsible for reimbursing OWNER for cost of ENGINEER's time and expenses for observing stored materials and equipment.
      b. When storage location is more than 20 miles from the Site and more than 20 miles from ENGINEER's office, CONTRACTOR shall reimburse OWNER, via a set-off under the Contract Documents, for cost of ENGINEER's time and expenses, including travel time, to visit the storage location and observe the stored materials and equipment.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 ATTACHMENTS

A. The forms listed below, following this Section's "End of Section" designation, are part of this Specification Section:
   1. EJCDC document C-620, "Contractor's Application for Payment" (four pages).
   2. List of Subcontractors and Suppliers form (two pages).

+ + END OF SECTION + +

LIST OF SUBCONTRACTORS AND SUPPLIERS

Owner: _____
Project Name: _____

Contractor: _____ Date: _____
Contract Designation: _____

Indicate below complete information for each Subcontractor and Supplier known to Contractor, regardless of whether the firm has a direct contract with Contractor. Include all lower-tier Subcontractors and associated Suppliers. Copy and paste the paragraphs below as required to indicate all Subcontractors and Suppliers.

SUBCONTRACTORS

1. **Subcontractor Name**:
   - *Address*:
   - *Contact Person*:
   - *Telephone No.*:
   - *E-mail Address*:
   - *Work Under Specifications Section Nos.*:
   - *Brief Description of Work*:
   - *Current Subcontract Price*:
   - *Approximate Subcontract Start Date*:
   - *Approximate Subcontract End Date*:

2. **Subcontractor Name**:
   - *Address*:
   - *Contact Person*:
   - *Telephone No.*:
   - *E-mail Address*:
   - *Work Under Specifications Section Nos.*:
   - *Brief Description of Work*:
   - *Current Subcontract Price*:
   - *Approximate Subcontract Start Date*:
   - *Approximate Subcontract End Date*:

3. **Subcontractor Name**:
   - *Address*:
   - *Contact Person*:
   - *Telephone No.*:
   - *E-mail Address*:
   - *Work Under Specifications Section Nos.*:
   - *Brief Description of Work*:
   - *Current Subcontract Price*:
   - *Approximate Subcontract Start Date*:
   - *Approximate Subcontract End Date*:

Total of Subcontract Prices for all subcontracts equals approximately ___ percent of the Contract Price *(Contractor to fill in blank monthly)*

SUPPLIERS

1. **Supplier Name**:
   - *Address*:
   - *Contact Person*:
   - *Telephone No.*:
   - *E-mail Address*:
   - *Furnishing Items Under Specifications Section Nos.*:
   - *Brief Description of Items*:
   - *Current Purchase Order Amount*:
   - *Approximate Purchase Order Date*:
   - *Approximate Purchase Order End Date*:

2. **Supplier Name**:
   - *Address*:
   - *Contact Person*:
   - *Telephone No.*:
   - *E-mail Address*:
   - *Furnishing Items Under Specifications Section Nos.*:
   - *Brief Description of Items*:
   - *Current Purchase Order Amount*:
   - *Approximate Purchase Order Date*:
   - *Approximate Purchase Order End Date*:

3. **Supplier Name**:
   - *Address*:
   - *Contact Person*:
   - *Telephone No.*:
   - *E-mail Address*:
   - *Furnishing Items Under Specifications Section Nos.*:
   - *Brief Description of Items*:
   - *Current Purchase Order Amount*:
   - *Approximate Purchase Order Date*:
   - *Approximate Purchase Order End Date*:

EJCDC
ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

Contractor's Application for Payment No.

	Application Period:	Application Date:
To (Owner):	From (Contractor):	Via (Engineer):
Project:	Contract:	
Owner's Contract No.:	Contractor's Project No.:	Engineer's Project No.:

Application For Payment

Change Order Summary

Approved Change Orders		
Number	Additions	Deductions
TOTALS		
NET CHANGE BY CHANGE ORDERS		

1. ORIGINAL CONTRACT PRICE	**$**
2. Net change by Change Orders	**$**
3. Current Contract Price (Line 1 ± 2)	**$**
4. TOTAL COMPLETED AND STORED TO DATE (Column F on Progress Estimate)	**$**
5. RETAINAGE:	
a. X _____ Work Completed	**$**
b. X _____ Stored Material	**$**
c. Total Retainage (Line 5a + Line 5b)	**$**
6. AMOUNT ELIGIBLE TO DATE (Line 4 - Line 5c)	**$**
7. LESS PREVIOUS PAYMENTS (Line 6 from prior Application)	**$**
8. AMOUNT DUE THIS APPLICATION	**$**
9. BALANCE TO FINISH, PLUS RETAINAGE (Column G on Progress Estimate + Line 5 above)	**$**

Contractor's Certification

The undersigned Contractor certifies that to the best of its knowledge: (1) all previous progress payments received from Owner on account of Work done under the Contract have been applied on account to discharge Contractor's legitimate obligations incurred in connection with Work covered by prior Applications for Payment; (2) title of all Work, materials and equipment incorporated in said Work or otherwise listed in or covered by this Application for Payment will pass to Owner at time of payment free and clear of all Liens, security interests and encumbrances (except such as are covered by a Bond acceptable to Owner indemnifying Owner against any such Liens, security interest or encumbrances); and (3) all Work covered by this Application for Payment is in accordance with the Contract Documents and is not defective.

By:	Date:

Payment of: $ _____
(Line 8 or other - attach explanation of the other amount)

is recommended by: _____ _____
(Engineer) (Date)

Payment of: $ _____
(Line 8 or other - attach explanation of the other amount)

is approved by: _____ _____
(Owner) (Date)

Approved by: _____ _____
Funding Agency (if applicable) (Date)

Progress Estimate - Lump Sum Work

Contractor's Application

For (Contract):	Application Number:
Application Period:	Application Date:

			Work Completed		E	F		G
A		B	C	D				
Specification Section No.	Description	Scheduled Value ($)	From Previous Application (C+D)	This Period	Materials Presently Stored (not in C or D)	Total Completed and Stored to Date (C + D + E)	% (F / B)	Balance to Finish (B - F)
	Totals							

Progress Estimate - Unit Price Work

Contractor's Application

For (Contract):							Application Number:			
Application Period:							Application Date:			
A				B	C	D	E	F		G
Item		Bid Item Quantity	Unit Price	Bid Item Value ($)	Estimated Quantity Installed	Value of Work Installed to Date	Materials Presently Stored (not in C)	Total Completed and Stored to Date (D + E)	% (F / B)	Balance to Finish (B - F)
Bid Item No.	Description									
	Totals									

Stored Material Summary

Contractor's Application

For (Contract):								Application Number:			
Application Period:								Application Date:			
A		B	C		D		E		F		G
Bid Item No.	Supplier Invoice No.	Submittal No. (with Specification Section No.)	Storage Location	Description of Materials or Equipment Stored	Stored Previously		Amount Stored this Month ($)	Subtotal Amount Completed and Stored to Date (D + E)	Incorporated in Work		Materials Remaining in Storage ($) (D + E - F)
					Date Placed into Storage (Month/Year)	Amount ($)			Date (Month/ Year)	Amount ($)	
				Totals							

SECTION 01 31 13

PROJECT COORDINATION

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall coordinate the Work, including testing agencies whether hired by CONTRACTOR, OWNER, or others; Subcontractors, Suppliers, and others with whom coordination is necessary, in accordance with the General Conditions, Supplementary Conditions, and this Section, to perform the Work within the Contract Times and in accordance with the Contract Documents.

B. Coordination:
   1. In accordance with the General Conditions as may be modified by the Supplementary Conditions, CONTRACTOR shall cooperate with and coordinate the Work with other contractors, utility owners, utility service companies, OWNER's and facility manager's employees working at the Site, and other entities working at the Site, in accordance with Section 01 11 13, Summary of Work.
   2. CONTRACTOR will not be responsible or liable for damage unless damage is through negligence of CONTRACTOR, or Subcontractors, Supplier, or other entity employed by CONTRACTOR.
   3. Attend and participate in all project coordination and progress meetings, and report on the progress of the Work and compliance with the Progress Schedule.

C. Layout and Coordination Drawings:
   1. Maintain sufficient competent personnel, drafting and computer-aided drafting/design (CADD) equipment, software, systems, and supplies at the Site for preparing layout drawings, coordination drawings, and record documents.
   2. With the Contract Documents and Shop Drawings, use such coordination drawings as tools for coordinating the Work of various trades.
   3. Where such coordination drawings are to be prepared by mechanical, electrical, plumbing, or heating-ventilating-air conditioning Subcontractors and other Subcontractors, ensure that each Subcontractor maintains required personnel and facilities at the Site.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 31 19.13

PRE-CONSTRUCTION CONFERENCE

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. A pre-construction conference will be held for the Project.
   2. CONTRACTOR shall attend the conference prepared to discuss all items on the pre-construction conference agenda.
   3. ENGINEER will distribute an agenda, preside at conference, and prepare and distribute minutes to all conference participants and others as requested.

B. Purpose of Pre-construction Conference:
   1. Purpose of conference is to designate responsible personnel, establish working relationships, discuss preliminary schedules submitted by CONTRACTOR, and review administrative and procedural requirements for the Project.
   2. Matters requiring coordination will be discussed and procedures for handling such matters will be established.
   3. Unless otherwise indicated in the Contract Documents or otherwise agreed to by the entities involved, Site mobilization meeting will be part of the pre-construction conference.

1.2 PREPARATION FOR PRE-CONSTRUCTION CONFERENCE

A. Date, Time, and Location:
   1. Conference will be held after execution of the Contract and before Work starts at the Site.
   2. ENGINEER will establish the date, time, and location of conference and notify the interested and involved entities.

B. Submittals Required Prior to Pre-construction Conference:
   1. Not less than three days prior to pre-construction conference, submit the following preliminary schedules in accordance with the General Conditions and other requirements of the Contract Documents:
      a. Preliminary Progress Schedule.
      b. Preliminary Schedule of Submittals.
      c. Preliminary Schedule of Values.
      d. Listing of identity and general scope of Work or supply (as applicable) of planned Subcontractors and Suppliers. Indicate extent of each Subcontract proposed and overall percentage of Contract Price to be subcontracted.

C. CONTRACTOR shall furnish information required and contribute appropriate items for discussion at the pre-construction conference.

D. Handouts for Pre-Construction Conference:
   1. CONTRACTOR shall bring to the conference the following, with sufficient number of copies for each attendee:
      a. Preliminary Progress Schedule, as submitted to ENGINEER.
      b. Preliminary Schedule of Submittals, as submitted to ENGINEER.
      c. Preliminary Schedule of Values, as submitted to ENGINEER.
      d. Listing of identity and general scope of Work or supply of planned Subcontractors and Suppliers.
      e. List of emergency contact information, in accordance with Article 1.5 of Section 01 35 23, Safety Requirements.

1.3 REQUIRED ATTENDEES

A. Representative of each entity attending the conference shall be authorized to act on that entity's behalf.

B. Contractor Attendance: Conference shall be attended by CONTRACTOR's:
   1. Project manager.
   2. Site superintendent
   3. Project managers for major Subcontractors, and major equipment Suppliers as CONTRACTOR deems appropriate.

C. Other attendees will be representatives of:
   1. OWNER.
   2. ENGINEER.

1.4 AGENDA

A. Preliminary Agenda: Be prepared to discuss in detail the topics indicated below. Revisions, if any, to the agenda below will be furnished to required attendees prior to the pre-construction conference.
   1. Procedural and Administrative:
      a. Personnel and Teams:
         1) Designation of roles and personnel.
         2) Limitations of authority of personnel, including personnel who will sign Contract modifications and make binding decisions.
         3) Subcontractors and Suppliers in attendance.
         4) Authorities having jurisdiction.
      b. Procedures for communications and correspondence, including electronic communication protocols.
      c. Copies of the Contract Documents and availability.
      d. Subcontractors and Suppliers.

1) Lists of proposed Subcontractors and Suppliers.

e. The Work and Scheduling:
   1) General scope of the Work.
   2) Contract Times, including Milestones (if any).
   3) Phasing and sequencing.
   4) Preliminary Progress Schedule.
   5) Critical path activities.

f. Safety:
   1) Responsibility for safety.
   2) Contractor's safety representative.
   3) Emergency procedures and accident reporting.
   4) Emergency contact information.
   5) Confined space entry permits.
   6) Hazardous materials communication program.

g. Permits.

h. Review of insurance requirements and insurance claims.

i. Coordination:
   1) Project coordination, and coordination among contractors.
   2) Coordination with Owner's operations.
   3) Progress meetings.

j. Products and Submittals:
   1) Preliminary Schedule of Submittals.
   2) Procedures for furnishing and processing submittals.
   3) Work not eligible for payment until submittals are approved or accepted (as required).
   4) Construction photographic documentation.

k. Substitutes and "Or-Equals":
   1) Product options.
   2) Procedures for proposing "or-equals".
   3) Procedures for proposing substitutes.

l. Contract Modification Procedures
   1) Requests for interpretation
   2) Written clarifications
   3) Field Orders
   4) Proposal Requests
   5) Change Proposals
   6) Work Change Directives.
   7) Change Orders.
   8) Procedure for Claims and dispute resolution

m. Payment:
   1) Owner's Project financing and funding, as applicable.
   2) Owner's tax-exempt status.
   3) Preliminary Schedule of Values
   4) Procedures for measuring for payment.
   5) Retainage.
   6) Progress payment procedures.

7) Prevailing wage rates and payrolls.

n. Testing and inspections, including notification requirements.
o. Disposal of demolition materials.
p. Record documents.
q. Preliminary Discussion of Contract Closeout:
   1) Procedures for Substantial Completion.
   2) Contract closeout requirements.
   3) Correction period.
   4) Duration of bonds and insurance.

2. Site Mobilization (if not covered in a separate meeting):
   a. Working hours and overtime.
   b. Field offices, storage trailers, and staging areas.
   c. Temporary facilities.
   d. Temporary utilities and limitations on utility consumption (where applicable).
   e. Utility company coordination (if not done as a separate meeting).
   f. Access to Site, access roads, and parking for construction vehicles.
   g. Maintenance and protection of traffic.
   h. Use of Site and premises.
   i. Protection of property.
   j. Security.
   k. Temporary controls, such as sediment and erosion controls, noise controls, dust control, storm water controls, and other such measures.
   l. Site barriers and temporary fencing.
   m. Storage of materials and equipment.
   n. Reference points and benchmarks; surveys and layouts.
   o. Site maintenance during the Project.
   p. Cleaning and removal of trash and debris.
   q. Restoration.
3. General discussion and questions.
4. Next meeting.
5. Site visit, if required.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 31 19.23

PROGRESS MEETINGS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Progress meetings will be held throughout the Project. CONTRACTOR shall attend each progress meeting prepared to discuss in detail all items on the agenda.
   2. ENGINEER will preside at progress meetings and will prepare and distribute minutes of progress meetings to all meeting participants and others as requested.

1.2 PREPARATION FOR PROGRESS MEETINGS

A. Date and Time:
   1. Regular Meetings: Every month on a day and time agreeable to OWNER, ENGINEER, and CONTRACTOR.
   2. Other Meetings: As required.

B. Location:
   1. CONTRACTOR's field office at the Site or other location mutually agreed upon by OWNER, CONTRACTOR, and ENGINEER.

C. Handouts:
   1. CONTRACTOR shall bring to each progress meeting not less than eight copies of each of the following:
      a. List of Work accomplished since the previous progress meeting.
      b. Up-to-date Progress Schedule.
      c. Up-to-date Schedule of Submittals.
      d. Detailed "look-ahead" schedule of Work planned through the next progress meeting, with specific starting and ending dates for each activity, including shutdowns, deliveries of important materials and equipment, Milestones (if any), and important activities affecting the OWNER, Project, and Site.
      e. When applicable, list of upcoming, planned time off (with dates) for personnel with significant roles on the Project, and the designated contact person in their absence.

1.3 REQUIRED ATTENDANCE

A. Representatives present for each entity shall be authorized to act on that entity's behalf.

B. Required Attendees:
   1. CONTRACTOR:
      a. Project manager.
      b. Site superintendent.
      c. Safety representative.
      d. When needed for the discussion of a particular agenda item, representatives of Subcontractors and Suppliers shall attend meetings.
   2. Construction coordinator (if any).
   3. ENGINEER:
      a. Project manager or designated representative
      b. Resident Project Representative (if any).
      c. Others as required by ENGINEER.
   4. OWNER's representative(s), as required.
   5. Testing and inspection entities, as required.
   6. Others, as appropriate.

1.4 AGENDA

A. Preliminary Agenda: Be prepared to discuss in detail the topics listed below. Revised agenda, if any, will be furnished to CONTRACTOR prior to first progress meeting. Progress meeting agenda may be modified by ENGINEER during the Project as required.
   1. Review, comment, and amendment (if required) of minutes of previous progress meeting.
   2. Review of progress since the previous progress meeting.
   3. Planned progress through next progress meeting.
   4. Review of Progress Schedule
      a. Contract Times, including Milestones (if any)
      b. Critical path.
      c. Schedules for fabrication and delivery of materials and equipment.
      d. Corrective measures, if required.
   5. Submittals:
      a. Review status of critical submittals.
      b. Review revisions to Schedule of Submittals.
   6. Contract Modifications
      a. Requests for interpretation
      b. Written clarifications
      c. Field Orders
      d. Proposal Requests
      e. Change Proposals
      f. Work Change Directives.

g. Change Orders.
h. Claims.

7. Applications for progress payments.
8. Problems, conflicts, and observations.
9. Quality standards, testing, and inspections.
10. Coordination between parties.
11. Site management issues, including access, security, maintenance and protection of traffic, maintenance, cleaning, and other Site issues.
12. Safety.
13. Permits.
14. Construction photographic documentation.
15. Record documents status.
16. Punch list status, as applicable.
17. Other business.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 31 26

ELECTRONIC COMMUNICATION PROTOCOLS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. This Section establishes the procedures with which the parties will comply regarding transmission or exchange of electronic data for the Project.
   2. CONTRACTOR shall provide labor, materials, tools, equipment, services, utilities, and incidentals shown, specified, and required for complying with this Section throughout the Project.
   3. This Section does not supersede the General Conditions, as may be modified by the Supplementary Conditions, regarding transmitting of the Contract Documents to CONTRACTOR after the Effective Date of the Contract.
   4. In addition to the requirements of this Section, comply with requirements for exchange of electronic data in the following:
      a. Section 01 32 16, Progress Schedule.
      b. Section 01 32 33, Photographic Documentation.
      c. Section 01 33 00, Submittal Procedures.
      d. Section 01 78 39, Project Record Documents.

B. Coordination:
   1. CONTRACTOR shall require all Subcontractors and Suppliers to comply with the electronic communication protocols established in this Section.

C. Related Sections:
   1. Section 01 32 16, Progress Schedule.
   2. Section 01 32 33, Photographic Documentation.
   3. Section 01 33 00, Submittal Procedures.
   4. Section 01 78 39, Project Record Documents.

1.2 TERMINOLOGY

A. The following words or terms are not defined but, when used in this Section, have the following meaning:
   1. “Electronic data” means information, communications, drawings, or designs created or stored for the Project in electronic or digital form.
   2. “Confidential information” means electronic data that the transmitting party has designated as confidential and clearly marked with an indication such as “Confidential”, “Business Proprietary”, or similar designation.
   3. “Written” or “in writing” means any and all communications, including without limitation a notice, consent, or interpretation, prepared and sent to

an address provided in the Contract Documents or otherwise agreed upon by the parties and ENGINEER using a transmission method sent forth in this Section that allows the recipient to print or store the communication. Communications transmitted electronically are presumed received when sent in conformance with this Paragraph 1.2.A.3.

1.3 TRANSMISSION OF ELECTRONIC DATA

A. Transmission of electronic data constitutes a warrant by the transmitting party to the receiving party that the transmitting party is one or more of the following:
   1. The copyright owner of the electronic data.
   2. Has permission from the copyright owner to transmit the electronic data for its use on the Project.
   3. Is authorized to transmit confidential information.

B. Receiving party agrees to keep confidential information confidential and not to disclose it to another person except to (1) its employees, (2) those who need to know the content of the confidential information to perform services or construction solely and exclusively for the Project, or (3) its consultants, contractors, Subcontractors, and Suppliers whose contracts include similar restrictions on the use of electronic data and confidential information.

C. Transmitting party does not convey any right in the electronic data or in the software used to generate or transmit such data. Receiving party may not use electronic data unless permission to do so is provided in the Contract Documents, or in a separate license.

D. Unless otherwise granted in a separate license, receiving party's use, modification, or further transmission of electronic data, as provided the Contract Documents, is specifically limited to the design and construction of the Project in accordance with this Section, and nothing contained in this Section conveys any other right to use the electronic data for any other purpose.

E. To the fullest extent permitted by Laws and Regulations, receiving party shall indemnify and defend the transmitting party from and against all claims arising from or related to receiving party's modification to, or unlicensed use of, electronic data.

F. Means of Transmitting Electronic Data: Unless otherwise indicated in Table 01 31 26-A of this Section or elsewhere in the Contract Documents, transmission of electronic data for the Project will generally be via:
   1. Project's Internet-based website.
      a. Software Platform: Sharepoint.
      b. Website hosting will be by ENGINEER.
      c. Website address will be furnished to CONTRACTOR within ten days after the Effective Date of the Contract.

d. To access the Project website, CONTRACTOR shall acquire and maintain throughout the Project high-speed Internet service suitable for transferring electronic data, and Internet browsing software such as Microsoft Internet Explorer 9.0 or equal.

d. Upon request of one or both parties, ENGINEER will provide training for requesting party for up to four hours (one time) via, at ENGINEER's option, web-based meeting interface such as Citrix WebEx or in person at requesting party's place of business. ENGINEER will provide additional training upon requesting party's request. Requesting party shall compensate ENGINEER for cost of such additional training.

1.4 ELECTRONIC DATA PROTOCOLS

A. Comply with the data formats, transmission methods, and permitted uses set forth in Table 01 31 26-A, Electronic Data Protocol Table, below, when transmitting or using electronic data on the Project. Where a row in the table has no indicated means of transmitting electronic data, use for such documents only printed copies transmitted to the receiving party via appropriate delivery method.

TABLE 01 31 26-A
ELECTRONIC DATA PROTOCOL TABLE (WEBSITE)

Electronic Data	Data Format	Transmitting Party	Transmission Method	Receiving Party	Permitted Uses	Notes
1.4.A.1. Project communications						
General communications & correspondence	EM, PDF	O, E, C	EM, EMA	O, E, C	R	
Meeting notices and agendas	EM, PDF	E	PW	O, C	R	
Meeting minutes	PDF	E	PW	O, C	R	
1.4.A.2. Contractor's submittals to Engineer						
Shop Drawings	PDF	C	PW	E	M (1)	(1)
Product data	PDF	C	PW	E	M (1)	(1)
Informational and closeout submittals:	PDF	C	PW	E	M (1)	(1) (6)
Documentation of delivery of maintenance materials submittals	PDF	C	PW	E	M (1)	
1.4.A.3. Engineer's return of reviewed submittals to Contractor						
Shop Drawings	PDF	E	PW	O., C	R	
Product data	PDF	E	PW	O., C	R	
Informational and closeout submittals:	PDF	E	PW	O., C	R	(6)
Documentation of delivery of maintenance materials submittals	PDF	E	PW	O. C	R	
1.4.A.4. Contract Modifications Documents						
Requests for interpretation to Engineer	PDF	C., O	PW	E	M (1)	(1)
Engineer's interpretations (RFI responses)	PDF	E	PW	C, O	R	
Engineer's clarifications to Contractor	EM, PDF	E	PW	C, O	R	
Engineer's issuance of Field Orders	PDF	E	PW	C, O	R	
Proposal Requests	PDF	E, O	PW	C	R	
Change Proposals – submitted to Engineer	PDF	C	PW	O, E	S	
Change Proposals – Engineer's response	PDF	E	PW	C. O		
Work Change Directives (for Contractor signature)	PDF	E	PW	C	R	(2)

Change Orders (for Contractor signature)	PDF	E	PW	C	R	(2)
1.4.A.5. Applications for Payment						(3)
1.4.A.6. Claims and other notices						(4)
1.4.A.7. Closeout Documents						
Record drawings	DWG and PDF	C	PW	E, O	M (5)	(5)
Other record documents	PDF	C	PW	E. O	M (5)	(5)
Contract closeout documents						

B. Key to Electronic Data Protocol Table:

Data Format:

EM .msg, .htm, .txt, .rtf, e-mail text
W .docx, Microsoft® Word 2007 or later
EX .xlsx, Microsoft® Excel 2007 or later
PDF .pdf. Portable Document Format
DWG .dwg. Autodesk AutoCAD 2013 drawing.

Transmitting Party:

O OWNER
C CONTRACTOR
E ENGINEER

Transmission Method:

EM Via e-mail
EMA As an attachment to an e-mail transmission
CD Delivered via compact disc
PW Posted to Project website
FTP FTP transfer to receiving FTP server

Receiving Party:

O OWNER
C CONTRACTOR
E ENGINEER

Permitted Uses:

S Store and view only
R Reproduce and distribute
I Integrate (incorporate additional electronic data without modifying data received)
M Modify as required to fulfill obligations for the Project

Notes:

(1) Modifications by ENGINEER to CONTRACTOR's submittals and requests for interpretations are limited to printing out, marking-up, and adding comment sheets.

(2) May be distributed only to affected Subcontractors and Suppliers. Print out, sign document, and return executed printed copy originals to ENGINEER.

(3) Submit printed Applications for Payment with original ("wet") signatures.

(4) Submit notices, including Claims, in accordance with the notice provisions of the General Conditions, as may be modified by the Supplementary Conditions.

(5) Submit record drawings in native CAD format indicated when CONTRACTOR has executed ENGINEER's standard agreement for release of electronic files. In addition, always submit record drawings as a PDF file. Comply with requirements of Section 01 78 39, Project Record Documents.

(6) For operation and maintenance data, also submit printed copies as required by Section 01 78 23, Operations and Maintenance Data.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 32 16

PROGRESS SCHEDULE

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. General CONTRACTOR shall prepare and submit Progress Schedules and related documents in accordance with the General Conditions (as may be modified by the Supplementary Conditions) and this Section, unless otherwise accepted by ENGINEER.
   2. Maintain and update Progress Schedules. Submit updated Progress Schedules as specified in this Section unless otherwise directed by ENGINEER.
   3. ENGINEER's acceptance of the Progress Schedule, and comments or opinions concerning the activities in the Progress Schedule shall not control CONTRACTOR's independent judgment relative to means, methods, techniques, sequences, and procedures of construction. CONTRACTOR is solely responsible for complying with the Contract Times.

B. Factors Affecting the Progress Schedule:
   1. In preparing and maintaining the Progress Schedule, take into consideration submittal requirements and submittal review times, rime for fabricating and delivering materials and equipment, Subcontractors' work, availability and abilities of workers, availability of construction equipment, weather conditions, restrictions in operations at the Site and coordination with OWNER's operations, and other factors that have the potential to affect completion of the Work within the Contract Times.
   2. Comply with sequencing requirements indicated in the following:
      a. Section 01 12 13, Summary of Work.
      b. Section 01 14 16, Coordination with Owner's Operations.

1.2 SUBMITTALS

A. Informational Submittals: Submit the following:
   1. Initial Progress Schedules:
      a. Submit preliminary Progress Schedule in accordance with Paragraph 2.03 of the General Conditions. Submit in accordance with Section 01 33 00, Submittal Procedures and Section 01 31 26, Electronic Communication Protocols.
      b. After making revisions in accordance with ENGINEER's comments on the preliminary Progress Schedule, submit the Progress Schedule in accordance with Paragraph 2.05 of the General Conditions. Submit in accordance with Section 01 33 00, Submittal Procedures and Section 01 31 26, Electronic Communication Protocols.

2. Progress Schedule Updates:
    a. Submit updated Progress Schedule at each progress meeting. If a Progress Schedule remains unchanged from one progress meeting to the next, submit a written statement to that effect. For monthly Progress Schedule submittals, bring to progress meeting the number of printed copies of the updated Progress Schedule specified in Section 01 31 19.23, Progress Meetings, and formally submit in accordance with Section 01 33 00, Submittal Procedures and Section 01 31 26, Electronic Communication Protocols .
    b. Furnish each Progress Schedule submittal with letter of transmittal complying with requirements of Section 01 33 00, Submittal Procedures, and specifically indicating the following:
        1) Listing of activities and dates that have changed since the previous Progress Schedule submittal.
        2) Discussion of problems causing delays, anticipated duration of delays, and proposed countermeasures.
3. Recovery Schedules: Submit in accordance with this Section,.

1.3 PROGRESS SCHEDULE FORMAT AND CONTENT

A. Format:
1. Type:
    a. Gantt chart prepared using software such as Microsoft Project 2007 or later edition, Oracle Primavera P6, Oracle Primavera Project Planner – P3, or similar software.
2. Sheet Size: 11 inches by 17, unless otherwise accepted by ENGINEER.
3. Time Scale: Indicate first date of each work week.
4. Organization:
    a. Indicate on the separate Schedule of Submittals dates for submitting and reviewing Shop Drawings, Samples, and other submittals.
    b. Group deliveries of materials and equipment into a separate sub-schedule that is part of the Progress Schedule.
    c. Show complete sequence of construction by activity, identifying Work of Separate stages and other logically grouped activities. Indicate the early and later start, early and late finish, float dates, and duration.
    d. Indicate estimated percentage of completion for each item of Work at each submission.
    e. Group critical activities that dictate the rate of progress (the “critical path”) into a separate sub-schedule that is part of the Progress Schedule. Clearly indicate the critical path on the Progress Schedule.
    e. Organize each sub-schedule by Specification Section number.
5. Activity Designations: Indicate title and related Specification Section number.

B. Content: Progress Schedules shall indicate the following:
1. Dates for shop-testing.
2. Delivery dates for materials and equipment to be incorporated into the Work.

3. Dates for beginning and completing each phase of the Work by activity and by trade.
4. Dates for start-up and check-out, field-testing, and instruction of operations and maintenance personnel.
5. Dates corresponding to the Contract Times, and planned completion date associated with each Milestone (if any), Substantial Completion, and readiness for final payment.

C. Coordinate the Progress Schedule with the Schedule of Submittals.

1.4 RECOVERY SCHEDULES

A. Recovery Schedules – General:
1. When updated Progress Schedule indicates that the ability to comply with the Contract Times falls ten (10) or more days behind schedule, and the delay is within the control of CONTRACTOR, and there is no corresponding Change Order or Work Change Directive to support an extension of the Contract Times, CONTRACTOR shall prepare and submit a Progress Schedule demonstrating CONTRACTOR's plan to accelerate the Work to achieve compliance with the Contract Times ("recovery schedule") for ENGINEER's acceptance.
2. Submit recovery schedule within five (5) days after submittal of updated Progress Schedule where need for recovery schedule is indicated.

B. Implementation of Recovery Schedule:
1. At no additional cost to OWNER, do one or more of the following: furnish additional resources (additional workers, additional construction equipment, increased work hours or additional shifts, and other resources), provide suitable materials, expedite procurement of materials and equipment to be incorporated into the Work, and other measures necessary to complete the Work within the Contract Times.
2. Upon acceptance of recovery schedule by ENGINEER, incorporate recovery schedule into the next Progress Schedule update.

C. Lack of Action:
1. CONTRACTOR's refusal, failure, or neglect to take appropriate recovery action, or to submit a recovery schedule, shall constitute reasonable evidence that CONTRACTOR is not prosecuting the Work or separable part thereof with the diligence that will ensure completion within the Contract Times. Such lack of action shall constitute sufficient basis for OWNER to exercise remedies available to OWNER under the Contract Documents.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 32 33

PHOTOGRAPHIC DOCUMENTATION

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall retain professional photographer to perform services specified, including:
      a. Digital photography.
   2. Furnish photographic documentation for the following:
      a. Pre-construction.
      b. Construction progress.
      c. Final.

B. Image Quality:
   1. Photographic documentation shall be in color.
   2. Photographic images shall be suitably staged and set up ("framed"), focused, and shall have adequate lighting to illuminate the Work and conditions that are the subject of the photograph.
   3. For still photographs, use camera with minimum 16.0-megapixel resolution.

1.2 QUALITY ASSURANCE

A. Qualifications:
   1. Photographer:
      a. Photographer shall be a specialist regularly engaged in professional photography and experienced in photographing construction sites.
      b. Upon request of ENGINEER, submit documentation of photographer having successfully performed photographic documentation for not less than five previous construction projects, each lasting not less than six months.

B. At the Site, ENGINEER or Resident Project Representative will indicate the views to be taken and will select time at which images will be taken. Photographic subjects, views, and angles will vary with progress of the Work.

1.3 SUBMITTALS

A. Informational Submittals: Submit the following:
   1. Pre-construction Photographic Documentation: Submit acceptable pre-construction photographic documentation (prints and digital files) prior to mobilizing to and disturbing the Site. Submit pre-construction photographic

documentation not later than the first Application for Payment, unless other schedule for pre-construction photographic documentation is accepted by ENGINEER.

2. Construction Progress Photographic Documentation: Submit acceptable construction progress photographic documentation (prints and digital files) not less-often than monthly. Submit with each Application for Payment, unless otherwise agreed to by ENGINEER.
3. Qualifications Statements:
    a. When requested by ENGINEER, prior to starting photographic documentation, submit photographer qualifications and record of experience. List of construction photography experience shall include the following for each project:
        1) Project name and location
        2) Nature of construction.
        3) Photographer's client with contract information.
        4) Approximate duration of photographer's services.

B. Closeout Submittals: Submit the following:
    1. Final Photographic Documentation: Submit acceptable final photographic documentation (prints and digital files) prior to requesting the final inspection by ENGINEER.

1.4 PHOTOGRAPHIC DOCUMENTATION – GENERAL

A. Digital Files of Photographs:
    1. For each photograph taken, furnish high-quality digital image in "JPG" file format compatible with Microsoft Windows 7 and higher operating systems.
    2. Image resolution shall be sufficient for clear, high-resolution prints. Minimum resolution shall be 150 dots per inch (dpi). Minimum size of digital images shall be eight-inch by ten-inch size .
    3. Do not imprint date and time in the image.
    4. Electronic image filename shall describe the image; do not submit filenames automatically created by digital camera. For example, an acceptable electronic filename would be, "Dewatering Building – Looking West at Centrifuge No. 2.jpg".
    5. Form of Digital Submittal – Images on Discs:
        a. Submit digital files on compact discs (CD) or digital video discs (DVD).
        b. Submit three copies of each disc with digital files of photographic images.
        c. Include the following information on front of each disc containing photographic documentation:
            1) Date(s) photographs were taken.
            2) Name of OWNER.
            3) Name of the Site.
            4) Project name.
            5) Photographer name and address.

1.5 PRE-CONSTRUCTION PHOTOGRAPHIC DOCUMENTATION

A. Pre-construction Photographic Documentation:
   1. Obtain and submit sufficient pre-construction photographic documentation to record Site conditions prior to construction. Photographs shall document work areas of all prime contracts under the Project.
   2. Pre-construction photographs are not part of required number of construction progress photographs specified in Article 1.6 of this Section.

B. If disagreement arises on the condition of the Site and insufficient pre-construction photographic documentation was submitted prior to the disagreement, restore the grounds or area in question to extent directed by ENGINEER and to satisfaction of ENGINEER.

1.6 CONSTRUCTION PROGRESS PHOTOGRAPHIC DOCUMENTATION

A. Progress Photographs:
   1. Take photographs not less often than twice per month.
   2. Take not less than five photographs each time photographer is at the Site.
   3. Maximum number of progress photographs required will be based on the Contract Times to Substantial Completion of the entire Project and scope of the Project on date the Contract Times commence running. Proportionately modify the extent of photographic documentation if scope of the Project or the Contract Times are modified.
   4. Obtain and submit interior and exterior photographic documentation of each structure in the work area as directed by ENGINEER at the time photographic documentation is taken.

1.7 FINAL PHOTOGRAPHIC DOCUMENTATION

A. Final Photographs:
   1. Take photographs at time and day acceptable to ENGINEER. Do not take final photographs prior to Substantial Completion of the entire Project. Work documented in final photographs shall be generally complete, including painting and finishing, furnishings, landscaping, and other visible Work
   2. Take not less than 10 final photographs, based on scope of the Project at the time that the Contract Times commence running. Proportionately modify the number of final photographs if scope of Project is modified. Final photographs are not part of construction progress photographs required under Paragraph 1.6.A of this Section.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall prepare and furnish submittals in accordance with the General Conditions, as may be modified by the Supplementary Conditions, and this Section.
   2. Provide submittals well in advance of need for the material or equipment, or procedure (as applicable), in the Work and with ample time required for delivery of materials and equipment and to implement procedures following ENGINEER's approval or acceptance of the associated submittal. Work covered by a submittal will not be included in progress payments until approval or acceptance of related submittals has been obtained in accordance with the Contract Documents.
   3. CONTRACTOR is responsible for dimensions to be confirmed and corrected at the Site; quantities; information pertaining solely to fabrication processes; means, methods, sequences, procedures, and techniques of construction; safety precautions and programs incident thereto; and for coordinating the work of all trades.
   4. CONTRACTOR's signature of submittal's stamp and letter of transmittal shall be CONTRACTOR's representation that CONTRACTOR has complied with his obligations under the Contract Documents relative to that submittal. ENGINEER and OWNER shall be entitled to rely on such representations by CONTRACTOR.
   5. Provisions of the General Conditions, as may be modified by the Supplementary Conditions, apply to all CONTRACTOR-furnished submittals required by the Contract Documents, regardless of whether such submittals are other than Shop Drawings or Samples.

B. Samples:
   1. Submittal of Samples shall comply with the General Conditions, as may be modified by the Supplementary Conditions, this Section, and the Specifications Section in which the Sample is specified.
   2. Furnish at the same time those Samples and submittals that are related to the same element of the Work or Specifications Section. ENGINEER will not review submittals without associated Samples, and will not review Samples without associated submittals.
   3. Samples shall clearly illustrate functional characteristics of materials, all related parts and attachments, and full range of color, texture, pattern, and materials.

C. Restrictions on Quantity of Submittals and Compensation of OWNER:
   1. CONTRACTOR shall furnish required submittals with sufficient information and accuracy to obtain required approval or acceptance of submittal by ENGINEER with not more than the number of resubmittals indicated in the General Conditions (as may be modified by the Supplementary Conditions).
   2. Total number of CONTRACTOR's submittals shall not exceed 25 percent above the total number of first-time submittals indicated in the Schedule of Submittals initially accepted by ENGINEER in accordance with the General Conditions. ENGINEER will record ENGINEER's time for reviewing submittals of Shop Drawings, Samples, and other submittals and items requiring approval or acceptance, beyond the quantity of first-time submittals indicated in the Schedule of Submittals initially accepted by ENGINEER, and CONTRACTOR shall reimburse OWNER for ENGINEER's charges for such time.
   3. In the event that CONTRACTOR requests a substitution for a previously approved item, Contractor shall reimburse OWNER for ENGINEER's charges for such time unless the need for such substitution is beyond the control of CONTRACTOR.
   4. OWNER may impose set-offs against CONTRACTOR for the costs for which CONTRACTOR is to reimburse or compensate OWNER, in accordance with the General Conditions.

1.2 TYPES OF SUBMITTALS

A. Submittal types are classified as follows: 1) Action Submittals, 2) Informational Submittals, 3) Closeout Submittals, and 4) Maintenance Material submittals. Type of each required submittal is designated in the respective Specifications Sections; when type of submittal is not designated in the associated Specification Section, submittal will be classified as follows:
   1. Action Submittals include:
      a. Shop Drawings.
      b. Product data.
      c. Delegated design submittals, which include documents prepared, sealed, and signed by a design professional retained by CONTRACTOR, Subcontractor, or Supplier for materials and equipment to be incorporated into the completed Work. Delegated design submittals do not include submittals related to temporary construction unless specified otherwise in the related Specifications Section. Delegated design submittals include: design drawings, design data including calculations, specifications, certifications, and other submittals prepared by such design professional.
      d. Samples.
      e. Testing plans, procedures, and testing limitations.
   2. Informational Submittals include:
      a. Certificates.

b. Design data not sealed and signed by a design professional retained by CONTRACTOR, Subcontractor, or Supplier.
c. Pre-construction test and evaluation reports, such as reports on pilot testing, subsurface investigations, testing for a potential Hazardous Environmental Condition, and similar reports.
d. Supplier instructions, including installation data, and instructions for handling, starting-up, and troubleshooting.
e. Source quality control submittals (other than testing plans, procedures, and testing limitations), including results of shop testing.
f. Field or Site quality control submittals (other than testing plans, procedures, and testing limitations), including results of operating and acceptability tests at the Site.
g. Supplier reports.
h. Sustainable design submittals (other than sustainable design closeout documentation).
i. Special procedure submittals, including plans for shutdowns and tie-ins and other procedural submittals.
j. Qualifications statements.
k. Administrative submittals including:
1) Progress Schedules.
2) Schedules of Submittals.
3) Schedules of Values.
4) Photographic documentation.
5) Coordination drawings, when submittal of such is required.
6) Copies of permits obtained by CONTRACTOR.
7) Field engineering reports, survey data, and similar information.

3. Closeout Submittals include:
a. Maintenance contracts.
b. Operations and maintenance data.
c. Bonds, such as special maintenance bonds and bonds for a specific material, equipment item, or system.
d. Warranty documentation.
e. Record documentation.
f. Sustainable design closeout documentation.
g. Software.
i. Keying.

4. Maintenance Material Submittals include:
a. Spare parts.
b. Extra stock materials.
c. Tools.

5. When type of submittal is not specified and is not included in the list above, request an interpretation from ENGINEER and ENGINEER will determine the type of submittal.

B. Not Included in this Section: Administrative and procedural requirements for following are covered elsewhere in the Contract Documents:

1. Requests for interpretations of the Contract Documents.
2. Change Orders, Work Change Directives, and Field Orders.
3. Applications for Payment
4. Reports, documentation, and permit applications required to be furnished by CONTRACTOR to authorities having jurisdiction.

1.3 REQUIREMENTS FOR SCHEDULE OF SUBMITTALS

A. Informational Submittals: Submit the following:
   1. Schedule of Submittals:
      a. Timing:
         1) Furnish submittal within time frames indicated in the Contract Documents.
         2) Submit updated Schedule of Submittals with each submittal of the updated Progress Schedule.
      b. Content: In accordance with the General Conditions, as may be modified by the Supplementary Conditions, and this Section. Requirements for content of preliminary Schedule of Submittals and subsequent submittals of the Schedule of Submittals are identical. Identify on Schedule of Submittals all submittals required in the Contract Documents. Updates of Schedule of Submittals shall show scheduled dates and actual dates for completed tasks. Indicate submittals that are on the Project's critical path. Indicate the following for each submittal:
         1) Date by which submittal will be received by ENGINEER.
         2) Whether submittal will be for a substitution or "or-equal". Procedures for requesting approval of substitutes and "or-equals" are specified in the General Conditions, Section 01 25 00, Substitution Procedures, and Section 01 62 00, Product Options (for "or-equals").
         3) Date by which ENGINEER's response is required. Not less than 15 days shall be allowed for ENGINEER's review, starting upon ENGINEER's actual receipt of each submittal. Allow increased time for large or complex submittals.
         4) For submittals for materials or equipment, date by which material or equipment must be at the Site to avoid delaying the Work and to avoid delaying the work of other contractors, if any.
      c. Prepare Schedule of Submittals using same software, and in same format, specified for Progress Schedules in Section 01 32 16, Progress Schedule.
      d. Coordinate Schedule of Submittals with the Progress Schedule.
      e. Schedule of Submittals that is not compatible with the Progress Schedule, or that does not indicate submittals on the Project's critical path, or that that places extraordinary demands on ENGINEER for time and resources, is unacceptable. Do not include submittals not required by the Contract Documents.
      f. In preparing Schedule of Submittals:
         1) Considering the nature and complexity of each submittal, allow sufficient time for review and revision.

2) Reasonable time shall be allowed for: ENGINEER's review and processing of submittals, for submittals to be revised and resubmitted, and for returning submittals to CONTRACTOR.
3) Identify and accordingly schedule submittals that are expected to have long anticipated review times.

1.4 PROCEDURE FOR SUBMITTALS

A. Submittal Identification System: Use the following submittal identification system, consisting of submittal number and review cycle number.
   1. Submittal Number: Shall be separate and unique number correlating to each individual submittal required. Assign submittal numbers as follows:
      a. First part of submittal number shall be the applicable Specifications Section number, followed by a hyphen.
      b. Second part of submittal number shall be a three-digit number (sequentially numbered from 001 through 999) assigned to each separate and unique submittal furnished under the associated Specifications Section.
      c. Typical submittal number for the third submittal furnished for Section 40 05 19, Ductile Iron Process Pipe, would be "40 05 19-003".
   2. Review Cycle Number: Shall be a letter designation indicating the initial submittal or re-submittal associated with each submittal number:
      a. "A" = Initial (first) submittal.
      b. "B" = Second submittal (e.g., first re-submittal).
      c. "C" = Third submittal (e.g., second re-submittal).
   3. Examples:

Example Description	Submittal Identification	
	Submittal No.	**Review Cycle**
Initial (first) review cycle of the third submittal provided under Section 40 05 19, Ductile Iron Process Pipe	40 05 19-003-	A
Second review cycle (first re-submittal) of third submittal provided under Section 40 05 19, Ductile Iron Process Pipe	40 05 19-003-	B

B. Letter of Transmittal for Submittals:
   1. Furnish separate letter of transmittal with each submittal. Each submittal shall be for one Specifications Section.
   2. At beginning of each letter of transmittal, include a reference heading indicating: CONTRACTOR's name, OWNER's name, Project name, Contract designation, transmittal number, and submittal number.
   3. For submittals with proposed deviations from requirements of the Contract Documents, letter of transmittal shall specifically describe each proposed variation.

C. Contractor's Review and Stamp:

1. Contractor's Review: Before transmitting submittals to ENGINEER, review submittals to:
   a. ensure proper coordination of the Work;
   b. determine that each submittal is in accordance with CONTRACTOR's desires;
   c. verify that submittal contains sufficient information for ENGINEER to determine compliance with the Contract Documents.
2. Incomplete or inadequate submittals will be returned without review.
3. Contractor's Stamp and Signature:
   a. Each submittal furnished shall bear CONTRACTOR's stamp of approval and signature, as evidence that submittal has been reviewed by CONTRACTOR and verified as complete and in accordance with the Contract Documents.
   b. Submittals without CONTRACTOR's stamp and signature will be returned without review. Signatures that appear to be computer-generated will be regarded as unsigned and the associated submittal will be returned without review.
   c. CONTRACTOR's stamp shall contain the following:

"Project Name: _____

Contractor's Name: _____

Contract Designation: _____

Date: _____

---------- *Reference* ----------

Submittal Title: _____

Specifications:

Section: _____

Page No.: _____

Paragraph No.: _____

Drawing No.: _____ of _____

Location of Work: _____

Submittal No. and Review Cycle: _____

Coordinated by Contractor with Submittal Nos.: _____

_____

I hereby certify that the Contractor has satisfied Contractor's obligations under the Contract Documents relative to Contractor's review and approval of this submittal.

Approved for Contractor by: _____"

D. Submittal Marking and Organization:

1. Mark on each page of submittal and each individual component submitted with submittal number and applicable Specifications paragraph.
2. Arrange submittal information in same order as requirements are written in the associated Specifications Section.
3. Each Shop Drawing sheet shall have title block with complete identifying information satisfactory to ENGINEER.
4. Package together submittals for the same Specifications Section. Do not furnish required information piecemeal.

E. Format of Submittal and Recipients:
1. Action Submittals and Informational Submittals: Furnish in accordance with Table 01 33 00-A, except that submittals of Samples shall be as specified elsewhere in this Section:

TABLE 01 33 00-A: SUBMITTAL CONTACTS AND REQUIRED FORMAT

	Address for Deliveries	Contact Person	E-mail Address	Format*	No. of Printed Copies
a.	Engineer: ARCADIS U.S., Inc.	David Frank	Dave.frank@arcadis.com	E	Zero
b.	Resident Project Representative: At the Site.	TBD	_____@arcadis.com	E & P	One
* **Format**: E = Electronic files; P = Printed copies. TBD = To Be Determined					

2. Samples:
   a. Securely label or tag Samples with submittal identification number. Label or tag shall include clear space at least four inches by four inches in size for affixing ENGINEER's review stamp. Label or tag shall not cover, conceal, or alter appearance or features of Sample. Label or tag shall not be separated from the Sample.
   b. Submit quantity of Samples required in Specifications. If quantity of Samples is not indicated in the associated Specifications Section, furnish not less than three identical Samples of each item required for ENGINEER's approval. Samples will not be returned to CONTRACTOR. If CONTRACTOR requires Sample(s) for CONTRACTOR's use, so advise ENGINEER in writing and furnish additional Sample(s). CONTRACTOR is responsible for furnishing, shipping, and transporting additional Samples.
   c Deliver Samples to ENGINEER at address indicated in Table 01 33 00-A, unless otherwise directed by ENGINEER.
3. Closeout Submittals:
   a. Furnish the following Closeout Submittals in accordance with Table 01 33 00-A: maintenance contracts; bonds for specific materials, equipment, or systems; warranty documentation; and sustainable design closeout documentation. On documents such as maintenance contracts and bonds, include on each document furnished original ("wet") signature

of entity issuing said document. When original "wet" signatures are required, furnish such submittals in printed form and electronic form to ENGINEER, and to other entities furnish as indicated in Table 01 33 00-A.

b. Operations and Maintenance Data: Submit in accordance with Section 01 78 23, Operation and Maintenance Data.

c. Record Documentation: Submit in accordance with Section 01 78 39, Project Record Documentation.

d. Software: Submit number of copies required in Specifications Section where the software is specified. If number of copies is not specified, provide two copies on compact disc in addition to software loaded on OWNER's computer(s) or microprocessor(s).

4. Maintenance Material Submittals: For spare parts, extra stock materials, and tools, furnish quantity of items specified in associated Specifications Section. Furnish in accordance with Section 01 78 43, Spare Parts and Extra Materials.

F. Electronic Submittals:

1. Format: Electronic files shall be in "portable document format" (.PDF). Files shall be electronically searchable.

2. Organization and Content:

a. Each electronic submittal shall be one file; do not divide individual submittals into multiple files each.

b. When submittal is large or contains multiple parts, furnish PDF file with bookmark for each section of submittal.

c. Content shall be identical to printed submittal. First page of electronic submittal shall be CONTRACTOR's letter of transmittal.

3. Quality and Legibility: Electronic submittal files shall be made from the original and shall be clear and legible. Do not submit scans of faxed copies. Electronic file shall be full size of original, printed documents. Properly orient all pages for reading on a computer screen.

4. Provide sufficient Internet service and e-mail capability for CONTRACTOR's use in transferring electronic submittals, receiving responses to electronic submittals, and associated electronic correspondence. Check not less than once per day for distribution of electronic submittals, electronic responses ot submittal, and electronic correspondence related to submittals.

5. Submitting Electronic Files:

a. Transmit electronic files in accordance with Section 01 31 26, Electronic Communication Protocols.

G. Distribution:

1. Distribution of ENGINEER's Response via Electronic Files: Upon completion of ENGINEER's review, electronic submittal response will be distributed by ENGINEER to

a. CONTRACTOR.

b. OWNER.

c. Resident Project Representative (RPR).

d. ENGINEER's file.

H. Resubmittals: Refer to the General Conditions for requirements regarding resubmitting required submittals.

1.5 ENGINEER'S REVIEW

A. Timing: ENGINEER's review will conform with timing indicated in the Schedule of Submittals accepted by ENGINEER.

B. Submittals not required by the Contract Documents will not be reviewed by ENGINEER and will not be recorded in ENGINEER's submittal log. All printed copies of such submittals will be returned to CONTRACTOR. Electronic copies of such submittals, if any, will not be retained by ENGINEER.

C. Action Submittals, Results of ENGINEER's Review: Each submittal will be given one of the following dispositions by ENGINEER:
   1. Approved: Upon return of submittal marked "Approved", order, ship, or fabricate materials and equipment included in the submittal (pending ENGINEER's approval or acceptance, as applicable, of source quality control submittals) or otherwise proceed with the Work in accordance with the submittal and the Contract Documents.
   2. Approved as Corrected: Upon return of submittal marked "Approved as Corrected", order, ship, or fabricate materials and equipment included in the submittal (pending ENGINEER's approval or acceptance, as applicable, of source quality control submittals) or otherwise proceed with the Work in accordance with the submittal and the Contract Documents, and in accordance with the corrections indicated in the ENGINEER's submittal response.
   3. Approved as Corrected – Resubmit: Upon return of submittal marked "Approved as Corrected – Resubmit", order, ship, or fabricate materials and equipment included in the submittal (pending ENGINEER's approval or acceptance, as applicable, of source quality control submittals) or otherwise proceed with the Work in accordance with the submittal and the Contract Documents, and in accordance with corrections indicated in ENGINEER's submittal response. Furnish to ENGINEER record re-submittal with all corrections made. Receipt of corrected re-submittal is required before materials or equipment covered in the submittal will be eligible for payment.
   4. Revise and Resubmit: Upon return of submittal marked "Revise and Resubmit", make the corrections indicated and re-submit to ENGINEER for approval.
   5. Not Approved: This disposition indicates material or equipment that cannot be approved. "Not Approved" disposition may also be applied to submittals that are incomplete. Upon return of submittal marked "Not Approved", repeat initial submittal procedure utilizing approvable material or equipment, with a complete submittal clearly indicating all information required.

D. Informational Submittals, Results of ENGINEER's Review:
   1. Each submittal will be given one of the following dispositions:
      a. Accepted: Information included in submittal complies with the applicable requirements of the Contract Documents, and is acceptable. No further action by CONTRACTOR is required relative to this submittal, and the Work covered by the submittal may proceed, and materials and equipment with submittals with this disposition may be shipped or operated, as applicable.
      b. Not Accepted: Submittal does not indicate compliance with applicable requirements of the Contract Documents and is not acceptable. Revise submittal and re-submit to indicate acceptability and compliance with the Contract Documents.
   2. The following types of Informational Submittals, when acceptable to ENGINEER, will not receive a written response from ENGINEER. Disposition as "accepted" will be recorded in ENGINEER's submittal log. When submittals of the following are not acceptable, ENGINEER will provide written response to CONTRACTOR
      a. Material safety data sheets (MSDS).
      b. Compaction testing reports.
      c. Concrete testing reports.
      d. Manufacturer's instructions.

E. Closeout Submittals, Results of ENGINEER's Review: Dispositions and meanings are the same as specified for Informational Submittals. When acceptable, Closeout Submittals will not receive a written response from ENGINEER. Disposition as "accepted" will be recorded in ENGINEER's submittal log. When Closeout Submittal is not acceptable, ENGINEER will provide written response to CONTRACTOR.

F. Maintenance Material Submittals, Results of ENGINEER's Review: Dispositions and meanings are the same as specified for Informational Submittals. When acceptable, Maintenance Material Submittals will not receive a written response from ENGINEER. Disposition as "accepted" will be recorded in ENGINEER's submittal log. When Maintenance Material Submittal is not acceptable, ENGINEER will provide written response to CONTRACTOR, and CONTRACTOR is responsible for costs associated with transporting and handling of maintenance materials until compliance with the Contract Documents is achieved.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 35 43.13

ENVIRONMENTAL PROCEDURES FOR HAZARDOUS MATERIALS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, tools, and incidentals necessary to comply with environmental procedures for Constituents of Concern.
   2. CONTRACTOR shall develop, implement, and maintain throughout the Project a hazardous materials management program (HMMP) in accordance with Laws and Regulations.
   3. Constituents of Concern Brought to Site by CONTRACTOR: Transport, handle, store, label, use, and dispose of in accordance with this Section, other applicable provisions of the Contract Documents, and Laws and Regulations.
   4. Constituents of Concern Generated by CONTRACTOR:
      a. Materials containing Constituents of Concern shall be properly handled, stored, labeled, transported and disposed of by CONTRACTOR in accordance with Laws and Regulations, and this Section.
      b. If CONTRACTOR will generate or has generated materials containing Constituents of Concern at the Site, obtain a USEPA identification number listing CONTRACTOR's name and address of the Site as generator of the Constituents of Concern. Obtain identification number from state environmental agency or similar authority having jurisdiction at the Site. Submit identification number within time frame specified in Article 1.3 of this Section.
      c. CONTRACTOR shall be responsible for identifying, analyzing, profiling, transporting, and disposing of Constituents of Concern generated by CONTRACTOR.
   5. Fines or civil penalties levied against OWNER for violations committed at the Site by CONTRACTOR, and costs to OWNER (if any) associated with cleanup of a Hazardous Environmental Condition created by CONTRACTOR shall be paid by CONTRACTOR. If CONTRACTOR has exacerbated a Hazardous Environmental Condition existing at the Site prior to the start of the Work, CONTRACTOR shall pay a share of costs associated with fines, civil penalties, and cleanup costs to in proportion equal to the extent of CONTRACTOR's responsibility for creating the Hazardous Environmental Condition and fines and civil penalties associated therewith.

B. Enforcement of Laws and Regulations:
   1. Interests of OWNER are that accidental spills and emissions, Site contamination, and injury of personnel at and near the Site are to be avoided.

2. When OWNER is aware of suspected violations, OWNER will notify CONTRACTOR, and authorities having jurisdiction if OWNER reasonably concludes that doing so is required by Laws or Regulations.
3. Responsibilities regarding Laws and Regulations shall be in accordance with the General Conditions, as may be modified by the Supplementary Conditions.

C. Related Sections:
1. Section 01 35 44, Spill Prevention Control and Countermeasures Plan.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with Laws and Regulations, including but not limited to the following:
1. 29 CFR 1910, OCCUPATIONAL SAFETY AND HEALTH STANDARDS.
2. 29 CFR 1926, SAFETY AND HEALTH REGULATIONS FOR CONSTRUCTION.
3. 40 CFR, PROTECTION OF ENVIRONMENT.
4. 49 CFR, TRANSPORTATION.
5. OCCUPATIONAL HEALTH AND SAFETY REQUIREMENTS OF STATE LABOR DEPARTMENT OR SIMILAR ENTITY; ENVIRONMENTAL LAWS AND REGULATIONS OF STATE ENVIRONMENTAL AGENCY, LAWS AND REGULATIONS OF STATE DEPARTMENT OF TRANSPORTATION.

1.3 SUBMITTALS

A. Informational Submittals: Submit the following to the entity(ies) specified for each:
1. Constituents of Concern (including Chemicals) Proposed for Use at the Site:
a. Content:
1) Current (dated within the past two years) material safety data sheets (MSDS) in accordance with 29 CFR 1910.1200 (OSHA Hazard Communication Standard).
2) Manufacturer of material or equipment containing such substance.
3) Supplier (if different than manufacturer).
4) Container size(s) and number of containers proposed to be at the Site.
5) Minimum and maximum volume of material intended to be stored at the Site.
6) Description of process or procedures in which Constituent of Concern will be used at the Site.
b. Furnish the information required above in sufficient time to obtain OWNER's acceptance not later least three days before bringing Constituent of Concern to the Site.
c. Submit to OWNER's environmental representative with copy to ENGINEER.
2. Material Containing Constituents of Concern Generated at the Site:
a. Submit for each Constituent of Concern generated at the Site

identification number, analysis results, and number and size of storage containers at the Site.

b. Furnish such information within not less than 48 hours after CONTRACTOR's receipt of analytical results.

c. Submit to OWNER's environmental representative with copy to ENGINEER.

3. Permits:

a. Submit copies of permits for storing, handling, using, transporting, and disposing of materials containing Constituents of Concern, obtained from authorities having jurisdiction.

b. Submit to OWNER's environmental representative with copy to ENGINEER.

4. Other Documents required for the HMMP: Submit to OWNER's environmental representative the requested documents within 72 hours of CONTRACTOR's receipt of such request. HMMP documents may include emergency/spill response plan, communication plan, and other documents.

1.4 HAZARDOUS MATERIALS MANAGEMENT

A. Obtain OWNER's environmental representative's acceptance before bringing to the Site each material containing a Constituent of Concern.

B. Communication Plan:

1. CONTRACTOR shall develop a communication plan relative to materials containing one or more Constituents of Concern.

2. MSDS Notebooks:

a. At minimum, maintain at the Site two notebooks containing: 1) Inventory of materials containing a Constituent of Concern (including all chemicals); and, 2) Current (dated within the past two years) material safety data sheets (MSDS) for all materials being used to accomplish the Work, whether or not defined as a Constituent of Concern.

b. Keep one notebook in CONTRACTOR's field office at the Site; keep second notebook at location acceptable by OWNER's environmental representative.

c. Keep notebooks up-to-date as materials are brought to and removed from the Site.

C. Emergency/Spill Response Plan: Develop, implement, and maintain an emergency/spill response plan, for each Constituent of Concern or each class/group of material containing a Constituent of Concern, as applicable. At minimum, response plan shall include the following:

1. Description of equipment available at the Site to contain or respond to emergency related to or spill of the material.

2. Procedures for notifying, and contact information for: authorities having jurisdiction, emergency responders, OWNER, ENGINEER, the public as applicable, and other entities as required.

3. Response coordination procedures between CONTRACTOR, OWNER, and others as appropriate.
4. Site plan showing proposed location of Constituents of Concern storage area and location of spill containment/response equipment, and location of storm water drainage inlets and drainage routes, including storm sewers, ditches and swales, and surface waters.
5. Description of Constituent of Concern handling and spill response training provided to CONTRACTOR's and Subcontractors' employees, in accordance with 29 CFR 1926.21(b) and other Laws and Regulations.
6. Comply with Section 01 35 44, Spill Prevention Control and Countermeasures Plan.

D. Storage of Materials Containing Constituents of Concern and Storage of Non-Hazardous Materials:
   1. Vessels containing materials with a Constituent of Concern shall bear applicable hazard diamond(s).
   2. Container Labeling:
      a. Properly label each container of consumable materials, whether or not classified as containing a Constituent of Concern.
      b. Stencil CONTRACTOR's name and, as applicable, Subcontractor's name, on each vessel containing a Constituent of Concern and, for non-hazardous materials, on each container over five-gallon capacity. Containers shall bear securely-attached label clearly identifying contents. Label containers that are filled from larger containers.
      c. If OWNER becomes aware of unlabeled containers at the Site, OWNER's environmental representative will so advise CONTRACTOR. Properly label container(s) within one hour of receipt of such notice from OWNER or remove container from the Site.
   3. To greatest extent possible, store off-Site materials containing a Constituent of Concern until required for use in the Work.

E. Area for Storing Materials Containing a Constituent of Concern:
   1. Maintain designated storage area for materials containing a Constituent of Concern. Storage area shall include secondary containment to prevent release of spilled or leaking substances. Storage area shall include barriers to prevent vehicles from colliding with storage containers, and shall include protection from environmental factors such as weather.
   2. Provide signage in accordance with Laws and Regulations, clearly identifying the storage area.

F. Not less than monthly, CONTRACTOR's safety representative shall meet with OWNER's environmental representative to review CONTRACTOR's HMMP documents, procedures, and inspect storage areas and the Site in general, to verify compliance with this Section.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 35 44

SPILL PREVENTION CONTROL AND COUNTERMEASURES PLAN

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. This Section pertains to spill prevention control and countermeasures applicable to the Project under the provisions of 40 CFR 112 and other Laws and Regulations.
   2. CONTRACTOR shall provide all labor, materials, equipment, tools, professional services (when required), and incidentals as shown, specified, and required to comply with Laws and Regulations regarding spill prevention control and countermeasures (SPCC) planning and compliance, including 40 CFR 112.
   3. Single Prime Contract: CONTRACTOR shall determine whether a SPCC Plan is required. If SPCC Plan is required, CONTRACTOR shall prepare, implement, and maintain SPCC Plan as required by Laws and Regulations.

1.2 DETERMINATION OF NEED FOR SPCC PLAN FOR PROJECT

A. Determination of Need for SPCC Plan:
   1. CONTRACTOR shall determine need for SPCC Plan for the Project.
   2. CONTRACTOR's Professional Engineer:
      a. If the Site will include storage of more than 10,000 gallons of oil in above-ground storage, or if the Site does not comply with oil discharge history criteria specified in 40 CFR 112, CONTRACTOR shall retain a qualified professional engineer to determine need for SPCC Plan for the Project and, if SPCC Plan is required, professional engineer shall prepare or supervise preparation of SPCC Plan for the Project.
      b. If a professional engineer is not required to prepare the full SPCC Plan for the Project, but the SPCC Plan includes environmentally-equivalent SPCC measures, or impracticality determinations, CONTRACTOR shall retain a qualified professional engineer to prepare and certify those portions of the SPCC Plan dealing with environmentally equivalent measures and impracticality determinations; the balance of the SPCC Plan may be prepared by and be self-certified by CONTRACTOR.
   3. Submit to ENGINEER letter presenting results of evaluation of whether a SPCC Plan is required for the Project in accordance with Laws and Regulations.

B. SPCC Plan is required when the Project activities at the Site meet the following criteria:

1. The Site and activities thereon are not exempt from Laws and Regulations relative to SPCC planning and implementation.
2. Oil is stored, used, transferred, or otherwise handled at the Site, unless otherwise exempted by Laws and Regulations.
3. Maximum oil storage capacity at the Site equals or exceeds either of the following thresholds: 42,000 gallons of completely-buried capacity, or 1,320 of above-ground capacity. Capacity includes total storage tank volume and operational storage volume at the Site for contractors and Subcontractors, including bulk storage tanks, containers with 55-gallon storage capacity and larger, mobile tanks located at the Site, and other containers covered by Laws and Regulations. Exempt are motive storage containers, such as those on construction equipment and vehicles. Oil includes petroleum products, fuel oil, hydraulic fluid, oil sludge, oil refuse, oil mixed with wastes other than dredged material, synthetic oil, vegetable oil, animal fats and oils, and other oils defined in Laws and Regulations.
4. There is reasonable expectation, based on location of the Site, that oil spill would reach navigable waters of the United States or adjoining shorelines.

C. When SPCC Plan is not required, CONTRACTOR shall ensure that conditions that preclude the need for SPCC Plan for the Project, including the activities of all contractors and Subcontractors working on the Project at the Site, are maintained throughout duration of the Project. Should changes that affect the storage, use, or handling of oil at the Site occur, reassess the need for SPCC Plan for the Project at no additional cost to OWNER and submit to ENGINEER evaluation letter regarding need for SPCC Plan.

1.3 SPCC PLAN AND IMPLEMENTATION

A. When SPCC Plan is required, develop SPCC Plan and submit for acceptance by OWNER, with copy to ENGINEER. SPCC Plan shall be specific to the Site and the Project and shall include the following:
1. Seal or stamp, original signature, and license number of CONTRACTOR'S professional engineer, when self-certification by CONTRACTOR is not allowed by Laws and Regulations.
2. Site plan identifying the name (or tag number) and location of each tank and container that will contain a substance regulated in 40 CFR 112 and other Laws and Regulations, including above-ground and buried tanks. Site plan shall indicate general directions of storm water runoff, including storm sewers and drainage inlets (including arrows indicating directions of flow), and storm sewer outfall locations shown and labeled.
3. For each tank and container shown or indicated on the Site plan, include a table that lists the tank or container's name and tag number, type of oil stored therein, and maximum storage capacity. List total storage capacity of all regulated tanks and containers at the Site covered by SPCC Laws and Regulations.
4. Predictions of direction, rate of flow, and total quantity of oil that could be discharged from the Site as result of storage tank or container failure.

5. Operating procedures that prevent oil spills, including procedures for oil handling, details of secondary containment structures at fuel and oil transfer areas, and details and descriptions of equipment to be used for oil handling, including piping.
6. Control Structures and Secondary Containment:
    a. Furnish details of and descriptions of control measures installed at the Site by CONTRACTOR to prevent spill from reaching navigable waters of the United States and associated shorelines, including secondary containment and diversionary structures.
    b. For on-shore Sites, one of the following must be used, at minimum: dikes, berms, or retaining walls; curbing; culverts, gutters, or other drainage systems; weirs, booms, or other barriers; spill diversion ponds; retention ponds; or sorbent materials.
    c. Where appropriate, the SPCC Plan shall clearly demonstrate that containment or diversionary structures or equipment are not practical.
    d. Include brittle fracture evaluation, where required, for field-constructed above-ground storage containers undergoing repair, alteration, construction, or change in service.
7. Plans for countermeasures to contain, clean up, and mitigate effects of oil spill that reaches navigable waters of the United States or their shorelines, including written commitment of manpower, equipment, and materials to quickly control and remove spilled oil. Include estimation of time required to contain spill after spill occurs.
8. Contact list and telephone numbers for facility response coordinator, National Response Center, cleanup contractors, and all appropriate federal, state, and local authorities having jurisdiction to be contacted in event of spill or discharge.
9. Program for monthly inspections of the Site by CONTRACTOR for SPCC Plan compliance. Advise OWNER in writing of each inspection not less than 72 hours in advance.
10. Measures for Site security relative to oil storage.
11. Procedures for safely handling mobile containers such as totes, drums, and fueling vehicles and construction equipment that remain at the Site.
12 Procedures and schedules for periodic testing of integrity of tanks and containers, and associated piping and valves.
13. Plans for bulk storage container compliance.
14. Plans for personnel training and oil spill prevention briefings.
15. For SPCC Plans that do not follow the format listed in Laws and Regulations, provide cross-reference to requirements of Laws and Regulations, including 40 CFR 112.7.

B. Obtain acceptance of SPCC Plan by OWNER, for coordination with OWNER's Site-specific SPCC Plan, if any.

C. SPCC Plan shall be reviewed by CONTRACTOR's professional engineer (when professional engineer is required) and OWNER every five years, as applicable. CONTRACTOR shall perform updates and revisions of the Project's SPCC Plan

as necessary and submit same in accordance with the provisions of this Section for submittal and acceptance of initial SPCC Plan.

D. Post a copy of accepted, certified SPCC Plan in conspicuous location at the Site and furnish copies to OWNER, ENGINEER, other contractors, and Subcontractors as appropriate. All contractors shall comply with SPCC Plan.

E. In event of violation of SPCC Plan or release of oils attributable to construction operations, CONTRACTOR shall:
   1. Immediately issue notifications in accordance with Laws and Regulations, including 40 CFR 110 and 40 CFR 112. When required by Laws and Regulations, report to National Response Center, US Environmental Protection Agency, and other authorities having jurisdiction, if any.
   2. Have spill clean-up performed in accordance with Laws and Regulations, the SPCC Plan, and requirements of authorities having jurisdiction.
   3. Pay fines and civil penalties (or responsible portion thereof) imposed on OWNER by authorities having jurisdiction, and pay costs associated with clean-up of spills.
   4. Should cleanup of spills attributable to CONTRACTOR be necessary, no resulting change in the Contract Price or Contract Times will be allowed. Should CONTRACTOR share responsibility for spill and cleanup with another entity, changes in Contract Price and Contract Times, if any, will be proportionate.

1.4 QUALITY ASSURANCE

A. Qualifications:
   1. CONTRACTOR's Professional Engineer:
      a. When required by Laws and Regulations, engage a licensed, registered professional engineer legally qualified to practice in the jurisdiction where the Site is located and experienced in performing engineering services of the type required.
      b. Submit qualifications data.
      c. Responsibilities include but are not necessarily limited to:
         1) Carefully reviewing Laws and Regulations relative to SPCC.
         2) Preparing written requests for clarifications or interpretations of criteria specified in the Contract Documents for submittal to ENGINEER by CONTRACTOR, and obtaining from authorities having jurisdiction clarifications regarding Laws and Regulations as required.
         3) Preparing or supervising the preparation of letter-report evaluation of need for SPCC Plan in accordance with the Contract Documents. Evaluation shall include professional engineer's seal or stamp, registration number, and original signature.
         4) When SPCC Plan is required, preparing, supervising the preparation of, or reviewing the SPCC Plan (or designated portions thereof when oil storage at the Site will be 10,000 gallons or less) in

accordance with the Contract Documents. SPCC Plan (or designated portions thereof) shall include professional engineer's seal or stamp, registration number, and original signature.

5) Periodically re-evaluating the need for SPCC Plan and issuing findings as letter-reports with seal or stamp, license number, and signature. When SPCC Plan is required, periodically evaluating the SPCC Plan and providing recommendations for compliance with Laws and Regulations, in accordance with the Contract Documents.
6) Certifying that:
   a) it is familiar with the Laws and Regulations, including 40 CFR 112, and
   b) it has visited, examined, and is familiar with the Site, planned modifications to the Site under the Project as such modifications pertain to SPCC Laws and Regulations, and
   c) it has performed the evaluations and prepared SPCC Plan in accordance with the Contract Documents, and
   d) procedures for required testing and inspections have been established, and
   e) the said evaluations and SPCC Plan are adequate for the Project, and
   f) the said evaluations and SPECC Plan complies with Laws and Regulations, applicable industry standards, and to prevailing standards of practice.

1.5 SUBMITTALS

A. Informational Submittals: Submit the following:
   1. Certifications: With each evaluation letter and SPCC Plan submittal, include certification signed by preparer of submittal that the submittal complies with the Contract Documents and Laws and Regulations. Signature on all certifications shall be original.
   2. Evaluations:
      a. Submit letter presenting results of evaluation of whether a SPCC Plan is required for the Project. Submit evaluation not later than fourteen days after the Contract Times commence running, unless longer time is allowed by ENGINEER.
      b. Submit updated evaluations as required when conditions at the Site change. Submit updated evaluation not later than seven days after the conditions at the Site change, or within seven days of ENGINEER's request, unless longer time is allowed by ENGINEER.
   3. SPCC Plan: When SPCC Plan is required:
      a. Submit jointly to OWNER and ENGINEER. Submit within 14 days of receipt of ENGINEER's acceptance of evaluation submittal.
      b. Update and resubmit the SPCC Plan, or acceptable SPCC Plan amendments, as required when conditions at the Site change. Submit updated SPCC Plan or amendments not later than seven days after the change in conditions at the Site change giving rise to the SPCC Plan

change or amendment, or within seven days of ENGINEER's request, unless longer time is allowed by ENGINEER.

4. SPPC Plan Distribution: When SPCC Plan is required, submit copies of letters transmitting SPCC Plan and amendments (if any) to contractors and Subcontractors working at the Site.
5. Qualifications Statements: CONTRACTOR's professional engineer, when requested by ENGINEER or OWNER.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 42 00

REFERENCES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Section includes the following:
      a. Definitions and terminology in general use in the Contract Documents.
      b. Applicable codes.
      c. Abbreviations in general use throughout the Contract Documents.
      d. General requirements regarding reference standards, including a listing of standard-issuing organizations (and their acronyms) used in the Contract Documents.

1.2 DEFINITIONS AND TERMINOLOGY

A. Definitions and terminology applicable to all the Contract Documents are included in the General Conditions, as may be modified by the Supplementary Conditions.

B. Additional terminology used in the Contract Documents includes the following:
   1. "Indicated" refers to graphic representations, notes, or schedules on the Drawings, or to other paragraphs, provisions, tables, or schedules in the Specifications and similar locations in the other Contract Documents. Terminology such as "shown", "noted", "scheduled", and "specified" are used to help the user locate the reference without limitation on the location.
   2. "Installer", "applicator", or "erector" is CONTRACTOR or another person or entity engaged by CONTRACTOR, either as an employee or Subcontractor, to perform a particular construction activity, including installation, erection, application, or similar Work. Installers shall be experienced in the Work that installer is engaged to perform.
      a. The term "experienced", when used in conjunction with the term "installer", means having successfully completed not less than five previous projects similar in size and scope to this Project; being familiar with the special requirements indicated and required; being familiar with Laws and Regulations; and having complied with requirements of authorities having jurisdiction, and complying with requirements of the Supplier of the material or equipment being installed, unless other experience requirements specific to that element of the Work are indicated elsewhere in the Contract Documents.
   3. Trades: Use of terms such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter", unless

otherwise indicated in the Contract Documents or required by Laws or Regulations. Such terminology also does not imply that specified requirements apply exclusively to trade personnel of the corresponding generic name.

1.3 APPLICABLE CODES

A. References in the Contract Documents to local code(s) shall mean the following:
   1. City of Canton, Ohio, Building Code.
   2. City of Canton, Ohio, Fire Ordinances.
   3. National Electric Code in effect at the location of the Project.
   4. NFPA 101, Life Safety Code.

1.4 ABBREVIATIONS

A. Common abbreviations that may be found in the Contract Documents are indicated below, alphabetically by their written-out meaning:

alternating current	a-c
ampere	A
antemeridian	a.m.
Architectural Barriers Act	ABA
Americans with Disabilities Act	ADA
Americans with Disabilities Act Accessibility Guidelines	ADAAG
ante meridian	a.m.
average	avg
biochemical oxygen demand	BOD
five-day biochemical oxygen demand	BOD_5
brake horsepower	bhp
British thermal unit	Btu
building information model	BIM
carbonaceous biochemical oxygen demand	CBOD
five-day carbonaceous biochemical oxygen demand	$CBOD_5$
chemical oxygen demand	COD
Centigrade (or Celsius)	C
chlorinated polyvinyl chloride	CPVC
chlorofluorocarbons	CFC
Code of Federal Regulations	CFR
computer-aided drafting and design	CADD, or CAD
cubic inch	cu in
cubic foot	cu ft

cubic yard		cu yd, or CY
cubic feet per minute		cfm
cubic feet per second		cfs
decibel		db
degree Centigrade (or Celsius)	(Write)	degrees C, ^{o}C, or deg C
degrees Fahrenheit		degrees F, ^{o}F, or deg F
diameter		dia
direct current		d-c
dollars		$
each		ea
efficiency		eff
Fahrenheit		F
feet		ft
feet per hour		fph, or ft/hr
feet per minute		fpm
feet per second		fps, or ft/min
figure		fig
flange		flg
foot-pound		ft-lb
gallon		gal
gallons per hour		gph, or gal/hr
gallons per minute		gpm
gallons per second		gps
gram		g
grams per liter		g/L
Hertz		Hz
horsepower		hp or HP
hour		hr
human-machine interface		HMI
inch		in.
inches of mercury		in. Hg
inches water gage		in. w.g.
inch-pound		in.-lb
inside diameter		ID
iron pipe size		IPS
thousand pounds		kips

thousand pounds per square inch	ksi
kilovolt-ampere	kva
kilowatt	kw
kilowatt-hour	kwhr or kwh
linear foot	lin ft or LF
liter	L
Leadership in Energy and Environmental Design (USGBC)	LEED
maximum	max
mercury	Hg
milligram	mg
milligrams per liter	mg/l or mg/L
milliliter	ml
millimeter	mm
million gallons per day	mgd or MGD
million gallon	MG
minimum	min
national pipe threads	NPT
net positive suction head	NPSH
net positive suction head available	NPSHA
net positive suction head required	NPSHR
nitrogen oxide (total concentration of mono-nitrogen oxides such as nitric oxide (NO) and nitrogen dioxide (NO_2))	NOx
nominal pipe size	NPS
number	no.
operator interface terminal	OIT
ounce	oz
ounce-force	ozf
outside diameter	OD
parts per hundred	pph
parts per million	ppm
parts per billion	ppb
polyvinyl chloride	PVC
post meridian	p.m.
pound	lb
pounds per square inch	psi
pounds per square inch absolute	psia

pounds per square inch gauge	psig
pounds per square foot	psf
process control system	PCS
programmable logic controller	PLC
revolutions per minute	rpm
second	sec
specific gravity	sp gr, or SG
square	sq
square foot	sq ft, sf, or ft^2
square inch	sq in., or in^2
square yard	sq yd, or SY
standard	std
standard cubic feet per minute	scfm
total dynamic head	TDH
totally-enclosed fan-cooled	TEFC
volt	V
volts alternating current	vac
volts direct current	vdc
volatile organic compounds	VOC

1.5 REFERENCE STANDARDS

A. Refer to Article 3 of the General Conditions, as may be modified by the Supplementary Conditions, relative to reference standards and resolving discrepancies between reference standards and the Contract Documents. Provisions of reference standards are in effect in accordance with the Specifications.

B. Copies of Standards: Each entity engaged in the Work shall be familiar with reference standards applicable to its construction activity. Copies of applicable reference standards are not bound with the Contract Documents. Where reference standards are needed for a construction activity, obtain copies of standards from the publication source.

C. Abbreviations and Names: Where reference standards, specifications, codes, manuals, Laws or Regulations, or other published data of international, national, regional or local organizations are referred to in the Contract Documents, the organization issuing the standard may be referred to by their acronym or abbreviation only. The following acronyms or abbreviations that may appear in the Contract Documents shall have the meanings indicated below. Listing is alphabetical by acronym.

AA	Aluminum Association
AABC	Associated Air Balance Council
AAMA	American Architectural Manufacturers Association
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
ACS	American Chemical Society
ADSC-IAFD	International Association of Foundation Drilling.
AEIC	Association of Edison Illuminating Companies
AF&PA	American Forest and Paper Association
ABMA	American Bearing Manufacturers Association (formerly Anti-Friction Bearing Manufacturers Association (AFBMA))
AGMA	American Gear Manufacturers Association
AI	Asphalt Institute
AIA	American Institute of Architects
AIChE	American Institute of Chemical Engineers
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
ALSC	American Lumber Standards Committee
AMA	Acoustical Materials Association
AMCA	Air Movement and Control Association
AMP	National Association of Architectural Metal Manufacturers, Architectural Metal Products Division
ANSI	American National Standards Institute
APA	The Engineered Wood Association
APHA	American Public Health Association
API	American Petroleum Institute
AREA	American Railway Engineering Association
ARI	Air Conditioning and Refrigeration Institute
ASAE	American Society of Agricultural Engineers
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASNT	American Society for Non-Destructive Testing
ASQ	American Society for Quality

ASSE	American Society of Safety Engineers
ASTM	American Society for Testing and Materials
AWCI	Association of the Wall and Ceiling Industry
AWI	Architectural Woodwork Institute
AWPA	American Wood Protection Association
AWPI	American Wood Preservers Institute
AWS	American Welding Society
AWWA	American Water Works Association
BAAQMD	Bay Area Air Quality Management District
BHMA	Builders Hardware Manufacturers Association
BIA	Brick Industry Association
CBMA	Certified Ballast Manufacturers Association
CDA	Copper Development Association
CEMA	Conveyor Equipment Manufacturers Association
CGA	Compressed Gas Association
CISCA	Ceilings and Interior Systems Construction Association
CISPI	Cast Iron Soil Pipe Institute
CLFMI	Chain Link Fence Manufacturers Institute
CMAA	Crane Manufacturers Association of America
CRSI	Concrete Reinforcing Steel Institute
CSI	Construction Specifications Institute
DIN	Deutsches Institut fur Normung eV (German Institute for Standardization)
DIPRA	Ductile Iron Pipe Research Association
EJCDC	Engineers Joint Contract Documents Committee
EJMA	Expansion Joint Manufacturers Association, Inc.
ETL	Intertek Testing Services, Inc. (formerly ETL Testing Laboratories, Inc.)
FCC	Federal Communications Commission
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FM	Factory Mutual (FM Global)
FRPI	Fiberglass Reinforced Plastics Institute
FS	Federal Specification
GA	Gypsum Association
GANA	Glass Association of North America
HEW	United States Department of Health, Education and Welfare
HI	Hydraulic Institute

HMI	Hoist Manufacturers Institute
HUD	United States Department of Housing and Urban Development
IBC	International Building Code
ICC	International Code Council
ICEA	Insulated Cable Engineers Association
IEEE	Institute of Electrical and Electronics Engineers
IESNA	Illuminating Engineering Society of North America
IFI	Industrial Fasteners Institute
IRI	Industrial Risk Insurers
ISA	Instrumentation, Systems, and Automation Society (formerly Instrument Society of America)
ISO	Insurance Services Office
ISO	International Organization for Standardization
LPI	Lightning Protection Institute
MIA	Marble Institute of America
ML/SFA	Metal Lath/Steel Framing Association
MS	Military Specifications
MSS	Manufacturers' Standardization Society
MMA	Monorail Manufacturers Association
NAAMM	National Association of Architectural Metal Manufacturers
NACE	National Association of Corrosion Engineers
NAPF	National Association of Pipe Fabricators, Inc.
NARUC	National Association of Regulatory Utilities Commissioners
NBHA	National Builders Hardware Association
NBS	United States Department of Commerce, National Bureau of Standards
NCMA	National Concrete Masonry Association
NEC	National Electric Code
NELMA	Northeastern Lumber Manufacturers' Association
NEMA	National Electrical Manufacturers Association
NESC	National Electrical Safety Code
NETA	International Electrical Testing Association
NFPA	National Fire Protection Association
NFRC	National Fenestration Rating Council
NGA	National Glass Association
NHLA	National Hardwood Lumber Association
NHPMA	Northern Hardwood and Pine Manufacturers Association
NIST	United States Department of Commerce, National Institute of Standards and Technology

NLGA	National Lumber Grades Authority
NRCA	National Roofing Contractors Association
NRMCA	National Ready Mixed Concrete Association
NSF	National Sanitation Foundation
NSSGA	National Stone, Sand, and Gravel Association
NTMA	National Terrazzo and Mosaic Association
OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
PCI	Precast/Prestressed Concrete Institute
PEI	Porcelain Enamel Institute
PFI	Pipe Fabrication Institute
PPI	Plastics Pipe Institute
PGMC	Primary Glass Manufacturers Council
PS	Product Standards Section, United States Department of Commerce
RCSC	Research Council on Structural Connections (part of AISC)
RMA	Rubber Manufacturers Association
SAE	Society of Automotive Engineers
SCAQMD	Southern California Air Quality Management District
SCPRF	Structural Clay Products Research Foundation
SCTE	Society of Cable Telecommunications Engineers
SDI	Steel Deck Institute
SDI	Steel Door Institute
SIGMA	Sealed Insulating Glass Manufacturing Association
SJI	Steel Joist Institute
SMACNA	Sheet Metal and Air Conditioning Contractor’s National Association
SPI	Society of the Plastics Industry
SPIB	Southern Pine Inspection Bureau
SSPC	Society for Protective Coatings
SWI	Steel Window Institute
TCNA	Tile Council of North America
TEMA	Tubular Exchanger Manufacturers Association
TIA/EIA	Telecommunications Industry Association/Electronic Industries Alliance
UL	Underwriters Laboratories, Inc.
USAB	United States Access Board
USDOE	United States Department of Energy
USEPA	United States Environmental Protection Agency

USGBC	United States Green Building Council
USGS	United States Geological Survey
USPHS	United States Public Health Service
WCLIB	West Coast Lumber Inspection Bureau
WCMA	Window Covering Manufacturers Association
WCMA	Wood Component Manufacturers Association
WDMA	Window and Door Manufacturers Association
WEF	Water Environment Federation
WWEMA	Water and Wastewater Equipment Manufacturers Association
WWPA	Western Wood Products Association

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 45 29.13

TESTING LABORATORY SERVICES FURNISHED BY CONTRACTOR

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall employ and pay for services of independent testing laboratory to perform specified services.
   2. Inspection, sampling, and testing shall be as specified in the Specifications including but not limited to:
      a. Section 03 30 00, Cast-in-Place Concrete.
      b. Section 03 60 00, Grouting.
      c. Section 05 05 33, Anchor Systems.
      d. Section 09 91 00, Painting.
      e. Section 50 05 05, Exposed Piping Installations.
      f. Other tests indicated in the Contract Documents that are not specifically assigned to others.
   3. CONTRACTOR shall pay for:
      a. Tests not specifically indicated in the Contract Documents as being OWNER's responsibility.
      b. Tests made for CONTRACTOR's convenience.
      c. Repeat tests required because of CONTRACTOR's negligence or defective Work, and retesting after failure of test for the same item to comply with the Contract Documents.
   4. Testing laboratory is not authorized to approve or accept any portion of the Work or defective Work; rescind, alter, or augment requirements of Contract Documents; and perform duties of CONTRACTOR.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. ASTM E329, Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.
   2. ISO/IEC 17025, General Requirements for the Competence of Testing and Calibration Laboratories.
   3. NIST SRM, Standard Reference Materials.

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Testing Laboratory:
      a. Comply with applicable requirements of ASTM E329.

b. Testing laboratory shall be licensed to operate in the same jurisdiction as the Site. Where applicable, laboratory shall be certified by the authority having jurisdiction for the types of testing required.
c. Testing equipment used by laboratory shall be calibrated at intervals of not more than twelve months by devices of accuracy traceable to one of the following: NIST SRM, ISO/IEC 17025, certified by state or local bureau of weights and measures, or values of natural physical constants generally accepted in the engineering and scientific community.

1.4 SUBMITTALS

A. Informational Submittals: Submit the following:
1. Quality Control Submittals and Test Reports: Testing laboratory shall promptly submit to CONTRACTOR results of testing and inspections, including:
a. Date issued.
b. Project title, number, and name of the Site.
c. Testing laboratory name and address.
d. Name and signature of inspector or person obtaining samples.
e. Date of inspection or sampling.
f. Record of temperature and weather conditions.
g. Date of test.
h. Identification of material or item tested, and associated Specifications Section.
i. Location in the Project.
j. Type of inspection or test.
k. Results of tests and observations regarding compliance with the Contract Documents.
2. Qualifications Statements:
a. Testing Laboratory:
1) Qualifications statement indicating experience and facilities for tests required under the Contract Documents.
2) Copy of report of inspection of facilities during most recent NIST inspection tour. Include memorandum of remedies of deficiencies reported during inspection.
3) Copy of certificate of calibration for each instrument or measuring device proposed for use, by accredited calibration agency.

1.5 TESTING LABORATORY DUTIES

A. Testing laboratory shall:
1. Cooperate with CONTRACTOR and provide qualified personnel promptly on notice.
2. Perform required inspections, sampling, and testing of materials and methods of construction; comply with applicable reference standards and the Contract Documents; and ascertain compliance with requirements of the Contract Documents.

3. Promptly notify ENGINEER and CONTRACTOR of irregularities or deficiencies in the Work that are observed during performance of services.
4. Promptly submit to CONTRACTOR reports of inspections and tests.
5. Perform additional tests and services, as required by CONTRACTOR.

1.6 CONTRACTOR'S RESPONSIBILITIES

A. CONTRACTOR shall:
   1. Cooperate with testing laboratory personnel.
   2. Provide to testing laboratory preliminary representative samples of materials and items to be tested, in required quantities.
   3. Promptly submit to ENGINEER results of tests and inspections received from testing laboratory.
   4. Furnish to laboratory the preliminary design mix proposed for concrete and other material mixes to be tested by testing laboratory.
   5. Provide labor and facilities:
      a. For access to the Work to be tested, and where required, to Suppliers' operations.
      b. For obtaining and handling samples at the Site.
      c. For facilitating inspections and tests.
      d. For testing laboratory's exclusive use for storing and curing of test samples.
      e. Forms for preparing concrete test beams and cylinders.
   6. Notify laboratory and ENGINEER sufficiently in advance of operations to allow assignment of personnel and scheduling of tests.
   7. Arrange with laboratory and pay for additional services, sampling, and testing required for CONTRACTOR's convenience.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 45 33

CODE-REQUIRED SPECIAL INSPECTIONS AND PROCEDURES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope
   1. CONTRACTOR shall provide labor, materials, tools, equipment, and incidentals as shown, specified, and required to cooperate with the Coordinating Special Inspector, individual special inspectors, and testing agencies employed by OWNER, to facilitate Special Inspections.
   2. Supplement A, Statement of Special Inspections, included with this Section, lists testing and inspections required.

1.2 DEFINITIONS

A. Coordinating Special Inspector: Professional engineer or architect, hired by OWNER, registered in the same state as the Site, responsible for coordinating and verifying the inspection and testing required by the Statement of Special Inspections included in this Section and reporting to the Building Official.

B. Building Official: Officer or other designated authority having jurisdiction charged with the administration and enforcement of the governing building code, or a duly authorized representative.

C. Special Inspections: Testing and inspection required in Supplement A, Statement of Special Inspections, of this Section.

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. OWNER will employ and pay for services of the Coordinating Special Inspector, who will have not less than five years of experience in managing,
   2. Inspectors will be qualified in the responsibilities of the Special Inspection for which each is responsible.

B. Regulatory Requirements:
   1. Special Inspections will be in accordance with applicable building code and other Laws and Regulations, and Supplement A, Statement of Special Inspections, of this Section.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Samples: Representative Samples of materials when required by ENGINEER.

B. Informational Submittals: Submit the following:
   1. Completed Supplement D, Fabricator's Certificate of Compliance, as attached to this Section, for fabrication of structural steel.

1.5 CONTRACTOR'S RESPONSIBILITIES

A. Provide safe access to the Work to be tested and inspected.

B. Provide assistance in obtaining and handling test samples at the Site.

C. Facilitate inspections and tests.

D. Provide access to Suppliers' and Subcontractors' operations as required.

E. Notify Coordinating Special Inspector and ENGINEER sufficiently in advance of the Work for the Coordinating Special Inspector and ENGINEER to coordinate their personnel at the Site. Do not cover the Work to be inspected until Special Inspection has been completed and the results thereof are acceptable.

F. Special Inspections required in this Section do not supersede or make unnecessary inspections and tests required under other Specification Sections or standard inspections required by Laws and Regulations.

1.6 COORDINATING SPECIAL INSPECTOR'S RESPONSIBILITIES

A. Coordinating Special Inspector will:
   1. Complete Supplement A, Statement of Special Inspections, of this Section to provide names of each inspector and testing agency for each Special Inspection required
   2. Engage services of inspectors and testing agencies for Special Inspections in accordance with Supplement A, Statement of Special Inspections, of this Section and as required by Laws and Regulations.
   3. Coordinate activities of individual inspectors and testing agencies with CONTRACTOR.
   4. Provide interim reports of inspections and material testing to Building Official, OWNER, ENGINEER, and ENGINEER's consultants, including structural engineer and architect.
   5. To obtain certificate of use and occupancy from the Building Official, complete and provide to the Building Official, OWNER, and ENGINEER Supplement B, Final Report of Special Inspections, of this Section, documenting completion of Special Inspections and correction of discrepancies noted in the Special Inspections.

1.7 INSPECTOR RESPONSIBILITIES

A. Perform specified inspections, sampling, and testing of materials and methods of construction; review and ascertain compliance with Laws and Regulations.

B. Promptly notify Coordinating Special Inspector, OWNER, ENGINEER and CONTRACTOR of irregularities or deficiencies in the Work observed during Special Inspections. Corrective action, if required, will be determined by ENGINEER.

C. Promptly submit two copies of each report of inspections and tests to Coordinating Special Inspector, ENGINEER, and CONTRACTOR including:
   1. Date issued.
   2. Project title and number.
   3. Name and signature of inspector.
   4. Date of inspection or sampling and test.
   5. Record of temperature and weather.
   6. Identification of product and Specification Section.
   7. Location in Project.
   8. Type of inspection or test.
   9. Results of inspections and tests, and observations regarding compliance with Laws and Regulations, and standards.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 SUPPLEMENTS

A. The supplements listed below, following the "End of Section" designation, are part of this Section:
   1. Supplement A – Statement of Special Inspections
   2. Supplement B – Final Report of Special Inspections
   3. Supplement D – Fabricator's Certificate of Compliance

+ + END OF SECTION + +

Supplement A - Statement of Special Inspections

Project:

Location:

Owner:

Design Professional in Responsible Charge:

This *Statement of Special Inspections* is submitted as a condition for permit issuance in accordance with the Special Inspection and Structural Testing requirements of the Building Code. It includes a schedule of Special Inspection services applicable to the Project as well as the name of the Coordinating Special Inspector and the identity of other approved agencies to be retained for conducting these inspections and tests. This *Statement of Special Inspections* encompass the following disciplines:

☒ Structural ☐ Mechanical/Electrical
☐ Architectural ☐ Other: _____

The Coordinating Special Inspector shall keep records of all inspections and shall furnish inspection reports to the Building Official and the Registered Design Professional in Responsible Charge. Discovered discrepancies shall be brought to the immediate attention of the Contractor for correction. If such discrepancies are not corrected, the discrepancies shall be brought to the attention of the Building Official and the Registered Design Professional in Responsible Charge. The Special Inspection program does not relieve the Contractor of his or her responsibilities.

Inspections listed are periodic unless indicated to be continuous or required by code to be continuous.

Interim reports shall be submitted to the Building Official and the Registered Design Professional in Responsible Charge.

A *Final Report of Special Inspections* documenting completion of all required Special Inspections, testing and correction of any discrepancies noted in the inspections shall be submitted prior to issuance of a Certificate of Use and Occupancy.

Job site safety and means and methods of construction are solely the responsibility of the Contractor.

Interim Report Frequency: Weekly or ☐ per attached schedule.

Prepared by:

_____
(type or print name)

_____
Signature Date

Design Professional Seal

Owner's Authorization:

Signature Date

Building Official's Acceptance:

Signature Date

Schedule of Inspection and Testing Agencies

This Statement of Special Inspections / Quality Assurance Plan includes the following building systems:

- ☐ Soils and Foundations
- ☒ Cast-in-Place Concrete
- ☐ Precast Concrete
- ☐ Masonry
- ☒ Structural Steel
- ☐ Cold-Formed Steel Framing
- ☐ Spray Fire Resistant Material
- ☐ Wood Construction
- ☐ Exterior Insulation and Finish System
- ☐ Mechanical & Electrical Systems
- ☒ Anchor Systems
- ☐ Special Cases

Note: The inspectors and testing agencies will be engaged by Owner or Owner's Agent, and not by Contractor or Subcontractor whose Work is to be inspected or tested. Conflicts of interest must be disclosed to the Building Official prior to commencing the Work.

Qualifications of Inspectors and Testing Technicians

The qualifications of all personnel performing Special Inspections are subject to the approval of the Building Official. The credentials of all inspectors and testing technicians shall be provided if requested.

Key for Minimum Qualifications of Inspection Agents:

When Engineer deems it appropriate that the individual performing a stipulated test or inspection have a specific certification or license as indicated below, such designation shall appear below the *Agency Number* on the Schedule.

PE/SE	Structural Engineer – a licensed SE or PE specializing in the design of building structures
PE/GE	Geotechnical Engineer – a licensed PE specializing in soil mechanics and foundations
EIT	Engineer-In-Training – a graduate engineer who has passed the Fundamentals of Engineering examination

American Concrete Institute (ACI) Certification

ACI-CFTT	Concrete Field Testing Technician – Grade 1
ACI-CCI	Concrete Construction Inspector
ACI-LTT	Laboratory Testing Technician – Grade 1&2
ACI-STT	Strength Testing Technician

American Welding Society (AWS) Certification

AWS-CWI	Certified Welding Inspector
AWS/AISC-SSI	Certified Structural Steel Inspector

American Society of Non-Destructive Testing (ASNT) Certification

ASNT	Non-Destructive Testing Technician – Level II or III.

International Code Council (ICC) Certification

ICC-SMSI	Structural Masonry Special Inspector
ICC-SWSI	Structural Steel and Welding Special Inspector
ICC-SFSI	Spray-Applied Fireproofing Special Inspector
ICC-PCSI	Prestressed Concrete Special Inspector
ICC-RCSI	Reinforced Concrete Special Inspector

National Institute for Certification in Engineering Technologies (NICET)

NICET-CT	Concrete Technician – Levels I, II, III & IV
NICET-ST	Soils Technician - Levels I, II, III & IV
NICET-GET	Geotechnical Engineering Technician - Levels I, II, III & IV

Exterior Design Institute (EDI) Certification

EDI-EIFS EIFS Third Party Inspector

Other

Cast-in-Place Concrete

Item	Agency # (Qualif.)	Scope
1. Mix Design	*ACI-CCI ICC-RCSI*	*Review concrete batch tickets and verify compliance with approved mix design. Verify that water added at the site does not exceed that allowed by the mix design.*
2. Material Certification	*PE/SE*	*Review trial batch or supporting test data to verify mix meets specified requirements. Confirm materials meet specified requirements.*
3. Reinforcement Installation	*ACI-CCI ICC-RCSI*	*Inspect size, spacing, cover, positioning and grade of reinforcing steel. Verify that reinforcing bars are free of form oil or other deleterious materials. Inspect bar laps and mechanical splices. Verify that bars are adequately tied and supported on chairs or bolsters*
4. Formwork Geometry		*Inspect formwork for proper materials, dimensions and alignment.*
5. Anchor Rods	*ACI-CCI ICC-RCSI*	*Inspect size, positioning and embedment of anchor rods. Inspect concrete placement and consolidation around anchors. (continuous)*
6. Concrete Placement	*ACI-CCI ICC-RCSI*	*Inspect placement of concrete. Verify that concrete conveyance and depositing avoids segregation or contamination. Verify that concrete is properly consolidated. (continuous)*
7. Sampling and Testing of Concrete	*ACI-CFTT ACI-STT*	*Test concrete compressive strength (ASTM C31 & C39), slump (ASTM C143), air-content (ASTM C231) and temperature (ASTM C1064).*
8. Curing and Protection	*ACI-CCI ICC-RCSI*	*Inspect curing, cold weather protection and hot weather protection procedures.*
9. Other:		

Structural Steel

Item	Agency # (Qualif.)	Scope
1. Fabricator Certification/ Quality Control Procedures ☐ Fabricator Exempt	*PE/SE* *AWS/AIS C-SSI ICC-SWSI*	• *Verify fabricator has certification from AISC for conventional buildings of the AISC Quality Certification Program and has approval by the Building Official.* • *Review fabricator's certificate of compliance.*
2. Material Certification	*AWS/AIS C-SSI ICC-SWSI*	*Review certified mill test reports and identification markings on wide-flange shapes, high-strength bolts, nuts and welding electrodes*
3. Bolting	*AWS/AIS C-SSI ICC-SWSI*	*Inspect installation and tightening of high-strength bolts. Verify that splines have separated from tension control bolts. Verify proper tightening sequence. Continuous inspection of bolts in slip-critical connections.*
4. Welding	*AWS-CWI* *ASNT*	• *Visually inspect all welds. Inspect pre-heat, post-heat and surface preparation between passes. Verify size and length of fillet welds. (continuous for all field welds)*
5. Structural Details	*PE/SE*	*Inspect steel frame for compliance with structural drawings, including bracing, member configuration and connection details.*
6. Other:		

Anchor Systems

Item	Agency # (Qualif.)	Scope
1. Material Certification	*PE/SE*	• *Confirm anchor type (including product name), anchor dimensions, and anchor material grade for each anchor application.* • *Confirm post-installed anchor compliance with specified requirements and suitability for each application type by review of the anchor system ICC-ES Evaluation Service Report.* • *For adhesive anchors, confirm adhesive type*
2. Installation of Adhesive Anchors for Concrete, Grout-filled Masonry, and Hollow Concrete Masonry	ICC-RCSI ICC-SMSI	• *Review compliance with the installation requirements of the anchor system ICC Evaluation Service Report.* • *Verify and record anchor type (including product name), anchor dimensions, anchor material grade, adhesive type, adhesive expiration date, concrete or masonry type, base material compressive strength, drill bit type, hole dimensions, hole cleaning procedures, anchor spacing, edge distances, base material thickness, anchor embedment, curing period prior to tightening, and tightening torque.* • *Inspect installation of each type and size of adhesive anchor by construction personnel on the site. (continuous)*
3. Installation of Concrete and Grout-filled Masonry Wedge Expansion Anchors	ICC-RCSI ICC-SMSI	• *Review compliance with the installation requirements of the anchor system ICC Evaluation Service Report.* • *Verify and record anchor type (including product name), anchor dimensions, anchor material grade, concrete or masonry type, base material compressive strength, drill bit type, hole dimensions, hole cleaning procedures, anchor spacing, edge distances, base material thickness, anchor embedment and tightening torque.* • *Inspect installation of each type and size of wedge anchor by construction personnel on the site. (continuous)*
4. Anchor Testing	ASNT	• *Perform tension pullout test on 10 percent of each post-installed anchor type and size.*

Supplement B - Final Report of Special Inspections

Project:

Location:

Owner:

Owner's Address:

Structural Engineer of Record:

To the best of my information, knowledge and belief, the Special Inspections required for this project, and itemized in the *Statement of Special Inspections* submitted for permit, have been performed and all discovered discrepancies have been reported and resolved other than the following:

Comments:

(Attach continuation sheets if required to complete the description of corrections.)

Interim reports submitted prior to this final report form a basis for and are to be considered an integral part of this final report.

Respectfully submitted,
Special Inspector

(Type or print name)

Signature Date

Licensed Professional Seal

Agent's Final Report

Project:

Agent:

Special Inspector:

To the best of my information, knowledge and belief, the Special Inspections or testing required for this project, and designated for this Agent in the *Statement of Special Inspections* submitted for permit, have been performed and all discovered discrepancies have been reported and resolved other than the following:

Comments:

(Attach continuation sheets if required to complete the description of corrections.)

Interim reports submitted prior to this final report form a basis for and are to be considered an integral part of this final report.

Respectfully submitted,
Agent of the Special Inspector

(Type or print name)

Signature Date

Licensed Professional Seal or Certification

Supplement D - Fabricator's Certificate of Compliance

Each approved fabricator that is exempt from Special Inspection of shop fabrication and implementation procedures per section 1704.2 of the International Building Code must submit a *Fabricator's Certificate of Compliance* at the completion of fabrication.

Project:

Fabricator's Name:

Address:

Certification or Approval Agency:

Certification Number:

Date of Last Audit or Approval:

Description of structural members and assemblies that have been fabricated:

I hereby certify that items described above were fabricated in strict accordance with the Contract Documents.

_____ _____
Signature Date

_____
Title

Attach copies of fabricator's certification or building code evaluation service report and fabricator's quality control manual.

SECTION 01 51 05

TEMPORARY UTILITIES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all temporary utilities and temporary facilities required for the Project, including the following:
      a. Electricity.
      b. Lighting.
      c. Telephone and communications.
      d. Heating, cooling, ventilating, and temporary enclosures.
      e. Water.
      f. Sanitary facilities.
      g. First-aid facilities.
      h. Fire protection.
   2. Make all arrangements with utility owners for temporary utilities and with others as appropriate for temporary facilities. Obtain required permits and approvals for temporary utilities and temporary facilities.
   3. Pay all service costs for utilities and facilities indicated in this Section as CONTRACTOR's responsibility, including cost of electricity, water, fuel, and other utility services and temporary facilities required for the Work.
   4. Continuously maintain adequate temporary utilities and temporary facilities for all purposes for the Project, until removal of temporary utilities and temporary facilities. At minimum, provide and maintain temporary utilities and temporary facilities through Substantial Completion and removal of temporary field offices and sheds unless otherwise approved in writing by ENGINEER.
   5. Should OWNER occupy part of the Work prior to Substantial Completion of the entire Work, cost of utilities consumed via temporary utilities serving the portion occupied by OWNER will be shared proportionately by OWNER and CONTRACTOR as mutually agreed to by the parties.
   6. Maintain, including cleaning, temporary utilities and temporary facilities, and continuously provide consumables as required.
   7. Temporary utilities and temporary facilities shall be adequate for personnel using the Site and the needs of the Project.
   8. Provide temporary utilities and temporary facilities in compliance with Laws and Regulations and, when applicable, requirements of utility owners.

1.2 REQUIREMENTS FOR TEMPORARY UTILITIES AND TEMPORARY FACILITIES

A. Electrical:

1. Provide temporary electrical service required for the Work, including continuous power for temporary field offices and sheds. Provide temporary outlets with circuit breaker protection and ground fault protection.
2. Temporary Electricity for Work in Existing Buildings:
    a. CONTRACTOR may use existing 120-volt convenience receptacles in OWNER's existing building spaces for items such as small hand tools. CONTRACTOR need not sub-meter or reimburse OWNER for such use.
    b. CONTRACTOR shall provide its own temporary electrical power source independent of OWNER's system for uses such as welding and other temporary electricity demands requiring greater than 120-volt, single-phase power, or during times when power to existing facility is completely shut down. Temporary generators shall have appropriate environmental controls, and shall be properly-located and properly-vented to avoid posing hazards to personnel and facilities.

B. Lighting.
1. Provide lighting at the Site of not less than five foot-candles for open areas and not less than ten foot-candles for stairs and shops. Provide not less than one, 300-watt lamp every 15 feet in indoor work areas. Provide night security lighting of not less than five foot-candles within 50 feet of all parts of the Site during hours of darkness, controlled by photocell.
2. Do not work in areas with insufficient lighting. Where lighting is insufficient for the work activities to be performed, provide additional temporary lighting.
3. Provide temporary lighting sufficient for observation of the Work by ENGINEER and inspection by CONTRACTOR and authorities having jurisdiction. Where required by ENGINEER, provide additional temporary lighting.
4. Provide temporary lighting for ENGINEER's field office in accordance with Section 01 52 11, Engineer's Field Office.

C. Telephone and Communications.
1. Provide temporary telephone and communications required for CONTRACTOR's operations at the Site and for summoning emergency medical assistance.
2. Provide temporary telephone and communications for ENGINEER's field office in accordance with Section 01 52 11, Engineer's Field Office.

D. Heating, Ventilating, and Enclosures.
1. Provide sufficient temporary heating, cooling, ventilating, and enclosures to ensure safe working conditions and prevent damage to existing facilities and the Work.
2. Except where otherwise specified, temporary heating shall maintain temperature of the space served between 50 degrees F and maximum design temperature of building or facility and its contents.
3. Maintain temperature of areas occupied by OWNER's personnel or electronic equipment, including offices, lunch rooms, locker rooms, toilet rooms, and

rooms containing computers, microprocessors, and control equipment, between 65 degrees F and 80 degrees F with relative humidity less than 75 percent.

4. Required temperature range for storage areas and certain elements of the Work, including preparation of materials and surfaces, installation or application, and curing as applicable, shall be in accordance with the Contract Documents for the associated Work and the Supplier's recommended temperature range for storage, application, or installation, as appropriate.
5. Provide temporary ventilation sufficient to prevent accumulation in construction areas and areas occupied by OWNER of hazardous and nuisance levels or concentrations of dust and particulates, mist, fumes or vapors, odors, and gases, associated with construction.
6. Provide temporary enclosures and partitions required to maintain required temperature and humidity.

E. Water:
   1. General:
      a. Provide temporary water facilities including piping, valves, meters if not provided by owner of existing waterline, backflow preventers, pressure regulators, and other appurtenances. Provide freeze-protection as required.
      b. Continuously maintain adequate water flow and pressure for all purposes during the Project, until removal of temporary water systems.
   2. Water for Construction Purposes:
      a. Provide water for Site maintenance and cleaning and, water necessary for construction activities, and water for disinfecting and testing of systems.
      b. CONTRACTOR may use existing hose bibbs for short-term wash-downs and intermittent use of water for work areas in the existing building. Obtain consent of ENGINEER and OWNER if connections to existing hose bibbs and similar existing connections will be used for more than one day at a time.
   3. Water for Human Consumption and Sanitation:
      a. Provide potable water in accordance with Laws and Regulations for consumption by personnel at the Site, for field offices, and for sanitary facilities.
      b. When necessary, provide bottled, potable water for use and consumption by personnel at the Site, including CONTRACTOR, ENGINEER, and visitors to the Site.
      c. Provide temporary water for ENGINEER's field office in accordance with Section 01 52 11, Engineer's Field Office.

F. Sanitary Facilities.
   1. Provide suitably-enclosed chemical or self-contained toilets for CONTRACTOR's employees, Subcontractors, Suppliers, ENGINEER, and visitors to the Site. Location of temporary toilets shall be acceptable to OWNER and ENGINEER.
   2. Refer to Paragraph 1.2.E of this Section for requirements for water intended for

human consumption during construction.

3. Provide suitable temporary washing facilities for employees and visitors.
4. Provide temporary sanitary facilities for ENGINEER's field office in accordance with Section 01 52 11, Engineer's Field Office.

G. First-aid Facilities.

1. Provide temporary first-aid stations at or immediately adjacent to the Site's work areas, and inside CONTRACTOR's temporary field office. Locations of first-aid stations shall be determined by CONTRACTOR's safety representative. Replenish supplies in first-aid stations as items are used, prior to expiration of items, and as necessary. Monitor and log inventory of supplies in first-aid stations in accordance with requirements for monitoring and logging safety equipment as indicagted in Section 01 35 23, Safety Requirements.
2. Provide list of emergency telephone numbers at each hardwired telephone at the Site. List shall be in accordance with the list of emergency contact information required in Section 01 35 23, Safety Requirements.
3. Provide temporary first-aid facilities for ENGINEER's field office in accordance with Section 01 52 11, Engineer's Field Office.

H. Fire Protection.

1. Provide temporary fire protection, including portable fire extinguishers rated not less than 2A or 5B in accordance with NFPA 10, Portable Fire Extinguishers, for each temporary building and for every 3,000 square feet of floor area under construction.
2. Provide Class A (ordinary combustibles), Class B (combustible liquids and gases), and Class C (electrical equipment) fire extinguishers as necessary.
3. Comply with NFPA 241, Standard for Safeguarding Construction, Alternation, and Demolition Operations, and requirements of fire marshals and authorities having jurisdiction at the Site.
4. Provide temporary fire protection for ENGINEER's field office in accordance with Section 01 52 11, Engineer's Field Office.

1.3 USE OF OWNER'S SYSTEM

A. Existing Utility Systems: Do not use systems in existing buildings or structures for temporary utilities without OWNER's written permission and mutually acceptable basis agreed upon by the parties for proportionate sharing of costs between OWNER and CONTRACTOR.

B. Use of Permanent Utility Systems Provided Under the Project:

1. Permanent electrical, lighting, water, heating, ventilating, and fire protection systems and first-aid facilities may be used to provide temporary utilities and temporary facilities if the following are met:
   a. Obtain OWNER's written permission to use permanent systems.

b. Permanent systems to be used for temporary utilities or temporary facilities shall be substantial complete, including complete functionality of all controls.
c. CONTRACTOR shall pay all costs while using permanent system, including operation, maintenance, replacement of consumables, and provide replacement parts.

2. Do not use the following permanent facilities:
a. Telephone and communication facilities.
b. Sanitary facilities.

PART 2 – PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Materials and equipment for temporary utilities and temporary facilities may be new or used, but shall be adequate for purposes intended and shall not create unsafe conditions, and shall comply with Laws and Regulations.

B. Provide required materials, equipment, and facilities, including piping, cabling, controls, and appurtenances.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install temporary utilities and temporary facilities in neat, orderly, manner, and make structurally, mechanically, and electrically sound throughout.

B. Location of Temporary Utilities and Temporary Facilities:
1. Locate temporary systems for proper function and service.
2. Temporary systems shall not interfere with or provide hazards or nuisances to: the Work under this and other contracts, movement of personnel, traffic areas, materials handling, hoisting systems, storage areas, finishes, and work of utility owners and others.
3. Do not install temporary utilities on the ground, with the exception of temporary extension cords, hoses, and similar systems in place for short durations.

C. Modify and extend temporary systems as required by progress of the Work.

3.2 USE

A. Maintain temporary systems to provide safe, continuous service as required.

B. Properly supervise operation of temporary systems:
   1. Enforce compliance with Laws and Regulations.
   2. Enforce safe practices.
   3. Prevent abuse of services.
   4. Prevent nuisances and hazards caused by temporary systems and their use.
   5. Prevent damage to finishes.
   6. Ensure that temporary systems and equipment do not interrupt continuous progress of construction.

C. At end of each work day, check temporary systems and verify that sufficient consumables are available to maintain operation until work is resumed at the Site. Provide additional consumables if the supply on hand is insufficient.

3.3 REMOVAL

A. Completely remove temporary utilities, temporary facilities, equipment, and materials when no longer required. Repair damage caused by temporary systems and their removal and restore the Site to condition required by the Contract Documents; if restoration of damaged areas is not specified, restore to preconstruction condition.

B. Where temporary utilities are disconnected from existing utility, provide suitable, watertight or gastight (as applicable) cap or blind flange, as applicable, on service line, in accordance with requirements of utility owner.

C. Where permanent utilities and systems were used for temporary utilities, upon Substantial Completion replace all consumables such as filters and light bulbs and parts used during the Work.

+ + END OF SECTION + +

SECTION 01 52 13

CONTRACTOR'S FIELD OFFICE AND SHEDS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide a temporary field office for CONTRACTOR's use with not less than the minimum facilities specified.
   2. Provide required temporary storage and work sheds.
   3. Obtain and pay for required permits and utilities. Field offices and sheds shall comply with Laws and Regulations.

B. Coordination:
   1. Coordinate with OWNER, facility manager, other contractors, and others using the Site the location of field offices and sheds, including contracts indicated in Section 01 11 13, Summary of Work.

C. Location:
   1. Locate field offices and sheds in accordance with the Contract Documents and in accordance with the Site mobilization discussions at the preconstruction conference.

D. Furnish in CONTRACTOR's field office one complete set of the Contract Documents for ready reference by interested persons. In addition to the reference set, comply with Section 01 78 39, Project Record Documents and related provisions of the General Conditions, as may be modified by the Supplementary Conditions.

PART 2 – PRODUCTS

2.1 FIELD OFFICE AND SHEDS – FURNISHINGS, AND EQUIPMENT

A. Contractor's Field Office and Furnishings:
   1. Construction: As required by CONTRACTOR and sufficient for Project meetings.
   2. Utilities and Services: Provide the following:
      a. Telephone service.
      b. Computer network and related facilities as required for CONTRACTOR's needs.
      c. Electrical Service as required, including paying all costs, and interior lighting of 50 foot-candles at desktop height.

d. Heating, ventilation and air conditioning system to maintain indoor temperature of at least 65 degrees F in cold weather and no warmer than 75 degrees in warm weather, including paying all fuel and utility costs.

3. Furnishings:
   a. Conference Facilities: CONTRACTOR shall provide conference area with conference table and chairs sufficient for eight people. Conference facilities and furnishings shall be provided with suitable utilities, lighting, ventilation, and temperature controls prior to the first progress meeting, unless otherwise approved by ENGINEER.
   b. Other furnishings required by CONTRACTOR.
4. Provide on field office's exterior an identification sign displaying CONTRACTOR's company name. Maximum size of sign shall be four feet by eight feet. Sign shall be suitable for outdoor use for the duration of the Project.
5. Furnish and maintain at CONTRACTOR's field office 12 protective helmets ('hard hats") for use by visitors to the Site.

B. Contractor's Storage and Work Sheds:
   1. Provide storage and work sheds sized, furnished, and equipped to accommodate personnel, materials, and equipment involved in the Work, including temporary utility services and facilities required for environmental controls sufficient for personnel, materials, and equipment.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Installation:
   1. Install CONTRACTOR's temporary field offices, sheds, and related facilities in accordance with Laws and Regulations.
   2. Install materials and equipment, including prefabricated structures, in accordance with manufacturer's instructions.

3.2 MAINTENANCE AND REMOVAL

A. Maintenance:
   1. Clean and maintain field offices and sheds as required.
   2. Provide consumables as required.

B. Removal:
   1. Do not remove temporary field offices and sheds until after Substantial Completion of the entire Work, unless otherwise approved by ENGINEER.
   2. Remove field offices and sheds and restore areas prior to final inspection.

+ + END OF SECTION + +

SECTION 01 52 19

SANITARY FACILITIES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. This Section includes requirements for temporary sanitary facilities, including toilet facilities, drinking water for personnel, and personnel washing facilities.

CONTRACTOR shall provide all temporary sanitary facilities required for the Project.

   a. Make all arrangements with temporary sanitary facility providers for temporary sanitary services and obtain required permits and approvals for temporary sanitary facilities and associated services.
   b. Pay all costs for temporary sanitary facilities and associated services, including cost of electricity, water, fuel, and other utility services required for temporary sanitary facilities.
   c. Continuously maintain adequate temporary sanitary facilities for all purposes during the Project, until removal of temporary sanitary facilities. At minimum, provide and maintain temporary sanitary facilities through Substantial Completion and removal of temporary field offices and sheds, and at all times thereafter when CONTRACTOR is at the Site performing Work.
   d. Maintain and clean the temporary sanitary facilities and continuously provide consumables as required.
   e. Temporary sanitary facilities shall be adequate for personnel using the Site and requirements of Project.
   f. Provide temporary sanitary facilities in compliance with Laws and Regulations and, when applicable, requirements of utility owners.

1.2 REQUIREMENTS FOR TEMPORARY SANITARY FACILITIES

A. Sanitary Facilities.
   1. Portable Toilets:
      a. Provide suitably-enclosed, temporary chemical or self-contained toilets for CONTRACTOR's employees and visitors to the Site.
      b. Location of temporary toilets shall be acceptable to OWNER.
   2. Drinking Water:
      a. Provide supply of potable drinking water and related facilities and consumables for all personnel using the Site, including employees of contractors, OWNER, facility manager, ENGINEER, visitors, and others.
      b. Location of potable drinking water supply shall be as required by CONTRACTOR and convenient for access by personnel
      c. Provide potable drinking water supply and cups.

d. Replenish drinking water supply as needed. Avoid creating hazards to health and safety caused by shortages of drinking water quantity and inadequate quality.
e. Drinking water quality shall comply with Laws and Regulations.

3. Washing Facilities:
   a. Provide suitable temporary washing facilities for employees, ENGINEER, and visitors to the Site.
   b. Washing facilities shall be adequate for the nature of work underway at the Site.
   c. Properly handle, store, and dispose of sued wash water, in accordance with Laws and Regulations.

1.3 USE OF OWNER'S SYSTEM

A. Existing Sanitary Facilities:
   1. Do not use facilities in existing buildings or structures for temporary sanitary facilities without written permission of OWNER and facility manager and mutually acceptable basis agreed upon by the parties for proportionate sharing of costs between OWNER and CONTRACTOR.

PART 2 – PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Materials and equipment for temporary sanitary facilities may be new or used, but shall be adequate for purposes intended and shall not create unsafe conditions, and shall comply with Laws and Regulations.

B. Provide required materials, equipment, and facilities, including piping, wiring, and controls.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install temporary sanitary facilities in neat, orderly, manner, and make structurally, mechanically, and electrically sound throughout.

B. Location of Temporary Sanitary Facilities:
   1. Locate temporary sanitary facilities for proper function and service.
   2. Temporary sanitary facilities shall not interfere with or provide hazards or nuisances to: the Work under this and other contracts, movement of personnel, traffic areas, materials handling, hoisting systems, storage areas, finishes, and work of utility companies.

C. Modify and extend temporary sanitary facilities as required by progress of the Work.

3.2 USE

A. Maintain temporary sanitary facilities to provide safe, continuous service as required.

B. Supervision and Enforcement of Use:
   1. Properly supervise operation of temporary sanitary facilities.
   2. Enforce compliance with Laws and Regulations.
   3. Enforce safe practices.
   4. Prevent abuse of services.
   5. Prevent nuisances and hazards caused by temporary sanitary facilities and their use.
   6. Prevent damage to finishes.
   7. Ensure that temporary sanitary facilities do not interrupt continuous progress of the Work.

C. Checks and Consumables:
   1. At end of each work day, check temporary sanitary facilities and verify that sufficient consumables are available to maintain operation until work is resumed at the Site.
   2. Provide additional consumables if the supply on hand is insufficient.

3.3 REMOVAL

A. Completely remove temporary sanitary facilities and materials when no longer required. Repair damage caused by temporary sanitary facilities and their removal and restore the Site to condition required by the Contract Documents; if restoration of damaged areas is not specified, restore to pre-construction condition.

B. When permanent sanitary facilities were used for temporary sanitary facilities, immediately prior to requesting inspection for Substantial Completion, replace all consumables used during the Work and verify suitability of sanitary facilities for OWNER's permanent use. Correct deficiencies and damage.

+ + END OF SECTION + +

SECTION 01 55 13

ACCESS ROADS AND PARKING AREAS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide temporary construction roads, walks, parking areas, and appurtenances required during the Project for use by CONTRACTOR, other contractors employed on the Project, OWNER's, facility manager's, and emergency vehicles.
   2. Temporary roads and parking areas shall be designed and maintained by CONTRACTOR and shall be fully passable to vehicles in all weather conditions.

B. Use of Existing Access Roads:
   1. CONTRACTOR is allowed to use OWNER's existing roads starting on the Effective Date of the Contract and satisfying other Contract requirements relative to starting the Work.
   2. Prevent interference with traffic on existing roads and parking areas. Always keep access roads and entrances serving the Site clear and available to OWNER, facility manager, and their respective employees; emergency vehicles; and other contractors. Do not use access roads or Site entrances for parking or storage of materials or equipment.
   3. CONTRACTOR shall indemnify and hold harmless OWNER and ENGINEER from expenses and losses caused by CONTRACTOR's operations over existing roads, drives, and parking areas.
   4. Schedule deliveries to minimize use of driveways and Site entrances.

1.2 SITE ACCESS

A. Site Access:
   1. CONTRACTOR access to the Site shall be via the main entrance off of Central Ave SE.

1.3 CONTRACTOR PARKING

A. CONTRACTOR employee vehicles shall park in area(s) as designated by OWNER.

B. Park construction vehicles and equipment in work areas off of permanent roads and parking areas, in areas of the Site designated for CONTRACTOR staging.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Materials for temporary roads and parking areas shall comply with the Contract Documents' requirements for permanent roads, drives, and parking areas.

B. Traffic controls shall comply with requirements of authorities having jurisdiction. When such authority is the OWNER or facility manager, and no requirements are indicated, comply with the standard specifications of the state department of transportation in the area of the Project.

PART 3 – EXECUTION

3.1 TEMPORARY ROADS AND PARKING AREAS

A. Temporary Roads and Parking in Same Areas as Permanent Pavement:
   1. Provide temporary roads and parking areas adequate to support and withstand traffic and construction loads during the Project. Locate temporary roads and parking areas in same location as permanent roads and parking areas. Extend temporary roads and parking areas, within construction limits indicated, as required for construction operations.
   2. Coordinate elevations of temporary roads and parking areas with permanent roads and parking areas.
   3. Prepare subgrade, subbase, and base for temporary roads and parking areas in accordance with the Contract Documents requirements for permanent roads, drives, and parking areas.
   4. Where required by subgrade conditions and construction loads and traffic, provide geosynthetic separation fabric as required on compacted subgrade for subbase support and separation of subbase and subgrade materials.
   5. Re-condition granular subbase of temporary roads and parking areas, including removing and properly disposing of granular material that has become intermixed with soil, re-grading, proof-rolling, compacting, and testing.

3.3 MAINTENANCE OF ROADS

A. General:
   1. Maintain temporary roads and parking to continuously provide at the Site access for construction vehicles and trucks, OWNER and facility manager vehicles, deliveries for OWNER and facility manager, emergency vehicles, and parking areas for OWNER's and facility manager's personnel.
   2. Public roads shall be passable at all times unless a road closure is allowed in writing by authority having jurisdiction.

3. When granular material of temporary roads and parking without hard surfacing become intermixed with soil or when temporary roads otherwise create a nuisance, remove intermixed granular-and-soil material and replace with clean granular material as required.
4. Provide snow and ice removal for temporary roads and parking areas.

B. Cleaning and Dust Control:
   1. Cleaning: Clean paved surfaces over which construction vehicles travel. Perform cleaning not less often than the frequency indicated in Section 01 74 05, Cleaning, or more frequently as directed by ENGINEER, by mechanical sweeping or other means acceptable to ENGINEER.
   2. Clean the following surfaces:
      a. Roads within limits of the Project.
      b. Permanent roads at the Site between the Site entrance and the work areas, and between the Site entrance and construction parking and staging areas.
      c. Public roads that require sweeping and cleaning due to construction operations.
   3. Dust Control:
      a. Control dust resulting from construction activities to prevent nuisances at the Site and in nearby areas.
      b. Apply water or use other methods subjet to ENGINEER's acceptance that will minimize airborne dust. Do not use water when water will cause hazardous or objectionable conditions such as ice, mud, ponds, and pollution.
      c. Provide dust control that is non-polluting and does not contribute to tracking-out of dirt and dust onto pavement. Re-apply dust control treatment as required.
      b. Comply with Section 01 57 00, Temporary Controls.

C. Protection of Underground Facilities: Comply with the General Conditions, as may be modified by the Supplementary Conditions, Section 01 71 33, Protection of the Work and Property, and other requirements of the Contract Documents.

3.4 REMOVALS AND RESTORATION

A. Removals:
   1. Remove temporary roads, drives, walks, and parking areas that are not intended for, or acceptable for, integration into permanent pavement. Return areas of temporary roads, drives, walks, and parking to pre-construction condition unless otherwise required by the Contract Documents.
   2. Remove temporary gates, fencing, and traffic controls associated with temporary roads and parking areas.
   3. Remove and properly dispose of materials contaminated with oil, bitumen, and other petrochemical compounds resulting from CONTRACTOR's operations, and other substances that might impair growth of plants and lawns.

B. Restoration:
   1. Repair or replace paving, curbs, gutters, and sidewalks affected by temporary roads and parking, and restore to required conditions in accordance with authorities having jurisdiction.
   2. Restore to pre-construction conditions existing roads, walks, and parking areas damaged by CONTRACTOR, subject to approval of the owner of affected roads, drives, walks, and parking areas.

+ + END OF SECTION + +

SECTION 01 57 05

TEMPORARY CONTROLS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide and maintain methods, materials, equipment, and temporary construction as required for controlling environmental conditions at the Site and adjacent areas during construction.
   2. Maintain controls until no longer required. Provide temporary controls at all times when CONTRACTOR is working at the Site.
   3. Temporary controls include, but are not limited to, the following:
      a. Erosion and sediment controls.
      b. Noise controls.
      c. Dust controls.
      d. Pest and rodent controls.
      e. Control of water, including storm water runoff.
      f. Pollution controls.

B. Related Sections:
   1. Section 01 35 43.13, Environmental Procedures for Hazardous Materials.
   2. Section 01 35 44, Spill Prevention Control and Countermeasures Plan.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable provisions and recommendations of the following:
   1. Temporary environmental controls, as applicable to soil erosion and sediment control shall comply with the NPDES Construction General Permit Part III.G – SWP3 Requirements and shall be installed in accordance with standards and specification sin the most recent version of the ODNR Rainwater and Land Development Manual.

1.3 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Plan for construction staging and maintenance of the Site relative to erosion and sediment controls. Indicate on a site plan approximate areas of planned disturbance of soils and soil cove over time during the Project. For areas not indicated in the Contract Documents as being disturbed and that CONTRACTOR proposes to disturb, Shop Drawing shall include proposed erosion and sediment control measures for the additional area.

2. Product Data:
    a. Silt fencing materials.

B. Informational Submittals: Submit the following:
    1. Procedural Submittals:
        a. Proposed dust control measures, when submittal is requested by ENGINEER.

PART 2 – PRODUCTS

2.1 MATERIALS FOR TEMPORARY EROSION AND SEDIMENT CONTROLS

A. Materials for temporary erosion and sediment controls shall be as shown or indicated on the Drawings.

2.1 MATERIALS FOR TEMPORARY EROSION AND SEDIMENT CONTROLS

A. General:
    1. Materials utilized for temporary erosion and sediment controls shall be in accordance with the applicable regulatory requirements indicated in Article 1.2 of this Section, unless otherwise shown or indicated in the Contract Documents.

B. Silt Fencing:
    1. Filter Cloth:
        a. Products and Manufacturers: Provide one of the following:
            1) Contech “Silt Fence”.
            2) Hanes Geo Components “Silt Fence”.
            3) Atlantic Construction Fabrics (ACF) Environmental “Silt Fence”.
            4) Or equal.
        b. Height: Two feet, minimum.
        c. Securely fasten filter cloth to wire mesh using ties spaced at maximum intervals of two feet on centers at top and mid-height of wire mesh.
    2. Wire Mesh: Support filter cloth with wire mesh complying with the following:
        a. Woven wire mesh, 14-gauge steel wire, maximum mesh size six-inch by six-inch.
        b. Height: To match filter cloth height.
        c. Fasten wire mesh to fence supports with wire ties or staples.
    3. Fence Support Posts:
        a. Length: Not less than three feet.
        a. Material: Metal or other acceptable material with "U", “T”, or "I" cross section, or hardwood measuring not less than 1.25-inch by 1.25-inch in cross-section.

C. Straw Bale Dike.

1. Bales shall be firmly-packed, unrotted straw bound firmly with baling wire. Cross-sectional area on the small end of each bale shall be approximately 12 inches by 12 inches or larger.
2. Posts shall comply with requirements for silt fencing support posts, or may be suitable reinforcing steel rods.

D. Mulch Materials and Soil Stabilization.
   1. Mulch shall be unrotted straw or salt hay.
   2. Soil stabilization emulsions, when used, shall be an inert, eco-friendly chemical manufactured for the specific purpose of erosion control and soil stabilization, applied with mulch or stabilization fibers.
   3. Wood-fiber or paper-fiber, when used, shall be 100 percent natural and biodegradable.
   4. Erosion control mat or netting shall be biodegradable. Acceptable materials include jute, excelsior, straw or coconut fiber, and cotton.

E. Protection of Storm Water Drainage Inlets and Catch Basins:
   1. Inlet Filter Bag:
      a. Product and Manufacturer: Provide one of the following for each drainage inlet or catch basin to be protected:
         1) Atlantic Construction Fabrics (ACF) Environmental, “Silt Sack”.
         2) Mutual Industries, Inc. “Silt Sack”.
         3) Or equal.
      b. Inlet filter bag permeability shall be not less than 40 gallons per square foot of bag area exposed to the flow. Fabric shall be woven polypropylene with double stitching to prevent bursting.
      c. Inlet filter bags shall shall:
         1) Fit inside the drainage inlet or catch basin and shall be secured by the structure's grate or by other acceptable means.
         2) Have means of removing inlet filter bag and the silt and sediment collected therein without dumping filter bag's contents into the drainage inlet or catch basin.

F. Filter Bag on Dewatering Pump Discharge:
   1. Provide filter bag on discharge of each dewatering pump drawing from an excavation. Filter bag is not required on pumps associated with dewatering wells.
   2. Products and Manufacturers: Provide one of the following:
      a. UltraTech Dewatering Bag, by Interstate Products.
      b. Filter Bag, by US Fabrics.
      c. Dewatering (Filter) Bag, by Indian Valley Industries.
      d. DirtBag, by Atlantic Construction Fabrics (ACF) Environmental
      e. Or equal.
   3. Size filter bags for maximum flow of the pump. Filter bags shall be specifically fabricated for use as a dewatering pump filter bag.
   4. Provide sufficient spare filter bags for continuous dewatering operations.

PART 3 – EXECUTION

3.1 NOISE CONTROL

A. Noise Control – General:
   1. CONTRACTOR's vehicles and equipment shall minimize noise emissions to greatest degree practicable. When necessary, provide mufflers and silencers on construction equipment, and provide temporary sound barriers onsite when necessary.
   2. Noise levels shall comply with Laws and Regulations, including OSHA requirements and local ordinances.
   3. Noise emissions shall not interfere with the work of OWNER, facility manager, or others.

3.2 DUST CONTROL

A. Dust Control – General:
   1. Control objectionable dust caused by CONTRACTOR's operation of vehicles and equipment, clearing, demolition, cleaning, and other actions. To minimize airborne dust, apply water or use other methods subject to acceptance of ENGINEER and approval of authorities having jurisdiction.
   2. CONTRACTOR shall prevent blowing and movement of dust from exposed soil surfaces and access roads to reduce onsite and off-Site damage, nuisances, and health hazards associated with dust emissions.

B. Dust Control Methods:
   1. Dust control may be achieved by irrigation in which the dust-prone area of the Site shall be sprinkled with water until the surface is moist.
   2. Apply dust controls as frequently as required without creating nuisances such as excessive mud and ponding of water at the Site. Do not use water for dust control when water will cause hazardous or objectionable conditions such as ice, mud, ponds, and pollution.
   3. Provide dust control that is non-polluting and does not contribute to tracking-out of dirt and dust onto pavement.

C. Removal of Dust and Dirt from Travelled Surfaces:
   1. Remove dust and dirt from roadways, drives, parking areas, and other travelled surfaces not less than the frequency indicated in Section 01 74 05, Cleaning.
   2. Perform dust and dirt removals from travelled surfaces by mechanical sweeping or other method acceptable to ENGINEER.

3.3 PEST AND RODENT CONTROL

A. Pest and Rodent Control – General:

1. Provide pest and rodent controls as required to prevent infestation of the Site and storage areas.
2. Employ methods and use materials that do not adversely affect conditions at the Site or on adjoining properties.
3. In accordance with Laws and Regulations, promptly and properly dispose of pests and rodents trapped or otherwise controlled.

3.4 WATER CONTROL

A. Water Control – General:
   1. Provide methods to control surface water and water from excavations and structures to prevent damage to the Work, the Site, and adjoining properties.
   2. Control fill, grading, and ditching to direct water away from excavations, pits, tunnels and other construction areas and to direct drainage to proper runoff courses to prevent erosion, damage, or nuisance. Avoid directing to adjoining properties runoff from the Site and construction operations.

B. Equipment and Facilities for Water Control:
   1. Provide, operate, and maintain equipment and facilities of adequate size to control surface water.

C. Discharge and Disposal:
   1. Dispose of storm water and ground water in manner to prevent flooding, erosion, and other damage to any and all parts of the Site and adjoining areas, and that complies with Laws and Regulations.

3.5 POLLUTION CONTROL

A. Pollution Control – General:
   1. Provide means, methods, and facilities required to prevent contamination of soil, water, and atmosphere caused by discharge of noxious substances from or caused by construction operations.
   2. Equipment used during construction shall comply with Laws and Regulations.
   3. Comply with Section 01 35 43.13, Environmental Procedures for Hazardous Materials.

B. Spills and Contamination:
   1. Provide equipment and personnel to perform emergency measures required to contain spills and to remove contaminated soils and liquids.
   2. Excavate contaminated material and properly dispose of off-Site, and replace with suitable compacted fill and topsoil.
   3. Comply with Section 01 35 44, Spill Prevention Control and Countermeasures Plan, and OWNER's and facility manager's hazard control procedures as indicated in Section 01 35 23, Safety Requirements.

C. Protection of Surface Waters and Ground Water:

1. Provide and maintain special measures to prevent harmful substances from entering surface waters and ground water. Prevent disposal of wastes, effluents, chemicals, and other such substances in or adjacent to surface waters and open drainage routes, in sanitary sewers, or in storm sewers, and in ground water.

D. Atmospheric Pollutants:
   1. Provide and maintain systems for controlling atmospheric pollutants related to the Work.
   2. Prevent toxic concentrations of chemicals and vapors.
   3. Prevent harmful dispersal of pollutants into atmosphere.

E. Solid Waste:
   1. Provide and maintain systems for controlling and managing solid waste related to the Work.
   2. Prevent solid waste from becoming airborne, and from discharging to surface waters and drainage routes.
   3. Properly handle and dispose of solid waste.
   4. Comply with requirements for cleaning and disposal of debris in the General Conditions, as may be modified by the Supplementary Conditions, and Section 01 74 05, Cleaning.

3.6 EROSION AND SEDIMENT CONTROLS

A. Installation and Maintenance of Erosion and Sediment Controls – General:
   1. General:
      a. Provide temporary erosion and sediment controls as shown and indicated on the Drawings and as indicated elsewhere in the Contract Documents. Provide erosion and sediment controls as the Work progresses into previously-undisturbed areas.
      b. Installation of erosion and sediment controls shall be in accordance with the applicable regulatory requirements indicated in Article 1.2 of this Section, unless more-stringent methods are otherwise shown or indicated in the Contract Documents.
      c. Use necessary methods to successfully control erosion and sedimentation, including ecology-oriented construction practices, vegetative measures, and mechanical controls. Use best management practices (BMP) in accordance with Laws and Regulations, and regulatory requirements indicated in Article 1.2 of this Section, to control erosion and sedimentation during the Project.
      d. Plan and execute construction, disturbances of soils and soil cover, and earthwork by methods to control surface drainage from cuts and fills, and from borrow and waste disposal areas, to prevent erosion and sedimentation. Provide temporary measures for controlling erosion and sedimentation, as indicated in the Contract Documents and as required for the Project.

e. Where areas must be cleared for storage of materials or equipment, or for temporary facilities, provide measures for regulating drainage and controlling erosion and sedimentation, subject to the ENGINEER'S approval.
f. Provide erosion and sediment controls, including stabilization of soils, at the end of each workday.

2. Coordination:
   a. Coordinate temporary erosion and sediment controls with construction of permanent drainage facilities and other Work to the extent necessary for economical, effective, and continuous erosion and sediment controls.
3. Before commencing activities that will disturb soil or soil cover at the Site, provide all erosion and sediment control measures required by the Contract Documents for the areas where soil or soil cover will be disturbed.
4. In general, implement construction procedures associated with, or that may affect, erosion and sediment control to ensure minimum damage to the environment during construction. CONTRACTOR shall implement any and all additional measures required to comply with Laws and Regulations.
5. Vegetation Removal: Remove only those shrubs, grasses, and other vegetation that must be removed for construction. Protect remaining vegetation.
6. Access Roads and Parking Areas: When possible, access roads and temporary roads and parking shall be located and constructed to avoid adverse effects on the environment. Provide measures to regulate drainage, avoid erosion and sedimentation, and minimize damage to vegetation.
7. Inspection and Maintenance:
   a. Periodically inspect areas of earthwork and areas where soil or soil cover are disturbed to detect evidence of the start of erosion and sedimentation; promptly implement corrective measures as required to control erosion and sedimentation. Continue inspections and corrective measures until soils are permanently stabilized and permanent vegetation has been established
   b. Inspect not less often than the frequency indicated in Section 01 41 26, Storm Water Pollution Prevention Plan and Permit.
   c. Repair or replace damaged erosion and sediment controls within 24 hours of CONTRACTOR becoming aware of such damage.
   d. Periodically remove silt and sediment that has accumulated in or behind sediment and erosion controls. Properly dispose of silt and sediment.
8. Duration of Erosion and Sediment Controls:
   a. Maintain erosion and sediment controls in effective working condition until the associated drainage area has been permanently stabilized.
   b. Maintain erosion and sediment controls until the Site is restored and site improvements including landscaping, if any, are complete with underlying soils permanently stabilized.
9. Work Stoppage:
   a. If the Work is temporarily stopped or suspended for any reason, CONTRACTOR shall provide additional temporary controls necessary to

prevent environmental damage to the Site and adjacent areas while the Work is stopped or suspended.

10. Failure to Provide Adequate Controls:
    a. In the event CONTRACTOR repeatedly fails to satisfactorily control erosion and sedimentation, OWNER reserves the right to employ outside assistance or to use OWNER's own forces for erosion and sediment control.
    b. Cost of such work by OWNER, plus engineering and inspection costs, will be deducted from amounts due CONTRACTOR, as set-offs in accordance with the Contract Documents.

C. Silt Fencing:
1. Install and maintain silt fencing in a vertical plane, at the location(s) shown or indicated in the Contract Documents and where required.
2. Locations of Silt Fencing:
    a. Where possible, install silt fencing along contour lines so that each given run of silt fencing is at the same elevation.
    b. On slopes, install silt fencing at intervals that do not exceed the maximum intervals indicated in the following table:

Slope (percent)	Maximum Length of Slope Above Each Silt Fence (feet)
2 and less	150
2.1 to 5	100
5.1 to 10	50
10.1 to 20	25
20.1 to 25	20
25.1 to 40	15
40.1 to 50	10

    c. Provide silt fencing around perimeter of each stockpile of topsoil, general fill material, and excavated material. Install silt fencing before expected precipitation and maintain until stockpile is removed.
    d. Do not install silt fencing at the following types of locations:
        1) Area of concentrated storm water flows such as ditches, swales, or channels.
        2) Where rock or rocky soils prevent full and uniform anchoring of silt fencing.
        3) Across upstream or discharge ends of storm water piping or culverts.
3. Installation:
    a. Securely fasten wire mesh to posts, and securely fasten filter cloth to wire mesh.
    b. When two sections of filter cloth abut each other, fold over edges and overlap by not less than six inches and securely fasten to wire mesh.

c. Embed posts in the ground to the depth necessary for proper controls; embed posts to not less than 16 inches below ground.
d. Filter cloth and wire mesh shall extend not less than eight inches below ground and not less than 16 inches above ground.
e. Remove sediment accumulated at silt fencing as required. Repair and reinstall silt fencing as required.

4. Maintenance:
a. Do not allow formation of concentrated storm water flows on slopes above silt fencing unless so shown or indicated in the Contract Documents. If unauthorized concentrated storm water flows occur, stabilize the slope via earthmoving and other stabilization measures as required to prevent flow of concentrated storm water flows toward silt fencing.

D. Protection of Storm Water Drainage Inlets and Catch Basins:
1. Protect each drainage inlet and catch basin that has the potential to receive storm water runoff from exposed soils, and does not discharge into a storm water settlement basin.
2. Install inlet filter bags inside of drainage inlet or catch basin in accordance with manufacturer's instructions. Secure inlet filter bag with the structure's grate or by other acceptable means.
3. Inlet filter bags shall not pose any obstruction above the pre-construction elevation of the drainage inlet or catch basin grate requiring barricades or flashers.
4. When removing silt and sediment from inlet filter bag, do not dump filter bag's contents into the drainage inlet or catch basin.
5. Remove silt and sediment from inlet filter bag, or replace inlet filter bag, when inlet filter bag is not more than half full.

3.7 REMOVAL OF TEMPORARY CONTROLS

A. Removals – General:
1. Upon completion of the Work, remove temporary controls and restore Site to specified condition; if condition is not specified, restore Site to pre-construction condition.
2. After soils are permanently stabilized, remove from the Site temporary erosion and sediment controls.

+ + END OF SECTION + +

SECTION 01 58 00

PROJECT IDENTIFICATION AND SIGNS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall furnish, install, and maintain temporary signage for Project identification and construction site information.
   2. Temporary signs required are indicated in Part 2 of this Section.
   3. Do not display any other temporary signs, other than those specified, without prior approved of OWNER.
   4. Permanent signage required under the Contract Documents is under Section 10 14 00, Signage.

1.2 QUALITY ASSURANCE

A. Qualifications:
   1. Sign Painter:
      a. Shall be a professional in the type of Work required, regularly engaged in work similar to that required.

1.3 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Layout of each temporary sign, indicating layout, text, font, character size, graphics (if any), type and grade of materials, including sign board, trim, supports, and bracing.
   2. Product Data:
      a. Specifications and product data for finishes proposed for use, when requested by ENGINEER.
   3. Samples: Submit color Samples when requested by ENGINEER.

PART 2 – PRODUCTS

2.1 MATERIALS AND CONSTRUCTION

A. Performance Criteria:
   1. Temporary signs, including supports and bracing, shall withstand sustained winds of 75 miles per hour.

B. Temporary Signage Required: Provide the following temporary signs:
   1. Project Identification Sign:
      a. Location: Erect on Site at location established by OWNER no later than 30 days after Notice to Proceed.
      b. Text: List title or Project as designated by ENGINEER, and names of OWNER, ENGINEER, and Prime CONTRACTOR.
      c. Background Color: To be selected by OWNER.
      d. Text Color: To be selected by OWNER.
      e. Dimensions:
         1) Minimum Sign Board Dimensions: 8 feet wide by 4 feet high.
         2) Distance from Ground to Bottom of Sign: 2 feet.

   1
   2. Site Informational Signage:
      a. Provide temporary signage as required for construction site operations and controlling traffic at the construction site.

C. Materials:
   1. Sign Board:
      a. Signs shall be 3/4-inch thick, exterior-grade plywood, unless otherwise shown or indicated.
      b. Provide signs with trim, mitered on edges.
   2. Supports and Bracing:
      a. Provide supports and bracing as required to adequately support and brace temporary signs to comply with the performance criteria indicated in this Section.

D. Finishing:
   1. Paint sign with exterior gloss-finish enamel, suitable for long-term exposure to sunlight without fading for the duration of the Project.

PART 3 – EXECUTION

3.1 INSTALLATION, MAINTENANCE, AND REMOVAL

A. Installation:
   1. Location of signs shall be as shown or indicated on the Contract Documents, or as directed by ENGINEER. Temporary signs shall be plainly visible to vehicular traffic.
   2. Install signs in a neat, professional, workmanlike manner to withstand the performance criteria indicated in this Section.

B. Maintenance:
   1. Maintain temporary signage so that signs are clean, legible, and upright.
   2. Cut grass, weeds, and other plants so that temporary signs are not covered or obscured.

3. Repair and repaint damaged temporary signs.
4. Relocate signs as required by progress of the Project.

C. Remove temporary signage prior to final inspection of the Work, or when directed by ENGINEER.

+ + END OF SECTION + +

SECTION 01 61 00

COMMON PRODUCT REQUIREMENTS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. This Section includes:
      a. Common requirements for materials and equipment.
      b. Compatibility of materials and equipment.

1.2 REQUIREMENTS FOR MATERIALS AND EQUIPMENT

A. Unless otherwise indicated in the Contract Documents, furnish materials and equipment that:
   1. have not been previously been incorporated into another project or facility; and
   2. have not changed ownership after initial shipment from the manufacturer's factory or facility; and
   3. if stored since their manufacture or fabrication, have, while in storage, been properly maintained and serviced in accordance with the manufacturer's recommendations for long-term storage; submit documentation as required by ENGINEER that such maintenance and service has been performed; and
   4. that the item(s) have not been subject to degradation or deterioration since manufacture; and
   5. are the current model(s) or type(s) furnished by the Supplier.

B. To the extent possible, furnish from a single source those materials and equipment that are of the same generic kind.

C. Furnish materials and equipment complete with accessories, trim, finish, fasteners, and other items shown, indicated, or required for a complete installation for the indicated use and performance.

D. Standard Items: When available, and unless custom or nonstandard options are specified or indicated, furnish standard materials and equipment of types that have been produced and used successfully in similar situations on other projects.

E. Visual Matching: Where required in the Contract Documents, furnish materials and equipment that match (as determined by ENGINEER) referenced existing construction, and mock-ups and Sample(s) approved by ENGINEER.

F. Where the Contract Documents include the phrase "as selected" for color of materials or equipment, finish pattern, option, or similar phrase, provide materials and equipment selected by ENGINEER as follows:

1. Standard Range: Where the Contract Documents include the phrase “standard range of colors, patterns, textures” or similar wording, provide color, pattern, density, or texture selected by ENGINEER from manufacturer’s product line that does not include premium items.
2. Full Range: Where the Contract Documents include the phrase “full range of colors, patterns, textures” or similar wording, ENGINEER will select color, pattern, density, or texture from manufacturer’s entire product line, including standard and premium items.

1.3 COMPATIBILITY

A. Similar materials and equipment by the same Supplier shall be compatible with each other, unless otherwise indicated in the Contract Documents or approved by ENGINEER.

B. Provide materials and equipment compatible with items previously selected or installed on the Project.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 62 00

PRODUCT OPTIONS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. This Section includes:
      a. CONTRACTOR's options for selecting materials and equipment.
      b. Requirements for consideration of "or-equal" materials and equipment.

1.2 PRODUCT OPTIONS

A. For materials and equipment specified only by reference standard or description, without reference to Supplier, furnish materials and equipment complying with such standard, by a Supplier or from a source that complies with the Contract Documents.

B. For materials and equipment specified by naming one or more items or Suppliers, furnish the named materials and equipment that comply with the Contract Documents, unless an "or-equal" or substitute item is approved by ENGINEER.

C. For materials and equipment specified by naming one or more items or Suppliers and the term, "or-equal", when CONTRACTOR proposes a material or equipment item or Supplier as an "or-equal", submit to ENGINEER a request for approval of an "or-equal" item or Supplier.

1.3 "OR-EQUAL" ITEMS

A. Procedure:
   1. For proposed materials and equipment not named in the Contract Documents and considered as an "or-equal" in accordance with the General Conditions, CONTRACTOR shall request in writing ENGINEER's approval of the "or-equal".
   2. Request for approval of an "or-equal" item shall accompany the Shop Drawing or product data submittal for the proposed item

B. Requests for approval of "or-equals" shall include:
   1. CONTRACTOR's written request that the proposed item be considered as an "or-equal" in accordance with the General Conditions, accompanied by CONTRACTOR's certifications required in the General Conditions.
   2. Documentation adequate to demonstrate to ENGINEER that proposed item does not require extensive revisions to the Contract Documents, that proposed item is consistent with the Contract Documents, and that proposed item will

produce results and performance required in the Contract Documents, and that proposed item is compatible with other portions of the Work.

3. Detailed comparison of significant qualities of proposed item with the materials and equipment and manufacturers named in the Contract Documents. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements shown or indicated.
4. Evidence that proposed item's manufacturer will furnish warranty equal to or better than that specified, if any.
5. List of similar installations for completed projects with project names and addresses, and names and address of design professionals and owners, when requested.
6. Samples, when requested by ENGINEER.
7. Other information requested by ENGINEER.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 65 00

PRODUCT DELIVERY REQUIREMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. This Section includes general requirements for preparing for shipping, delivering, and handling materials and equipment to be incorporated into the Work.
   2. CONTRACTOR shall make all arrangements for transporting, delivering, and handling of materials and equipment required for prosecution and completion of the Work.
   3. When required, move stored materials and equipment without changes to the Contract Price or Contract Times.

1.2 SUBMITTALS

A. Refer to individual Specifications Sections for submittal requirements relative to delivering and handling materials and equipment.

1.3 PREPARING FOR SHIPMENT

A. When practical, factory-assemble materials and equipment. Mark or tag separate parts and assemblies to facilitate field-assembly. Cover machined and unpainted parts that may be damaged by the elements or climate with strippable, protective coating.

B. Package materials and equipment to facilitate handling, and protect materials and equipment from damage during shipping, handling, and storage. Mark or tag outside of each package and crate to indicate the associated purchase order number, bill of lading number, contents by name, OWNER's contract designation, CONTRACTOR name, equipment number, and approximate weight. Include complete packing lists and bills of materials with each shipment.

C. Protect materials and equipment from exposure to the elements and damage by climate, and keep thoroughly dry and dust-free at all times. Protect painted surfaces against impact, abrasion, discoloration, and other damage. Lubricate bearings and other items requiring lubrication in accordance with manufacturer's instructions.

D. Advance Notification of Shipments:
   1. Keep ENGINEER informed of delivery of all materials and equipment to be incorporated in the Work.
   2. Upon receipt of Supplier's advance notice of shipment, not less than seven days prior to delivery of materials and equipment, provide ENGINEER written notification of anticipated date and place of arrival of the following:
      a. Dewatering centrifuge.
      b. Polymer feed skid-mounted systems.

E. Do not ship materials and equipment until:
   1. Related Shop Drawings, Samples, and other submittals required by the Contract Documents have been approved or accepted (as applicable) by ENGINEER, including, but not necessarily limited to, all Action Submittals associated with the materials and equipment being delivered.
   2. Manufacturer's instructions for handling, storing, and installing the associated materials and equipment have been submitted to and accepted by ENGINEER in accordance with the Specifications.
   3. Results of source quality control testing (factory testing), when required by the Contract Documents for the associated materials or equipment, have been submitted to and accepted by ENGINEER.
   4. Facilities required for handling materials and equipment in accordance with the Contract Documents and manufacturer's instructions are in place and available.
   5. Required storage facilities have been provided.

1.4 DELIVERY

A. Scheduling and Timing of Deliveries:
   1. Arrange deliveries of materials and equipment in accordance with the Progress Schedule accepted by ENGINEER and in ample time to facilitate inspection and observation prior to installation.
   2. Schedule deliveries to minimize space required for and duration of storage of materials and equipment at the Site or other delivery location, as applicable.
   3. Coordinate deliveries to avoid conflicting with the Work and conditions at Site, and to accommodate the following:
      a. Work of other contractors and OWNER.
      b. Storage space limitations.
      c. Availability of equipment and personnel for handling materials and equipment.
      d. OWNER's use of premises.
   4. Deliver materials and equipment to the Site during regular working hours.
   5. Deliver materials and equipment to avoid delaying the Work and the Project, including work of other contractors, as applicable. Deliver anchor system materials, including anchor bolts to be embedded in concrete or masonry, in ample time to avoid delaying the Work.

B. Deliveries:
   1. Shipments shall be delivered with CONTRACTOR's name, Subcontractor's name (if applicable), Site name, Project name, and contract designation (example: "ABC Construction Co., City of Happy Beach, Idaho, Wastewater Treatment Plant Primary Clarifier Improvements, Contract 25, General Construction") clearly marked.
   2. Site may be listed as the "ship to" or "delivery" address; but OWNER shall not be listed as recipient of shipment unless otherwise directed in writing by ENGINEER.
   3. Provide CONTRACTOR's telephone number to shipper; do not provide OWNER's telephone number.
   4. Arrange for deliveries while CONTRACTOR's personnel are at the Site. CONTRACTOR shall receive and coordinate shipments upon delivery. Shipments delivered to the Site when CONTRACTOR is not present will be refused by OWNER, and CONTRACTOR shall be responsible for the associated delays and additional costs, if incurred.
   5. Comply with Section 01 35 43.13, Environmental Procedures for Hazardous Materials.

C. Containers and Marking:
   1. Have materials and equipment delivered in manufacturer's original, unopened, labeled containers.
   2. Clearly mark partial deliveries of component parts of materials and equipment to identify materials and equipment, to allow easy accumulation of parts, and to facilitate assembly.

D. Inspection of Deliveries:
   1. Immediately upon delivery, inspect shipment to verify that:
      a. Materials and equipment comply with the Contract Documents and approved or accepted (as applicable) submittals.
      b. Quantities are correct.
      c. Materials and equipment are undamaged and of the required quality.
      d. Containers and packages are intact and labels are legible.
      e. Materials and equipment are properly protected.
   2. Promptly remove damaged materials and equipment from the Site and expedite delivery of new, undamaged materials and equipment, and remedy incomplete or lost materials and equipment. Furnish materials and equipment in accordance with the Contract Documents, to avoid delaying progress of the Work.
   3. Advise ENGINEER in writing when damaged, incomplete, or defective materials and equipment are delivered, and advise ENGINEER of the associated impact on the Progress Schedule.

1.5 HANDLING OF MATERIALS AND EQUIPMENT

A. Provide equipment and personnel necessary to handle materials and equipment, including those furnished by OWNER, by methods that prevent soiling or damaging materials and equipment and packaging.

B. Provide additional protection during handling as necessary to prevent scraping, marring, and otherwise damaging materials and equipment and surrounding surfaces.

C. Handle materials and equipment by methods that prevent bending and overstressing.

D. Lift heavy components only at designated lifting points.

E. Handle materials and equipment in safe manner and as recommended by the manufacturer to prevent damage. Do not drop, roll, or skid materials and equipment off delivery vehicles or at other times during handling. Hand-carry or use suitable handling equipment.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 66 00

PRODUCT STORAGE AND HANDLING REQUIREMENTS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. This Section includes general requirements for storing and protecting materials and equipment.
   2. CONTRACTOR shall provide all labor, materials, tools, equipment, and incidentals to store and handle materials and equipment to be incorporated into the Work, and other materials and equipment at the Site.

1.2 STORAGE

A. Store and protect materials and equipment in accordance with manufacturer's recommendations and the Contract Documents.

B. General:
   1. CONTRACTOR shall make all arrangements and provisions necessary for, and pay all costs for, storing materials and equipment.
   2. Excavated materials, construction equipment, and materials and equipment to be incorporated into the Work shall be placed to avoid injuring the Work and existing facilities and property, and so that free access is maintained at all times to all parts of the Work and to public utility installations in vicinity of the Work.
   3. Store materials and equipment neatly and compactly in locations that cause minimum inconvenience to OWNER, facility manager, other contractors, public travel, and owners, tenants, and occupants of adjoining property.
   4. Arrange storage in manner to allow easy access for inspection by ENGINEER and Resident Project Representative (RPR).

C. Storage Location:
   1. Areas available at the Site for storing materials and equipment are shown or indicated in the Contract Documents, or as acceptable to ENGINEER.

D. Protection of Stored Materials:
   1. Store materials and equipment to become OWNER's property to ensure preservation of quality and fitness of the Work, including proper protection against damage by freezing, moisture, and with outdoor ambient air high temperatures as high as 105 degrees F; temperature and humidity inside crates, containers, storage sheds, and packaging may be significantly higher than the outdoor ambient air temperature.

2. Store in indoor, climate-controlled storage areas all materials and equipment subject to damage by moisture, humidity, heat, cold, and other elements, unless otherwise acceptable to OWNER.
3. When placing orders to Suppliers for equipment and controls containing computer chips, electronics, and solid-state devices, CONTRACTOR shall obtain, coordinate, and comply with specific temperature and humidity limitations on materials and equipment, because temperature inside cabinets and components stored in warm temperatures can approach 200 degrees F.
4. CONTRACTOR shall be fully responsible for loss or damage (including theft) to stored materials and equipment.
5. Do not open manufacturer's containers until time of installation, unless recommended by the manufacturer or otherwise specified in the Contract Documents.
6. Comply with requirements of Article 1.3 of this Section.

1.3 PROTECTION – GENERAL

A. Equipment to be incorporated into the Work shall be boxed, crated, or otherwise completely enclosed and protected during shipping, handling, and storage, in accordance with Section 01 65 00, Product Delivery Requirements.

B. Store all materials and equipment off the ground (or floor) on raised supports such as skids or pallets.

C. Protect painted surfaces against impact, abrasion, discoloration, and other damage. Painted equipment surfaces that are damaged or marred shall be repainted in their entirety in accordance with equipment manufacturer and paint manufacturer requirements, to the satisfaction of ENGINEER.

D. Protect electrical equipment, controls, and instrumentation against moisture, water damage, humidity, heat, cold, and dust. Space heaters provided in equipment shall be connected and operating at all times until equipment is placed in operation and permanently connected.

1.4 UNCOVERED STORAGE

A. The following types of materials may be stored outdoors without cover on supports so there is no contact with the ground:
1. Reinforcing steel.
2. Precast concrete materials.
3. Structural steel.
4. Metal stairs.
5. Handrails and railings.
6 Grating.
7. Checker plate.
8. Metal access hatches.

9. Castings.
10. Fiberglass items.
11. Rigid electrical conduit, except PVC-coated conduit.
12. Piping, except PVC or chlorinated PVC (CPVC) pipe.

1.5 COVERED STORAGE

A. The following materials and equipment may be stored outdoors on supports and completely covered with covering impervious to water:
   1. Grout and mortar materials.
   2. Masonry units.
   3. Rough lumber.
   4. Soil materials and granular materials such as aggregate.
   5. PVC and CPVC pipe.
   6. PVC-coated electrical conduit.

B. Tie down covers with rope, and install covering properly sloped to prevent accumulation of water.

C. Store loose granular materials, with covering impervious to water, in well-drained area or on solid surfaces to prevent mixing with foreign matter.

1.6 FULLY PROTECTED STORAGE

A. Store all material and equipment not indicated in Articles 1.4 and 1.5 of this Section on supports in buildings or trailers that have concrete or wooden flooring, roof, and fully-closed walls on all sides. Covering with visquine plastic sheeting or similar material in space without floor, roof, and walls is unacceptable. Comply with the following:
   1. Provide heated storage for materials and equipment that could be damaged by low temperatures or freezing.
   2. Provide air-conditioned storage for materials and equipment that could be damaged by high temperatures or humidity.
   3. Protect mechanical and electrical equipment from being contaminated by dust, dirt, and moisture.
   4. Maintain humidity at levels recommended by manufacturers for electrical and electronic equipment.

1.7 HAZARDOUS MATERIALS AND EQUIPMENT

A. Prevent contamination of personnel, storage areas, and the Site. Comply with Laws and Regulations, manufacturer's instructions, Section 01 35 43.13, Environmental Procedures for Hazardous Materials, and other provisions of the Contract Documents.

1.8 MAINTENANCE OF STORAGE

A. On a scheduled basis, periodically inspect stored materials and equipment to ensure that:
   1. Condition and status of storage facilities is adequate to provide required storage conditions.
   2. Required environmental conditions are maintained on continuing basis.
   3. Materials and equipment exposed to elements are not adversely affected.

B. Mechanical and Electrical Equipment in Long-Term Storage:
   1. Mechanical and electrical equipment requiring long-term storage shall have complete manufacturer's instructions for servicing each item, with notice of enclosed instructions shown on exterior of container or packaging.
   2. Comply with manufacturer's instructions on scheduled basis.
   3. Space heaters that are part of electrical equipment shall be connected and operated continuously until equipment is placed in service and permanently connected.
   4. Affidavits:
      1. Submit to ENGINEER affidavit for each time that maintenance and inspection was performed on materials and equipment in long-term storage. Affidavit shall be signed by CONTRACTOR and entity performing the inspection and maintenance on the stored items.
      2. Affidavit shall indicate the date of the inspection, personnel and employer of each involved, specific stored items inspected, equipment condition, problems observed, problems corrected, maintenance tasks performed, conditions of storage environment, and other pertinent information.
      3. Affidavit shall include signed statement by the manufacturer of the item(s) indicating whether the storage conditions and tasks performed are suitable for continued compliance with manufacturer's warranties.

1.9 MICROPROCESSORS, PANELS, AND INSTRUMENTATION STORAGE

A. Store control panels, microprocessor-based equipment, electronics, and other devices subject to damage or decreased useful life because of temperatures below 40 degrees F or above 100 degrees F, relative humidity above 90 percent, or exposure to rain or exposure to blowing dust in climate-controlled storage space.

B. General:
   1. Storage shall be in third-party owned, bonded, insured, climate controlled warehouse in Stark County.
   2. OWNER and ENGINEER have the right to observe or inspect materials and equipment during normal working hours.
   3. Place inside each control panel or device a desiccant, volatile corrosion inhibitor blocks (VCI), moisture indicator, and maximum-minimum indicating thermometer.
   4. Check panels and equipment not less than once per month. Replace desiccant,

VCI, and moisture indicator as often as required, or every six months, whichever occurs first.

5. Certified record of daily maximum and minimum temperature and humidity in storage facility shall be available for inspection by OWNER and ENGINEER. Certified record of monthly inspection, noting maximum and minimum temperature for month, condition of desiccant, VCI, and moisture indicator, shall be made available to OWNER and ENGINEER upon request.

C. Costs for storing climate-sensitive materials and equipment shall be paid by CONTRACTOR. Replace panels and devices damaged during storage, or for which storage temperatures or humidity range has been exceeded, at no additional cost to OWNER. Delays resulting from such replacement are causes within CONTRACTOR's control.

D. Do not ship control panels and equipment to the Site until conditions at the Site are suitable for installation, including slabs and floors, walls, roofs, and environmental controls. Failure to have the Site ready for installation shall not relieve CONTRACTOR from complying with the Contract Documents.

1.10 RECORDS

A. Keep up-to-date account of materials and equipment in storage to facilitate preparation of Applications for Payment, if the Contract Documents provide for payment for materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 71 23

FIELD ENGINEERING

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. This Section includes field engineering, surveying, and layouts by CONTRACTOR, and associated requirements. This Section supplements the General Conditions' provisions on reference points and other matters.
   2. CONTRACTOR shall provide field engineering services, surveying and layout services, and professional services of the types indicated for the Project, including:
      a. Furnishing civil, structural, and other professional engineering services specified or required to execute CONTRACTOR's construction methods.
      b. Developing and making all detail surveys and measurements required for construction; including slope stakes, batter boards, and all other working lines, elevations, and cut sheets.
      c. Providing materials required for benchmarks, control points, batter boards, grade stakes, structure and pipeline elevation stakes, and other items.
      d. Keeping a transit, theodolite, or total station (i.e., theodolite with electronic distance measurement device); leveling instrument; and related implements such as survey rods and other measurement devices, at the Site at all times, and having a skilled instrument person available when necessary for laying out the Work.
      e. Being solely responsible for all locations, dimensions and levels. No data other than Change Order, Work Change Directive, or Field Order shall justify departure from dimensions and levels required by the Contract Documents.
      f. Rectifying all Work improperly installed because of not maintaining, not protecting, or removing without authorization established reference points, stakes, marks, and monuments.
      g. Providing such facilities and assistance necessary for ENGINEER and Resident Project Representative (if any) or Owner's Site Representative (if any) to check lines and grade points placed by CONTRACTOR. Do not perform excavation or embankment work until all cross-sectioning necessary for determining payment quantities for Unit Price Work have been completed and accepted by ENGINEER.

B. Coordination:
   1. Review requirements of this and other Sections and coordinate installation of items to be installed with or before field engineering, surveying, and layout Work.

1.2 SUBMITTALS

A. Informational Submittals: Submit the following:
   1. Certificates:
      a. When requested by ENGINEER, submit certificate signed by professional engineer or professional surveyor, as applicable, certifying that elevations and locations of the Work comply with the Contract Documents. Explain each deviation, if any.
   2. Surveying:
      a. Complete plan for performing survey work, submitted not less than 10 days prior to beginning survey Work.
      b. Example of proposed survey field books to be maintained by CONTRACTOR's surveyor. Example shall have sufficient information and detail, including example calculations and notes, to demonstrate that field books will be organized and maintained in a professional manner in accordance with the Contract Documents.
      c. Submit original field books within two days after completing survey Work.
      d. Submit certified survey in accordance with this Section.
   3. Qualifications Statements:
      a. Surveyor: Name, employer, and professional address of firm, and resumes of each professional land surveyor and crew chief that will be engaged in survey Work. Submit not less than 10 days prior to beginning survey Work. During the Project, submit resume for each new registered, licensed land surveyor and crew chief employed by or retained by CONTRACTOR not less than 10 days prior to starting on the survey Work.

1.3 CONTRACTOR'S SURVEYOR

A. Qualifications:
   1. Employ or retain the services, as needed, at the Site a surveyor with experience and capability of performing surveying and layout tasks required in the Contract Documents and as required for the Work.
   2. CONTRACTOR's surveyor shall possess not less than five years of experience performing duties similar in scope and extent to those required of CONTRACTOR's surveyor on this Project.
   3. Surveyor shall be a professional land surveyor registered and licensed in the jurisdiction where the Project is located, or a professional engineer registered and licensed as a professional engineer in the jurisdiction where the Project is located and authorized under Laws and Regulations to practice surveying.

B. Responsibilities of Contractor's Surveyor:
   1. Providing required surveying equipment, including transit, theodolite, or total station; level; stakes; and surveying accessories.
   2. Establishing required lines and grades for constructing all facilities, structures, pipelines, and site improvements, including outdoor electrical equipment and feeders.
   3. Preparing and maintaining professional-quality, accurate, well-organized, legible notes of all measurements and calculations made while surveying and laying out the Work.
   4. Prior to backfilling operations, survey, locate, and record on a copy of the Contract Documents accurate representation of buried Work and Underground Facilities provided and encountered.
   5. Locating on a site plan of the Site the actual location of above-ground Work to be indicated on record documents.
   6. Complying with requirements of the Contract Documents relative to surveying and related Work, including requirements of this Section's Articles 1.5 and 3.1.

1.4 RECORDS

A. Records – General:
   1. Maintain at the Site a complete and accurate log of control and survey Work as such Work progresses.

B. Field Books and Records:
   1. Survey data and records shall be in accordance with recognized professional surveying standards, Laws and Regulations, and prevailing standards of practice in the locality where the Site is located.
   2. Original field notes, computations, and other surveying data shall be recorded by CONTRACTOR's surveyor in CONTRACTOR-furnished hard-bound field books, and shall be signed and sealed by CONTRACTOR's surveyor.
   3. Completeness and accuracy of survey Work, and completeness and accuracy of survey records, including field books, shall be responsibility of CONTRACTOR.
   4. Failure to organize and maintain survey records in an appropriate manner that allows reasonable and independent verification of calculations, and to allow identification of elevations, dimensions, and grades of the Work, shall be cause for rejecting the survey records, including field books.
   5. Illegible notes or data, and erasures on any page of field books, are unacceptable. Do not submit copied notes or data. Corrections by ruling or lining out errors will be unacceptable unless initialed by the surveyor. Violation of these requirements may require re-surveying the data questioned by ENGINEER.

C. Certified Survey of Surface Structures:
   1. Upon completion of foundation walls and major site improvements, prepare a certified survey, signed and sealed by professional surveyor, showing or indicating dimensions, locations, angles and elevations of construction and locations and elevations of Underground Facilities installed and encountered during the Work.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 SURVEYING

A. Reference Points:
   1. Refer the General Conditions, as may be modified by the Supplementary Conditions, for requirements regarding reference points.
   2. OWNER's established reference points that are damaged or destroyed by CONTRACTOR will be re-established by OWNER at CONTRACTOR's expense. OWNER may deduct from payments owed CONTRACTOR such amounts as set-offs in accordance with the Contract Documents.
   3. From OWNER-established reference points, establish lines, grades, and elevations necessary to control the Work. Obtain measurements required for executing the Work to tolerances specified in the Contract Documents.
   4. Establish, place, and replace as required, such additional stakes, markers, and other reference points necessary for control, intermediate checks, and guidance of construction operations.

B. Surveys to Determine Quantities for Payment:
   1. For each application for progress payment, perform such surveys and computations necessary to determine quantities of Work performed or placed. Perform surveys necessary for ENGINEER to determine final quantities of Work in place.
   2. Notify ENGINEER not less than 24 hours before performing survey services for determining quantities to be included in Application for Payment. Unless waived in writing by ENGINEER, perform quantity surveys in presence of ENGINEER or Resident Project Representative (if any).

C. Construction Surveying: Comply with the following:
   1. Alignment Staking: Provide alignment stakes at 50-foot intervals on tangent, and at 25-foot intervals on curves.
   2. Slope Staking: Provide slope staking at 50-foot intervals on tangent, and at 25-foot intervals on curves. Re-stake at every ten-foot difference in elevation.
   3. Structure: Stake-out structures, including elevations, and check prior to and during construction.

4. Pipelines: Stake-out pipelines including elevations, and check prior to and during construction.
5. Roads, Drives, and Paved Areas: Stake-out roadway, driveway, and paved area elevations at 50-foot intervals on tangent, and at 25-foot intervals on curves.
6. Cross-sections: Provide original, intermediate, and final staking as required, for site work other locations as necessary for quantity surveys.
7. Easement Staking: Provide easement staking at 50-foot intervals on tangent, and at 25-foot intervals on curves. Also provide wooden laths with flagging at maximum intervals of 100 feet.
8. Record Staking: Provide permanent stake at each blind flange and each utility cap provided for future connections. Stakes for record staking shall be material acceptable to ENGINEER.

D. Accuracy:
1. Establish CONTRACTOR's temporary survey references points for CONTRACTOR's use to not greater than second-order accuracy (e.g., 1:10000). Construction staking used as a guide for the Work shall be set at not greater than third-order accuracy (e.g., 1:5000). Basis on which such orders are established shall provide the absolute margin for error specified below.
2. Horizontal accuracy of easement staking shall be plus or minus 0.1 feet. Accuracy of other staking shall be plus or minus 0.04 feet horizontally and plus or minus 0.02 feet vertically.
3. Survey calculations shall include an error analysis sufficient to demonstrate required accuracy.

+ + END OF SECTION + +

SECTION 01 71 33

PROTECTION OF THE WORK AND PROPERTY

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. This Section includes general requirements for safety and protection that augment the requirements of the General Conditions, as may be modified by the Supplementary Conditions. This Section also includes requirements for barricades and warning signals, and protection of trees and plants, existing structures, floors, roofs, installed items, and landscaping.
   2. CONTRACTOR shall be responsible for taking all precautions, providing all programs, and taking all actions necessary to protect personnel health and safety, and to protect the Work and all public and private property and facilities from damage, as specified in the General Conditions, Supplementary Conditions, and the Specifications.
   3. To prevent damage, injury, or loss, CONTRACTOR's actions shall include the following:
      a. Provide measures for safety of personnel at the Site, including workers engaged in the Work, delivery personnel, testing and inspection personnel, personnel of authorities having jurisdiction, other visitors to the Site, the public, OWNER's personnel, facility manager's personnel (if different from OWNER), ENGINEER, and Resident Project Representative (if any).
      b. Storing apparatus, materials, supplies, and equipment in an orderly, safe manner that does not unduly interfere with progress of the Work or work of other contractors, utility owners, and owners of transportation rights-of-way.
      c. Providing suitable storage facilities for materials and equipment subject to damage or degradation by exposure to climate, temperature, theft, breakage, or other cause.
      d. Placing upon the Work or any part thereof only loads consistent with the safety and integrity of that portion of the Work and existing construction.
      e. Frequently removing and disposing of refuse, rubbish, scrap materials, and debris caused by CONTRACTOR's operations so that, at all times, the Site is safe, orderly, and workmanlike in appearance.
      f. Providing temporary barricades, fencing, and guard rails around the following: openings, scaffolding, temporary stairs and ramps, around excavations, for elevated walkways, and other areas that may present a fall-hazard or hazard to vehicles.

4. Do not, except after written consent from proper parties, enter or occupy privately-owned property or premises with personnel, tools, materials or equipment, except on lands and easements provided by OWNER.
5. CONTRACTOR has full responsibility for preserving public and private property and facilities on and adjacent to the Site. Direct or indirect damage done by, or on account of, any act, omission, neglect, or misconduct by CONTRACTOR in executing the Work, shall be remedied by CONTRACTOR, at his expense, to condition equal to that existing before damage was done.
6. Owner May Remedy:
    a. Should CONTRACTOR fail to protect and safeguard property and the Work after requests from ENGINEER or OWNER, OWNER may implement measures to protect property and the Work.
    b. Cost of such OWNER-implemented measures shall be paid by CONTRACTOR. OWNER may deduct from payments due CONTRACTOR such amounts as set-offs in accordance with the Contract Documents.
    c. Such right, however, shall not result in any obligation by OWNER or ENGINEER to continuously monitor or have responsibility for protection of property and the Work, which responsibility is exclusively CONTRACTOR's.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 BARRICADES AND WARNING SIGNALS

A. Barricades and Warning Signals – General:
    1. Where the Work is performed on or adjacent to roadway, access road or driveway, right-of-way, or public place:
        a. Provide temporary barricades, fences, lights, warning signs, danger signals, watchmen, and take other precautionary measures for protecting persons, property, and the Work.
        b. Use appropriately colored and reflective barricades, or paint barricades accordingly, to be visible at night.
        c. From sunset to sunrise, provide and maintain not less than one temporary light at each barricade.
        d. Erect sufficient barricades to keep vehicles from being driven on or into Work under construction.
        e. Furnish watchmen in sufficient numbers to protect the Work.
    2. Provide temporary barricades to protect personnel and property for Work not in or adjacent to transportation routes and vehicular travel areas, including indoor work, in accordance with Laws and Regulations.

3. CONTRACTOR's responsibility for maintaining temporary barricades, signs, lights, and for providing watchmen shall continue until the Work is substantially complete in accordance with the Contract Documents, unless other provision for security and protection is agreed to by the parties. After Substantial Completion, protect Work and property during periods when final Work or corrective Work is underway.

B. Temporary Fencing: Refer to Section 01 57 33, Security.

3.2 PROTECTION OF EXISTING STRUCTURES

A. Underground Facilities:
   1. Underground Facilities known to OWNER and ENGINEER, except water, gas, sewer, electric, and communications services to individual buildings and properties, are shown. Information shown for Underground Facilities is the best available to OWNER and ENGINEER but, in accordance with the General Conditions, as may be modified by the Supplementary Conditions, is not guaranteed to be correct or complete.
   2. CONTRACTOR shall explore ahead of trenching and excavating Work and shall sufficiently uncover Underground Facilities that will or may interfere with the Work to determine their location, to prevent damage to Underground Facilities, and to prevent service interruption to structures and properties served by Underground Facilities. If CONTRACTOR damages an Underground Facility, CONTRACTOR shall restore it to its pre-construction condition, in accordance with requirements of the owner of the damaged facility and the Contract Documents.
   3. Necessary changes in the location of the Work may be directed by ENGINEER to avoid Underground Facilities not shown or indicated on the Contract Documents.
   4. If permanent relocation of an existing Underground Facilities is required and is not otherwise shown or indicated in the Contract Documents, CONTRACTOR may be directed in writing to perform the required work. When such relocation Work results in a change in the Contract Price, Contract Times, the associated Contract modification procedures and payment for such Work shall be in accordance with the Contract Documents.

B. Surface Structures:
   1. Surface structures are existing buildings, structures, and other facilities at or above ground surface, including their foundations and any extension below ground surface. Surface structures include, but are not limited to, buildings, tanks, walls, bridges, roads, dams, channels, open drainage routes, exposed piping and utilities, poles, exposed wires, posts, signs, markers, curbs, walks, fencing, and other facilities visible at or above ground surface.

2. Existing surface facilities, including but not limited to guard rails, posts, guard cables, signs, poles, markers, curbs, and fencing, that are temporarily removed to facilitate the Work shall be replaced and restored to their pre-construction condition at CONTRACTOR's expense.

C. Protection of Underground Facilities and Surface Structures:
   1. CONTRACTOR shall sustain in their places and protect from direct or indirect injury all Underground Facilities and surface structures located within or adjacent to the limits of the Work. Such sustaining and supporting shall be done carefully and as required by the party owning or controlling such structure or facility.
   2. Before proceeding with the Work of sustaining and supporting such structure or facility, CONTRACTOR shall satisfy ENGINEER that methods and procedures to be used have been approved by party owning same.
   3. CONTRACTOR shall bear all risks attending the presence or proximity of all Underground Facilities and surface structures within or adjacent to limits of the Work, in accordance with the Contract Documents.
   4. CONTRACTOR shall be responsible for damage and expense for direct or indirect injury, caused by CONTRACTOR's activities, to structures and facilities. CONTRACTOR shall promptly repair damage caused by CONTRACTOR's activities, to the satisfaction of owner of damaged structure or facility.
   5. Protection of Underground Facilities Under Roads and Parking Areas: Provide temporary, heavy-duty steel roadway plates to protect existing manholes, handholes, valve boxes, vaults, and other Underground Facilities near to or visible at the ground surface.

3.3 PROTECTION OF FLOORS AND ROOFS

A. Protection of Floors and Roofs – General:
   1. Use proper protective covering when moving equipment, handling materials or other loads, when painting, handling mortar or grout, and when cleaning walls, ceilings, or structure contents.
   2. Use metal pans to collect oil and cuttings from piping, conduits, and rod threading machines, and under metal cutting machines.
   3. Do not load concrete floors less than 28 days old without written permission of ENGINEER. Do not load floors, roofs, or slabs in excess of design loading.
   4. Do not load roofs without written permission of ENGINEER.
   5. Restrict access to roofs, and keep CONTRACTOR personnel off existing roofs, except as required for the Work.
   6. If access to roofs is required, roofing, parapets, openings, and all other construction on or adjacent to roof shall be protected with suitable plywood or other acceptable means.

3.5 PROTECTION OF INSTALLED MATERIALS, EQUIPMENT, AND LANDSCAPING

A. Protect installed Work to prevent damage from subsequent operations. Remove protective items when no longer needed, prior to Substantial Completion of the Work.

B. Control traffic to prevent damage to equipment, materials, and surfaces.

C. Coverings:
   1. Provide temporary coverings to protect materials and equipment from damage.
   2. Cover projections, wall corners and jambs, sills, and soffits of openings, in areas used for traffic and for passage of materials and equipment in subsequent work.

+ + END OF SECTION + +

SECTION 01 73 19

INSTALLATION

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. This Section describes general requirements for installing materials and equipment. Additional installation requirements are included in the various Specifications Sections in Divisions 02 through 49 and elsewhere in the Contract Documents.
   2. CONTRACTOR shall provide all labor, materials, equipment, services, tools, and incidentals required to install materials and equipment.

1.2 QUALITY ASSURANCE

A. General:
   1. Provide appropriate quality assurance for installing materials and equipment, and provide quality control over Suppliers, materials and equipment, services, Site conditions, and workmanship, to provide Work of the required quality.

B. Qualifications:
   1. Installer:
      a. Installers shall be experienced in the types of Work required, including, but not limited to, the requirements of Section 01 42 00, References, and the Division 02 through 49 Specifications where the particular element of the Work is specified.

C. Regulatory Requirements: Comply with the following:
   1. 29 CFR 1910, OSHA.

PART 2 – PRODUCTS

2.1 EQUIPMENT DRIVE GUARDS

A. Equipment Drive Guards – General:
   1. Unless otherwise shown or indicated, provide all-metal guards complying with 29 CFR 1910, Subpart O, with equipment driven by open shafts, belts, chains, pulleys, sheaves, or gears. Guards shall enclose drive and driven mechanism.
   2. If material of guards are not otherwise specified, guards shall be galvanized sheet steel, galvanized woven wire, or expanded metal set in a frame of galvanized steel members, as appropriate.

3. Secure guards in position by steel braces or straps, securely fastened to frame of equipment, floor, or wall as required.
4. Fastenings shall allow removal of guards for servicing equipment.

2.2 MISCELLANEOUS MATERIALS

A. Shims shall be Type 304L stainless steel, clean and free of slag.

PART 3 – EXECUTION

3.1 INSTALLATION

A. General:
   1. Installation Instructions and Requirements:
      a. Install materials and equipment in accordance with approved Shop Drawings and CONTRACTOR's other submittals approved by ENGINEER, the Contract Documents, and manufacturer's installation instructions. When manufacturer's installation instructions conflict with the Contract Documents, obtain interpretation or clarification from ENGINEER before proceeding.
      b. Manufacturer's installation instructions include manufacturer's written instructions; drawings; illustrative, wiring and schematic diagrams; diagrams identifying external connections, terminal block numbers and internal wiring; and other such information pertaining to installation of materials and equipment. Included are all of manufacturer's printed installation instructions, including those that may be attached to equipment upon delivery.
   2. Prior to installing materials and equipment, complete preparation of surfaces on which materials and equipment are to be installed. Prior to installing materials and equipment on new concrete, concrete shall achieve sufficient compressive strength to support the materials and equipment.
   3. Maintain the work area in a broom-clean condition while installing materials and equipment.
   4. Use proper tools to assemble materials and equipment. Do not deform or mar surface of shafts, nuts, and other parts.
   5. Do not support rigging from building or structure without written permission of ENGINEER. CONTRACTOR is responsible for and shall repair damage to building or structure resulting from CONTRACTOR's operations, in accordance with Section 01 71 33, Protection of the Work and Property.
   6. During installation, maintain materials and equipment in neutral position and do not exert undue stress on materials and equipment.
   7. Tighten connections requiring gaskets evenly all around to ensure uniform stress over entire gasket.
   8. Use only an oil bath heater to expand couplings, gears, and other mechanical components to be expanded for installation. Do not force or drive couplings,

gears, and other mechanical components onto equipment shafts, or subject such items to open flame or torch.

9. Do not alter or repair materials and equipment and do not burn or weld materials and equipment unless required in the Contract Documents or allowed by ENGINEER.
10. Provide plugs in lubrication holes to prevent entry of foreign matter.

B. Setting and Erection:
   1. Install materials and equipment plumb, level, true, and free of rack unless 1otherwise shown or indicated, and demonstrate plumbness and level to ENGINEER. Bring parts to proper bearing after installation and erection.
   2. Anchorages:
      a. Provide anchorage setting drawings in time to coordinate with fabrication of materials and equipment and the Work.
      b. Anchorages shall comply with Section 05 05 33, Anchor Systems. Requests for approval of substitute materials or methods of anchorage shall be in accordance with the General Conditions, Supplementary Conditions, and Section 01 25 00, Substitution Procedures.
   3. Shimming:
      a. Wedging is not allowed.
      b. During installation, use the minimum number of shims required for leveling the equipment.
      c. Provide shims, filling pieces, keys, packing, grouting of the type required by the Contract Documents, and other materials and equipment necessary to properly align, level, and secure apparatus in place.
   4. Installing Equipment onto Foundations:
      a. Using experienced millwrights, carefully set and align equipment on foundations, after equipment soleplates or baseplates (as applicable) have been shimmed to true alignment at anchorages.
      b. Set anchorages in place and tighten nuts against shims.
      c. Check bedplates or wing feet of equipment after securing to foundations and, after confirming alignments, grout soleplates or baseplates (as applicable) in place in accordance with the Contract Documents.
   5. Ream misaligned holes. Do not “force” bolts or keys.
   6. Where applicable, properly align equipment with associated piping and utility connections, without exerting undue stress on connecting piping and utilities.

C. Alignment and Leveling:
   1. Verify that all shafts, couplings, and sheaves are properly aligned and adjust to required tolerances.
   2. Align couplings while equipment is free of external loads.
   3. Check angular and parallel alignment and record actual alignment and submit to ENGINEER. Alignment shall be within tolerances specified in Contract Documents and as recommended by Supplier of the material or equipment item.

4. Use laser indicators or dial indicators for checking angular and parallel alignment. Using dial indicators requires that, during rotation of half-couplings in performing testing, dial indicator shall be maintained in same relative position, and dial indicator readings taken at same place on circumference of coupling.

D. Threaded Connections:
   1. Apply a molybdenum disulfide, anti-seize compound to threads in mechanical connections such as bolts, studs, cap screws, tubing, and other threads, unless otherwise shown or indicated.

3.2 FIELD QUALITY CONTROL

A. Supplier's Services:
   1. When specified, provide competent, qualified representatives of material or equipment Supplier to perform services required, including: supervising installation, checking the completed installation, adjusting, testing of materials and equipment, and where required instructing operations and maintenance personnel in the use and care of materials and equipment.

+ + END OF SECTION + +

SECTION 01 73 24

CONNECTIONS TO EXISTING FACILITIES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. This Section includes requirements for connections to existing facilities. Requirements for tie-ins and shutdowns necessary to complete the Work are in Section 01 14 16, Coordination with Owner's Operations.
   2. CONTRACTOR shall provide labor, materials, tools, equipment, and incidentals shown, specified, and required for performing connections to existing facilities.

B. Coordination:
   1. Review installation procedures under other Sections and coordinate Work that will be performed with or before the Work specified in this Section.

C. Related Sections:
   1. Section 01 14 16, Coordination with Owner's Operations.
   2. Section 01 51 05, Temporary Utilities.
   3. Section 01 73 29, Cutting and Patching.

D. General:
   1. Requirements for shutdowns, tie-ins, and other provisions on connections to existing facilities, are indicated in Section 01 14 16, Coordination with Owner's Operations.
   2. Requirements for temporary pumping for connections to existing facilities are in Section 01 14 16, Coordination with Owner's Operations, and Section 01 51 05, Temporary Utilities.
   3. Requirements for cutting and patching are in Section 01 73 29, Cutting and Patching.
   4. To extent possible, materials, equipment, systems, piping, and appurtenances that will be placed into service upon completion of connection to existing facilities shall be checked, successfully tested, and in condition for operation prior to making connections to existing facilities, if valves, gates, or similar watertight and gastight isolation devices are not provided at the connection point.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 73 29

CUTTING AND PATCHING

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. This Section includes general requirements for cutting and patching Work.
   2. CONTRACTOR shall perform cutting and coring, and rough and finish patching of holes and openings in existing construction.
   3. Provide cutting, coring, fitting and patching, including attendant excavation and fill, required to complete the Work, and to:
      a. remove and replace defective Work;
      b. remove samples of installed Work as specified or required for testing;
      c. remove construction required to perform required alterations or additions to existing construction;
      d. uncover the Work for ENGINEER's observation of covered Work, testing or inspection by testing entities, or observation by authorities having jurisdiction;
      e. connect to completed Work not performed in proper sequence;
      f. remove or relocate existing utilities and piping that obstruct the Work in locations where connections are to be made;
      g. make connections or alterations to existing or new facilities.

1.2 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Cutting and Patching Request:
      a. Submit written request to ENGINEER, well in advance of executing cutting or alteration that affects one or more of the following:
         1) Design function or intent of Project.
         2) Work of OWNER or other contractors.
         3) Structural value or integrity of an element of the Project.
         4) Integrity or effectiveness of weather-exposed or moisture-resistant elements or systems.
         5) Efficiency, operational life, maintenance, or safety of operational elements.
         6) Visual qualities of sight-exposed elements.
      b. Request shall include:
         1) Identification of Project and Contract designation.
         2) Description of affected Work of CONTRACTOR and work of others (if any).
         3) Necessity for cutting.

4) Effect on work or operations of OWNER, other contractors (if any), and on structural or weatherproof integrity of Project.
5) Description of proposed Work, describing: scope of cutting and patching; trades who will be executing the Work; materials and equipment to be used; extent of refinishing; schedule of operations; alternatives to cutting and patching, if any, and net effect on aesthetics following completion of finishing Work.
7) Designation of entity responsible for cost of cutting and patching, when applicable.
8) Written permission of other prime contractors (if any) whose work will or may be affected.

2. Recommendation Regarding Cutting and Patching:
   a. Should conditions of work or schedule indicate a change of materials or methods, submit written recommendation to ENGINEER including:
      1) Conditions indicating change.
      2) Recommendations for alternative materials or methods.
      3) Items required with request for approval of substitute, in accordance with the substitution request requirements of the Contract Documents.
3. Product Data:
   a. Submit manufacturer's data for the protective compound to be applied to core-drilled surfaces and cut concrete surfaces.
   b. When not required under other Sections, submit manufacturer's data on materials to be used for finishing around the cut or patched area.
   c. Furnish submittals for patching materials under the associated Specifications Section.

B. Informational Submittals: Submit the following:
1. Written Notification of Cutting and Patching:
   a. Submit written indication designating the day and time that the construction associated with cutting and patching will be uncovered to allow for observation. Do not begin cutting or patching operations until submittal is accepted by ENGINEER.
2. X-ray Investigations:
   a. Proposed method of investigation. Submit and obtain ENGINEER's acceptance prior to performing X-ray inspections.
   b. Report of X-ray evaluation of slabs, floors, and walls to be cut or core-drilled.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Materials - General:
1. Use materials that comply with the Contract Documents.

2. If not shown or indicated in the Contract Documents, use materials that are identical to existing materials affected by cutting and patching Work.
3. For exposed surfaces, use materials that visually match existing adjacent surfaces to fullest extent possible. If identical materials are unavailable or cannot be used, use materials whose installed performance will equal or surpass that of existing materials.
4. Replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, using materials that do not void required or existing warranties.

B. Compound Applied to Core-Drilled Surfaces and Cut Concrete Surfaces:
1. After core-drilling and before installing the utility or equipment through the penetration, coat exposed concrete and steel with solvent-free, two-component, protective, epoxy resin coating.
2. Color shall approximate the finish color of the existing surface to be coated.
3. Product and Manufacturer: Provide one of the following:
a. Sikagard 62, by Sika Corporation.
b. Or equal.

PART 3 – EXECUTION

3.1 GENERAL

A. Perform cutting and coring in such manner that limits extent of patching required.

B. Structural Elements:
1. Do not cut or patch structural elements in manner that would change the element's structural load-carrying capacity as load deflection ratio.

C. Operating Elements:
1. Do not cut or patch operating elements in manner that would reduce their capacity to perform as intended.
2. Do not cut or patch operating elements or related components in manner that would increase maintenance requirements or decrease operational life or safety.

D. Replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, using methods that do not void required or existing warranties.

3.2 INSPECTION

A. Examine surfaces to be cut or patched, and conditions under which cutting or patching will be performed before starting cutting or patching Work.

B. Report unsatisfactory or questionable conditions to ENGINEER in writing. Do not proceed with cutting or patching Work until unsatisfactory conditions are corrected.

C. Non-Destructive Investigation:
   1. In advance of cutting or coring through existing slabs or walls, use X-ray or other non-destructive methods accepted by ENGINEER to determine location of reinforcing steel, electrical conduits, and other items embedded in slabs or walls.
   2. Submit to ENGINEER written report of findings of evaluation.
   3. Perform X-ray investigation and submit results to ENGINEER sufficiently in advance of cutting Work to allow time to identify and implement alternatives, if changes to the Work are necessary because of conduit or other features in floor or wall.

3.3 PREPARATION

A. Provide temporary support required to maintain structural integrity of facilities, to protect adjacent work from damage during cutting, and to support the element(s) to be cut.

B. Protection of Existing Construction during Cutting and Patching:
   1. Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of the Project and facility that will be exposed during cutting and patching operations.
   2. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
   3. Do not cut existing pipe, conduit, ductwork, or other utilities serving facilities scheduled to be removed or relocated until provisions have been made to bypass them.

3.4 CORING

A. Use core-drilling to make penetrations through concrete and masonry walls, slabs, or arches, unless otherwise accepted by ENGINEER in writing.

B. Coring:
   1. Perform coring with non-impact rotary tool using diamond core-drills. Size holes for pipe, conduit, sleeves, equipment or mechanical seals, as required, to be installed through the penetration.
   2. Do not core-drill through electrical conduit or other utilities embedded in walls or slabs without approval of ENGINEER. To extent possible, avoid cutting reinforcing steel in slabs and walls.

C. Protection:
   1. Protect existing equipment, utilities, and adjacent areas from water and other damage caused by or resulting from core-drilling operations.
   2. After core-drilling and before installing the utility or equipment through the penetration, coat exposed concrete and steel with protective coating material

indicated in Paragraph 2.1.B of this Section. Apply protective coating in accordance with manufacturer's instructions.

D. Cleaning:
   1. After core-drilling, vacuum or otherwise remove slurry and tailings from the work area.

3.5 CUTTING

A. Cutting – General:
   1. Cut existing construction using methods least-likely to damage elements retained and adjoining construction and that provide proper surfaces to receive subsequent installation or repair.
   2. In general, use hand tools or small power tools suitable for sawing or grinding. When possible, avoid using hammering and avoid chopping.
   3. Cut holes and slots as small as possible, neatly to the size required, and with minimum disturbance of adjacent surfaces.
   4. Prior to starting cutting, provide adequate bracing of area to be cut.
   5. To avoid marring existing finished surfaces, cut or drill from exposed or finished side into concealed side.
   6. Provide equipment of adequate size to remove the cut panel or "coupon".
   7. Provide temporary covering over cut openings where not in use.

B. Cutting – Concrete and Masonry:
   1. Cut through concrete and masonry using concrete wall saw with diamond saw blades.
   2. On both of the element being cut, provide for control of slurry generated during sawing.
   3. After cutting concrete and before installing subsequent construction on or through the opening, coat exposed concrete and steel with protective coating material indicated in Paragraph 2.1.B of this Section. Apply protective coating in accordance with manufacturer's instructions.

3.6 PATCHING

A. Patching – General:
   1. Patch construction by filling, repairing, refinishing, closing-up, and similar operations following performance of other Work.
   2. Patch with durable seams that are as inconspicuous as possible. Provide materials and comply with installation requirements indicated in the Contract Documents.
   3. Patch to provide airtight and watertight connections to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
   4. Where feasible, test patched areas to demonstrate integrity of installation.

B. Restoration:
   1. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in manner that eliminates evidence of patching and refinishing.
   2. For continuous surfaces, refinish to nearest intersection.
   3. For an assembly, refinish the entire unit that was patched.
   4. Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.

3.7 CLEANING

A. Cleaning and Restoration:
   1. Clean areas and spaces where cutting, coring, or patching were performed.
   2. Clean piping, conduit, and similar constructions before applying paint or other finishing materials.
   3. Restore damaged coverings of pipe and other utilities to original condition.

+ + END OF SECTION + +

SECTION 01 74 05

CLEANING

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. This Section includes requirements for keeping the Site free of accumulations of waste materials during construction ("progress cleaning") and cleaning for Substantial Completion and prior to final inspection (collectively, "closeout cleaning").
   2. CONTRACTOR shall perform cleaning during the Project, including progress cleaning, upon completion of the Work, and as required by the General Conditions, as may be modified by the Supplementary Conditions, and this Section.
   3. Maintain in a clean manner the Site, the Work, and areas adjacent to or affected by the Work.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. NFPA 241, Safeguarding Construction, Alteration, and Demolition Operations.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 PROGRESS CLEANING

A. General:
   1. Clean the Site, work areas, and other areas occupied by CONTRACTOR not less than weekly. Dispose of materials in accordance with the General Conditions, as may be modified by the Supplementary Conditions, and the following:
      a. Comply with NFPA 241 for removing combustible waste materials and debris.
      b. Do not hold non-combustible materials at the Site more than three days if the temperature is expected to rise above 80 degrees F. When temperature is less than 80 degrees F, dispose of non-combustible materials within seven days of their generation.
      c. Provide suitable containers for storage of waste materials and debris.

d. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately.

B. Site:
   1. Keep outdoor, dust-generating areas wetted down or otherwise control dust emissions.
   2. Not less than weekly, brush-sweep roadways and paved areas at the Site that are used by construction vehicles or otherwise affected by construction activities.
   3. Comply with dust control requirements of Section 01 57 05, Temporary Controls.

C. Work Areas:
   1. Clean areas where the Work is in progress to maintain the extent of cleanliness necessary for proper execution of the Work.
   2. Remove liquid spills promptly. Immediately report spills to OWNER, ENGINEER, and authorities having jurisdiction, in accordance with the Contract Documents and Laws and Regulations.
   3. Where dust would impair proper execution of the Work, broom-clean or vacuum entire work area, as appropriate.
   4. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

D. Installed Work:
   1. Keep installed Work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of material or equipment installed, using only cleaning agents and methods specifically recommended by material or equipment manufacturer. If manufacturer does not recommend specific cleaning agents or methods, use cleaning agents and methods that are not hazardous to health and property and that will not damage exposed surfaces.

E. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration until Substantial Completion.

F. Cutting and Patching:
   1. Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, trailings and cuttings, and similar materials.
   2. Thoroughly clean piping, conduits, and similar features before applying patching material, paint, or other finishing materials. Restore damaged coverings on piping, ducting, and similar items to its pre-construction condition.

G. Cleaning of Hydraulic Structures: Clean hydraulic structures that will contain fluid, such as tanks and channels, in accordance with this Section and Section 01 45 53, Cleaning, Testing, and Disinfecting Hydraulic Structures.

H. Waste Disposal:
   1. Properly dispose of waste materials, surplus materials, debris, and rubbish off the Site.
   2. Do not burn or bury rubbish and waste materials at the Site.
   3. Do not discharge volatile or hazardous substances, such as mineral spirits, oil, or paint thinner, into storm sewers or sanitary sewers.
   4. Do not discharge wastes into surface waters or drainage routes.
   5. CONTRACTOR is solely responsible for complying with Laws and Regulations regarding storing, transporting, and disposing of waste generated by CONTRACTOR's operations or brought to the Site by CONTRACTOR.

I. During handling and installation of materials and equipment, clean and protect construction in progress and adjoining materials and equipment already in place. Apply protective covering where required for protection from damage or deterioration, until Substantial Completion.

J. Clean completed construction as frequently as necessary throughout the construction period.

3.2 CLOSEOUT CLEANING

A. Complete the following prior to requesting inspection for Substantial Completion:
   1. Clean and remove from the Site rubbish, waste material, debris, and other foreign substances.
   2. Sweep paved areas broom-clean. Remove petrochemical spills, stains, and other foreign deposits.
   3. Hose-clean sidewalks and loading areas.
   4. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
   5. Leave surface waterways, drainage routes, storm sewers, and gutters open and clean.
   6. Repair pavement, roads, sod, and other areas affected by construction operations and restore to specified condition; if condition is not specified, restore to pre-construction condition.
   7. Clean exposed exterior and interior hard-surfaced finishes to dirt-free condition, free of spatter, grease, stains, fingerprints, films, and similar foreign substances.
   8. Remove debris and surface dust from limited-access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, and similar spaces.
   9. In unoccupied spaces, sweep concrete floors broom-clean.
   10. Clean transparent materials, including mirrors and glazing in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials.
   11. Remove non-permanent tags and labels.
   12. Surface Finishes:

a. Touch-up and otherwise repair and restore chipped, scratched, dented or otherwise marred surfaces to specified finish and match adjacent surfaces.
b. Do not paint over "UL" or similar labels, including mechanical and electrical nameplates.

13. Wipe surfaces of mechanical and electrical equipment, and similar equipment. Remove excess lubrication, paint, and mortar droppings, and other foreign substances.
14. Clean plumbing fixtures to sanitary condition, free of stains, including stains resulting from water exposure.
15. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
16. Clean lighting fixtures, lamps, globes, and reflectors to function with full efficiency. Replace temporary lamps provided in permanent fixtures. Replace existing lighting fixture components that are burned out or noticeably dimmed from use during construction. Replace defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
17. Leave the Site clean, and in neat, orderly condition, satisfactory to OWNER and ENGINEER.

B. Complete the following prior to requesting final inspection:
1. Following completion of the Work on the "punch list" of Work uncompleted at Substantial Completion, clean in accordance with Paragraph 3.2.A of this Section.

+ + END OF SECTION + +

SECTION 01 75 11

CHECKOUT AND STARTUP PROCEDURES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall initially start up and place equipment and systems installed under the Contract into successful operation, in accordance with the equipment manufacturer's written instructions and as instructed by Supplier at the Site.
   2. Provide all material, labor, tools, and equipment required to complete equipment checkout and start-up.
   3. Provide chemicals, lubricants, and other required operating fluids.
   4. Provide fuel, electricity, water, filters, and other expendables required for start-up of equipment, unless otherwise specified.
   5. General activities by CONTRACTOR include the following:
      a. Cleaning, as required under other provisions of the Contract Documents.
      b. Removing temporary protective coatings.
      c. Flushing and replacing lubricants, where required by manufacturer.
      d. Lubrication.
      e. Checking shaft and coupling alignments and resetting where required.
      f. Checking and setting motor, pump, and other equipment rotation, safety interlocks, and belt tensions.
      g. Checking and correcting (as necessary) leveling plates, grout, bearing plates, anchorage devices, fasteners, and alignment of piping, conduits, and ducts that may place stress on the connected equipment.
      h. Performing all adjustments required.

B. Coordination:
   1. Coordinate checkout and start-up with other contractors, as necessary.
   2. Do not start up system or subsystem for continuous operation until all components of that system or subsystem, including instrumentation and controls, have been tested to the extent practicable and proven to be operable as intended by the Contract Documents.
   3. OWNER will furnish sufficient personnel to assist CONTRACTOR in starting up equipment, but responsibility for proper operation is CONTRACTOR's.
   4. Supplier shall be present during checkout, startup, and initial operation, unless otherwise acceptable to ENGINEER.
   5. Startup of heating equipment, air conditioning equipment, and other equipment that provides cooling or other temperature control, and systems is dependent upon the time of year. Return to the Site at beginning of next heating or cooling season (as applicable) to recheck and start the appropriate systems.

6. Do not start up system, unit process, or equipment without submitting acceptable preliminary operations and maintenance manuals by CONTRACTOR in accordance with Section 01 78 23, Operations and Maintenance Data.

C. OWNER's Assumption of Responsibility for Equipment and Systems:
   1. OWNER will assume responsibility for the equipment upon Substantial Completion, unless otherwise mutually agreed upon by OWNER and CONTRACTOR or as documented in the certificate of Substantial Completion.
   2. Before turning over to OWNER responsibility for operating and maintaining system or equipment CONTRACTOR shall:
      a. Provide training of operations and maintenance personnel in accordance with Section 01 79 23, Instruction of Operations and Maintenance Personnel.
      b. Complete performance of equipment and system field quality control testing in accordance with the Contract Documents, to the extent possible.
      c. Submit acceptable final operations and maintenance manuals in accordance with Section 01 78 23, Operations and Maintenance Data.
      d. Obtain from ENGINEER final certificate of Substantial Completion for either entire Work or the portion being turned over to OWNER.

1.2 SUBMITTALS

A. Closeout Submittals: Submit the following:
   1. Certifications:
      a. Supplier's certification of installation in accordance with Paragraph 3.1.B of this Section.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 SERVICES OF SUPPLIER

A. When specified, furnish services of competent, qualified representatives of material and equipment manufacturers, including supervising installation, adjusting, checkout, startup, and testing of materials and equipment.

B. Certification:
   1. When services by Supplier are required at the Site, within 14 days after first test operation of equipment, submit to ENGINEER a letter from Supplier, on Supplier's letterhead, stating that materials and equipment are installed in accordance with Supplier's requirements and installation instructions, and in accordance with the Contract Documents.

2. In lieu of Supplier letter, submit completed form attached to this Section.
3. Include in the final operations and maintenance manual for the associated equipment a copy of the letter or completed form, as applicable.

3.2 MINIMUM STARTUP REQUIREMENTS

A. Bearings and Shafting:
1. Inspect for cleanliness, and clean and remove foreign matter.
2. Verify alignment.
3. Replace defective bearings and those that operate in a rough or noisy manner.
4. Grease as necessary, in accordance with manufacturer's recommendations.

B. Drives:
1. Adjust tension in V-belt drives and adjust vari-pitch sheaves and drives for proper equipment speed.
2. Adjust drives for alignment of sheaves and V-belts.
3. Clean and remove foreign matter before starting operation.

C. Motors:
1. Check each motor for comparison to amperage nameplate value.
2. Correct conditions that produce excessive current flow and conditions that exist due to equipment malfunction.

D. Pumps:
1. Check glands and seals for cleanliness and adjustment before running pump.
2. Inspect shaft sleeves for scoring.
3. Inspect mechanical faces, chambers, and seal rings, and replace if defective.
4. Verify that piping system is free of dirt and scale before circulating liquid through pump.

E. Valves:
1. Inspect manual and automatic control valves, and clean bonnets and stems.
2. Tighten packing glands to ensure no leakage, but allow valve stems to operate without galling.
3. Replace packing in valves to retain maximum adjustment after system is determined to be complete.
4. Replace packing on valves that continue to leak.
5. Remove, correct, and replace bonnets that leak.
6. After cleaning, coat packing gland threads and valve stems with surface preparation of "Molycote" or "Fel-Pro".

F. Verify that control valve seats are free of foreign matter and are properly positioned for intended service.

G. Pipe Joints and Other Connections:
1. Tighten flanges and other pipe joints after system has been placed in operation.

2. Replace gaskets that show signs of leakage after tightening.
3. Inspect all joints for leakage.
4. Promptly remake each joint that appears to be faulty; do not wait for rust other corrosion to form.
5. Clean threads on both parts, and apply compound and remake joints.

H. After system has been placed in operation, clean strainers, drives, pockets, orifices, valve seats, and headers in fluid system to ensure freedom from foreign matter.

I. Open steam traps and air vents, where used, and remove operating elements. Clean thoroughly, replace internal parts, and place back into operation.

J. Remove rust, scale, and foreign matter from equipment and renew defaced surfaces.

K. Set and calibrate draft gauges of air filters and other equipment.

L. Inspect fan wheels for clearance and balance. Provide factory-authorized personnel for adjustment where needed.

M. Check each electrical control circuit to verify that operation complies with the Contract Documents.

N. Inspect each pressure gauge, thermometer, and other instruments for calibration. Replace items that are defaced, broken, or that read incorrectly.

O. Repair damaged insulation.

P. Excess Gasses and Fluids:
1. Vent gasses trapped in systems.
2. Verify that liquids are drained from all parts of gas or air systems.

3.3 ATTACHMENTS

A. The attachment listed below, following this Section's "End of Section" designation, is a part of this Specification Section.
1. Supplier's Installation Certification Form (one page).

+ + END OF SECTION + +

SUPPLIER'S INSTALLATION CERTIFICATION

Contract No. and Name: _____

Equipment Specification Section: _____

Equipment Name: _____

Contractor: _____

Manufacturer of Equipment: _____

The undersigned Supplier of the equipment or system described above hereby certifies that Supplier has checked the installation of the equipment or system and that the equipment or system, as specified in the Contract Documents, has been provided in accordance with the manufacturer's recommendations and the Contract Documents, and that the trial operation of the equipment or system has been satisfactory.

Comments: _____

_____ _____

Date Supplier Name (print)

_____

Signature of Supplier

_____ _____

Date Contractor Name (print)

_____

Signature of Contractor

SECTION 01 77 19

CLOSEOUT REQUIREMENTS

PART 1 – GENERAL

1.1 GENERAL

A. Scope:
   1. Section Includes.
      a. Substantial Completion.
      b. Final inspection.
      c. Request for final payment and acceptance of the Work.

1.2 SUBSTANTIAL COMPLETION

A. Substantial Completion – General:
   1. Prior to requesting Substantial Completion, perform the following for the substantially completed Work:
      a. Materials and equipment for which Substantial Completion is requested shall be fully ready for their intended use, including full operating and monitoring capability in automatic and manual modes.
      b. Complete field quality control Work, including testing at the Site, indicated in Specifications Sections for individual materials and equipment items. Submit results of, and obtain ENGINEER's acceptance of, field quality control tests required by the Contract Documents.
      b. Startup and checkout shall be completed in accordance with Section 01 75 11, Startup and Checkout Procedures, and requirements of the Specifications for the various materials and equipment in the substantially completed Work.
      c. Cleaning for Substantial Completion shall be completed in accordance with Section 01 74 05, Cleaning.
      d. Spare parts, extra stock materials, and tools shall be delivered and accepted in accordance with Section 01 78 43, Spare Parts and Extra Materials, and the Specifications for the various materials and equipment.
      e. Training shall be completed in accordance with Section 01 79 23, Instruction of Operations and Maintenance Personnel.
      f. Submit and obtain ENGINEER's acceptance of final operations and maintenance manuals.
      g. Obtain and submit to ENGINEER all required permits, inspections, and approvals of authorities having jurisdiction for the substantially completed Work to be occupied and used by Owner.
      h. Complete other tasks that the Contract require be completed prior to Substantial Completion.

2. Procedures for requesting and documenting Substantial Completion are in the General Conditions, as may be modified by the Supplementary Conditions.
3. Sample letter for CONTRACTOR to request inspection for Substantial Completion is attached to this Specifications Section. Use the model language of the sample letter, modified to suit the Project.
4. Unless decided otherwise by OWNER and ENGINEER, form of certificate of Substantial Completion will be EJCDC® C-625, "Certificate of Substantial Completion" (2013 edition), prepared by ENGINEER.
5. Refer to the Agreement and Section 01 29 76, Progress Payment Procedures, for requirements regarding consent of surety to partial release of or reduction in retainage.

1.3 FINAL INSPECTION

A. Final Inspection – General:
   1. Prior to requesting final inspection, verify that all of the Work is fully complete and ready for final payment. Partial checklist for this purpose is attached to this Specifications Section.
   2. Sample letter for CONTRACTOR to request final inspection is attached to this Specifications Section. Use the model language of the sample letter, modified to suit the Project.
   3. Procedures for requesting and documenting the final inspection are in the General Conditions, as may be modified by the Supplementary Conditions, and as augmented in this Section.

1.4 REQUEST FOR FINAL PAYMENT AND ACCEPTANCE OF THE WORK

A. Procedure:
   1. Submit request for final payment in accordance with the Agreement and General Conditions, as may be modified by the Supplementary Conditions, and using procedure specified in Section 01 29 76, Progress Payment Procedures, and this Section.
   2. Acceptance of the Work:
      a. Upon ENGINEER's receipt of the final Application for Payment, accompanied by other required Contract closeout documentation in accordance with the Contract Documents, ENGINEER will issue to OWNER and CONTRACTOR a notice of acceptability of the Work, in accordance with the General Conditions, as may be modified by the Supplementary Conditions.
      b. Nothing other than receipt of such notice of acceptability from ENGINEER constitutes acceptance of the Work.
      c. Unless decided otherwise by OWNER and ENGINEER, form of acceptance will be EJCDC® C-626, "Notice of Acceptability of Work", (2014 edition).

B. Request for final payment shall include:
   1. Documents required for progress payments in Section 01 29 76, Progress Payment Procedures.
   2. Documents required in the General Conditions, as may be modified by the Supplementary Conditions.
   3. List of all disputes that Contractor believes are unsettled.
   4. Consent of Surety to Final Payment:
      a. Acceptable form includes AIA® G707™, "Consent of Surety to Final Payment" (1994 or later edition), or other form acceptable to OWNER.
   5. Releases or Waivers of Lien Rights:
      a. When submitting releases or waivers of Lien rights, furnish release or waiver by CONTRACTOR and each Subcontractor and Supplier that provided CONTRACTOR, Subcontractor, or Supplier with labor, material, or equipment totaling $1,000 or more for the Contract.
      b. Furnish final list of Subcontractors and Suppliers, using the form included in Section 01 29 76, Progress Payment Procedures, indicating final amount of the associated subcontract or purchase order for each. Include on the list all lower-tier Subcontractors and Suppliers retained by Subcontractors and Suppliers with direct subcontract or purchase order with CONTRACTOR.
      c. Each release or waiver of Lien shall be signed by an authorized representative of the entity submitting release or waiver of Lien, and shall include CONTRACTOR's, Subcontractor's, or Supplier's (as applicable) corporate seal, when applicable.
      d. Release or waiver of Lien may be conditional upon receipt of final payment.
   6. Affidavits:
      a. In lieu of the release or waiver of Liens, CONTRACTOR may submit the following, for CONTRACTOR and each Subcontractor and Supplier that provided CONTRACTOR, Subcontractor, or Supplier with labor, material, or equipment totaling $1,000 or more, to OWNER's satisfaction:
         1) Affidavit of payment of debts and claims. Acceptable form includes AIA® G706™, "Contractor's Affidavit of Payment of Debts and Claims" (1994 or later edition), or other form acceptable to OWNER, and;
         2) Affidavit of release of Liens. Acceptable form includes AIA® G706A™, "Affidavit of Release of Liens" (1994 or later edition), or other form acceptable to OWNER.
      b. Affidavits and supporting documents furnished under this Paragraph 1.4.B.6 shall comply with the requirements of the General Conditions, as may be modified by the Supplementary Conditions.
      c. Each affidavit furnished shall be signed by an authorized representative of the entity furnishing the affidavit, and shall include CONTRACTOR's, Subcontractor's, or Supplier's (as applicable) corporate seal, when applicable.

7. Evidence satisfactory to OWNER that all title issues have been resolved such that title to all Work, materials, and equipment has passed to OWNER free and clear of Liens or other title defects, or will so pass upon final payment.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 ATTACHMENTS

A. The documents listed below, following this Section's "End of Section" designation, are part of this Specifications Section:
   1. Sample letter for Contractor's use in requesting inspection for Substantial Completion (two pages).
   2. Sample partial checklist to identify readiness for final inspection (four pages).
   3. Sample letter for Contractor's use in requesting final inspection (one page).
   4. AIA® G707™, "Consent of Surety to Final Payment" (two pages).

B. In the model language of the attached sample letters for the CONTRACTOR to request inspection for Substantial Completion and the final inspection, italicized language in brackets, e.g., "[*insert date*]" indicates instructions to the drafter of the letter and often indicates specific information to be inserted by CONTRACTOR; do not include bracketed, italicized text in the final version of the letter(s) prepared for the Project. Non-italicized language in brackets is optional language; use the appropriate language to complete the actual letter for the Project and edit where required to suit the specific circumstances.

+ + END OF SECTION + +

SAMPLE LETTER FOR CONTRACTOR'S USE IN REQUESTING INSPECTION FOR SUBSTANTIAL COMPLETION

SENT VIA E-MAIL AND U.S. CERTIFIED MAIL/RETURN RECEIPT REQUESTED

[*Date*]

[*Name of Engineer's contact person*]
ARCADIS U.S., Inc.
[*Street address*]
[*City, state, postal code*]

Subject:
[*Project name, Contract designation*]
Request for Inspection for Substantial Completion

Dear [*addressee*]:

In our opinion, [all of] [*or*] [a portion of] the Work under the above-referenced Contract is substantially complete as of [*insert month, day, year on which Substantial Completion was achieved*]. [The specific portion of the Work that we believe is substantially complete is [*insert identification of that portion of the Work that is substantially complete*].]

Enclosed is our listing of uncompleted Work items ("punch list"). In accordance with Paragraph 15.03.A of the General Conditions, we hereby request: 1) That the Engineer schedule and perform the inspection for Substantial Completion as soon as possible, and 2) Issuance of the certificate of Substantial Completion.

In accordance with Paragraph 15.03.D of the General Conditions, upon Substantial Completion, we propose the following relative to apportionment of responsibilities between the Owner and the Contractor:

1. Security, Protection, Insurance:
    a. Site Security: [*insert proposal; address whether Owner or Contractor will be responsible for security of the Site*].
    b. Protection of the Substantially Completed Work: [*insert proposal; address whether Owner or Contractor will be responsible for protection*].
    c. Property Insurance: [*insert proposal; typically Owner assumes responsibility for property insurance upon Substantial Completion*]
2. Operation and Maintenance:

a. Operation: [*insert proposal; address whether Owner or Contractor will be responsible for operating the substantially completed Work*].

b. Maintenance: [*insert proposal; address whether Owner or Contractor will be responsible for maintaining the substantially completed Work*].

3. Utilities: [*for each of the following, indicate whether Owner or Contractor will be responsible for utilities and services, or whether responsibility will be shared; if shared, indicate proposed cost-sharing*]

   a. Electricity: [*insert proposal*].

   b. Natural Gas/Fuel/Heating: [*insert proposal*].

   c. Water Supply: [*insert proposal*].

   d. Wastewater: [*insert proposal*].

   e. Communications (Telephone, Internet, Video): [*insert proposal*].

In accordance with Paragraph 15.08.A of the General Conditions, we understand that the Contract's correction period for the Work covered by the certificate of Substantial Completion commences on the Substantial Completion date documented in said certificate. [*Drafter: Also see Paragraph 15.08.C of the General Conditions and, where necessary, edit this paragraph of the letter accordingly.*]

Should you have questions or comments regarding this notice, please contact [the undersigned] [*or*] [*insert other contact person's name*], at [*insert telephone number and e-mail address*].

Sincerely,

[*Contractor's company name*]

[*Signatory name*]
[*Signatory's title*]

Attachments:
Preliminary list of uncompleted Work items ("punch list"; [##] pages)

Copies:
[*Owner's project manager*]

SAMPLE PARTIAL CHECKLIST TO IDENTIFY READINESS FOR FINAL INSPECTION

Project: _____
Contract: _____
Contractor: _____

Item No./Description	Completed/Date		In Progress	Not Started	Not Applicable	Target Date	Responsible Entity/Person
1. All Shop Drawings, Samples, and Submittals approved by Engineer	☐		☐	☐	☐		
Remarks:							
2. Final services completed by Suppliers, including submittal of "Supplier Installation Certification" in Section 01 75 11, Checkout and Startup Procedures	☐		☐	☐	☐		
Remarks:							
3. Final Work completed by Subcontractors	☐		☐	☐	☐		
Remarks:							
4. Permits closed out and regulatory compliance transitioned from construction to operations	☐		☐	☐	☐		
Remarks:							
5. All outstanding change issues	☐		☐	☐	☐		

Item No./Description	Completed/Date		In Progress	Not Started	Not Applicable	Target Date	Responsible Entity/Person
are addressed and all Change Proposals submitted							
Remarks:							
6. All Claims are resolved	☐		☐	☐	☐		
Remarks:							
7. All defective Work of which Contractor is aware has been corrected in accordance with the Contract Documents	☐		☐	☐	☐		
Remarks:							
8. Issues related to Constituents of Concern and potential Hazardous Environmental Condition have been fully addressed	☐		☐	☐	☐		
Remarks:							
9. All spare parts, tools, and extra stock materials have been furnished in accordance with the Contract Documents, and documentation thereof submitted to Engineer	☐		☐	☐	☐		
Remarks:							
10. All final Operations & Maintenance manuals have been	☐		☐	☐	☐		

Item No./Description	Completed/Date		In Progress	Not Started	Not Applicable	Target Date	Responsible Entity/Person
submitted and accepted by Engineer							
Remarks:							
11. Manufacturer warranties and software license(s) furnished	☐		☐	☐	☐		
Remarks:							
12. Instruction and training of operations and maintenance personnel is complete and records of training submitted	☐		☐	☐	☐		
Remarks:							
13. MBE/WBE/DBE compliance report(s) submitted (when applicable)	☐		☐	☐	☐		
Remarks:							
14. All field engineering submittals, including survey data, furnished	☐		☐	☐	☐		
Remarks:							
15. All Work on “punch list” is complete in accordance with the Contract Documents	☐		☐	☐	☐		
Remarks:							
16. All record documents submitted to and accepted by Engineer	☐		☐	☐	☐		

Item No./Description	Completed/Date		In Progress	Not Started	Not Applicable	Target Date	Responsible Entity/Person
Remarks:							
17. Contractor is fully demobilized from Site	☐		☐	☐	☐		
Remarks:							
18. All Site restoration is complete	☐		☐	☐	☐		
Remarks:							
19. Final cleaning of all work areas is complete	☐		☐	☐	☐		
Remarks:							
20. Lien waivers or affidavits of payment obtained from Subcontractors and Suppliers	☐		☐	☐	☐		
Remarks:							
21. Evidence of Contractor liability insurance furnished for correction period	☐		☐	☐	☐		
Remarks:							
22. All other required Contract closeout documents obtained	☐		☐	☐	☐		
Remarks:							

SAMPLE LETTER FOR CONTRACTOR'S USE IN REQUESTING FINAL INSPECTION

SENT VIA E-MAIL AND U.S. CERTIFIED MAIL/RETURN RECEIPT REQUESTED

[*Date*]

[*Name of Engineer's contact person*]
ARCADIS U.S., Inc.
[*Street address*]
[*City, state, postal code*]

Subject:
[*Project name, Contract designation*]
Request for Final Inspection

Dear [*addressee*]:

In our opinion, all of the Work under the above-referenced Contract is complete and ready for final payment as of [*insert month, day, year on which final completion was achieved*]. In accordance with Paragraph 15.05.A of the General Conditions, we hereby request that the Engineer schedule and perform the final inspection as soon as possible. Upon successful completion of the final inspection, we will submit our final Application for Payment accompanied by the required Contract closeout documentation in accordance with the Contract Documents.

Should you have questions or comments regarding this notice, please contact [the undersigned] [*or*] [*insert other contact person's name*], at [*insert telephone number and e-mail address*].

Sincerely,

[*Contractor's company name*]

[*Signatory name*]
[*Signatory's title*]

Attachments:
None

Copies:
[*Owner's project manager*]

INSTRUCTION SHEET

FOR AIA DOCUMENT G707, CONSENT OF SURETY TO FINAL PAYMENT

A. GENERAL INFORMATION

1. Purpose

This document is intended for use as a companion to AIA Document G706, Contractor's Affadavit of Payment of Debts and Claims, on construction projects where the Contractor is required to furnish a bond. By obtaining the Surety's approval of final payment to the Contractor and its agreement that final payment will not relieve the Surety of any of its obligations, the Owner may preserve its rights under the bond.

2. Related Documents

This document may be used with most of the AIA's Owner-Contractor agreements and general conditions, such as A201 and its related family of documents. As noted above, this is a companion document to AIA Document G706.

3. Use of Current Documents

Prior to using any AIA document, the user should consult the AIA, an AIA component chapter or a current AIA Documents List to determine the current edition of each document.

4. Limited License for Reproduction

B. CHANGES FROM THE PREVIOUS EDITION

Changes in the location of various items of information were made, without revision to the substance of the document.

C. COMPLETING THE G707 FORM

GENERAL: The bond form is the usual source of required information such as the contract date and the names and addresses of the Surety, Owner, Contractor and Project.

ARCHITECT'S PROJECT NO.: This information is typically supplied by the Architect and entered on the form by the Contractor.

CONTRACT FOR: This refers to the scope of the contract, such as "General Construction" or "Mechanical Work".

D. EXECUTION OF THE DOCUMENT

The G707 form requires both the Surety's seal and the signature of the Surety's authorized representative.

CONSENT OF SURETY TO FINAL PAYMENT

AIA Document G707

(Instructions on reverse side)

OWNER	☐
ARCHITECT	☐
CONTRACTOR	☐
SURETY	☐
OTHER	☐

TO OWNER:
(Name and address)

ARCHITECT'S PROJECT NO.:

CONTRACT FOR:

CONTRACT DATED:

PROJECT:
(Name and address)

In accordance with the provisions of the Contract between the Owner and the Contractor as indicated above, the
(Insert name and address of Surety)

, SURETY,

on bond of
(Insert name and address of Contractor)

, CONTRACTOR,

hereby approves of the final payment to the Contractor, and agrees that final payment to the Contractor shall not relieve the Surety of any of its obligations to
(Insert name and address of Owner)

, OWNER,

as set forth in said Surety's bond.

IN WITNESS WHEREOF, the Surety has hereunto set its hand on this date:
(Insert in writing the month followed by the numeric date and year.)

(Surety)

(Signature of authorized representative)

Attest:
(Seal):

(Printed name and title)

CAUTION: You should sign an original AIA document that has this caution printed in red. An original assures that changes will not be obscured as may occur when documents are reproduced. See Instruction Sheet for Limited License for Reproduction of this document.

SECTION 01 78 23

OPERATIONS AND MAINTENANCE DATA

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. This Section includes requirements for manufacturers' operations and maintenance manuals and related data to be furnished by CONTRACTOR.
   2. CONTRACTOR shall submit operation and maintenance data, in accordance with this Section and in accordance with requirements elsewhere in the Contract Documents, as instructional and reference manuals by operations and maintenance personnel at the Site.
   3. Required operation and maintenance data groupings are listed in table(s) in Article 1.2 of this Section. At minimum, submit operation and maintenance data for:
      a. All equipment and systems.
      b. Valves, gates, actuators, and related accessories.
      c. Instrumentation and control devices.
      d. Electrical equipment.
   4. For each operation and maintenance manual, submit the following:
      a. Preliminary Submittal: Printed and bound copy of entire operation and maintenance manual, except for test data, service reports by Supplier, and submit electronic copies.
      b. Final Submittal: Printed and bound copy of complete operations and maintenance manual, including test data and service reports by Supplier, and submit electronic copies.

1.2 SUBMITTALS

A. Closeout Submittals: Submit the following:
   1. Operation and Maintenance Data:
      a. Submit the operations and maintenance data indicated in the Contract Documents, grouped into submittals as indicated in Table 01 78 23-A:

TABLE 01 78 23-A, REQUIRED OPERATIONS AND MAINTENANCE DATA

Name of O&M Manual/Data	For Materials or Equipment Specified in Section(s)
HVAC Equipment	23 05 93
Switchboards	26 24 13
Surge Protective Devices	26 43 00
Process Valves	40 05 53
Stainless Steel Slide Gates	43 26 23
Polymer Blending and Feed Equipment	46 33 33
Dewatering Centrifuges	46 76 33

B. Quantity Required and Timing of Submittals:
    a. Printed Copies: Three (3) copies, exclusive of copies required by CONTRACTOR.
    b. Electronic Copies: One (1) copies.
    c. Submit to ENGINEER by the earlier of: 90 days following approval of Shop Drawings and product data submittals, or 10 days prior to starting training of operations and maintenance personnel, or 10 days prior to field quality control testing at the Site.
2. Final Submittal: Furnish final submittal prior to Substantial Completion, unless submittal is specified as required prior to an interim Milestone.
    a. Printed Copies: Four (4) copies.
    b. Electronic Copies: Two (2) copies.

1.3 FORMAT OF PRINTED COPIES

A. Binding and Cover:
1. Bind each operation and maintenance manual in durable, permanent, stiff-cover binder(s), comprising one or more volumes per copy as required. Binders shall be not less than one inch wide and maximum of three inches wide. Binders for each copy of each volume shall be identical.
2. Binders shall be locking three-ring/"D"-ring type, or three-post type. Three-ring binders shall be riveted to back cover and include plastic sheet lifter (page guard) at front of each volume.
3. Do not overfill binders.
4. Covers shall be oil-, moisture-, and wear-resistant, including identifying information on cover and spine of each volume.
5 Provide the following information on cover of each volume:
    a. Title: "OPERATING AND MAINTENANCE INSTRUCTIONS".
    b. Name or type of material or equipment covered in the manual.
    c. Volume number, if more than one volume is required, listed as "Volume __ of __", with appropriate volume-designating numbers filled in.
    d. Name of Project and, if applicable, Contract name and number.
    e. Name of building or structure, as applicable.
6 Provide the following information on spine of each volume:
    a. Title: "OPERATING AND MAINTENANCE INSTRUCTIONS".
    b. Name or type of material or equipment covered in the manual.
    c. Volume number, if more than one volume is required, listed as "Volume __ of __", with appropriate volume-designating numbers filled in.
    d. Project name and building or structure name.

B. Pages:
1. Print pages in operations and maintenance manual on 30-pound (minimum) paper, 8.5 inches by 11 inches in size.
2. Reinforce binding holes in each individual sheet with plastic, cloth, or metal. When published, separately-bound booklets or pamphlets are part of the

manual, reinforcing of pages within booklet or pamphlet is not required.

3. Furnish each page with binding margin not less than one inch wide. Punch each page with holes suitable for the associated binding.

C. Drawings:
   1. Bind into the operation and maintenance manual drawings, diagrams, and illustrations up to and including 11 inches by 17 inches in size, with reinforcing specified for pages.
   2. Documents larger than 11 inches by 17 inches shall be folded and inserted into clear plastic pockets bound into the manual. Mark pockets with printed text indicating content and drawing numbers. Include not more than three drawing sheets per pocket.

D. Copy Quality and Document Clarity:
   1. Contents shall be original-quality copies. Documents in the operations and maintenance manual shall be either original manufacturer-printed documents or first-generation photocopies indistinguishable from originals. If original is in color, copies shall be in color. Manuals that contain copies that are unclear, not completely legible, off-center, skewed, or where text or drawings are cut by binding holes, are unacceptable. Pages that contain approval or date stamps, comments, or other markings that cover text or drawing are unacceptable. Faxed copies are unacceptable.
   2. Clearly mark in ink to indicate all components of materials and equipment on catalog pages for ease of identification. In standard or pre-printed documents, indicate options furnished or cross out inapplicable content. Using highlighters to so indicate options furnished is unacceptable.

E. Organization:
   1. Table of Contents:
      a. Provide table of contents in each volume of each operations and maintenance manual.
      b. In table of contents and not less than once in each chapter or section, identify materials and equipment by their functional names. Thereafter, abbreviations and acronyms may be used if their meaning is clearly indicated in a table bound at or near beginning of each volume. Using material or equipment model or catalog designations for identification is unacceptable.
   2. Use dividers and indexed tabs between major categories of information, such as operating instructions, preventive maintenance instructions, and other major subdivisions of data in each manual.

1.4 FORMAT OF ELECTRONIC COPIES

A. Electronic Copies of Operation and Maintenance Manuals:
   1. Each electronic copy shall include all information included in the corresponding printed copy.

2. Submit each electronic copy on a separate compact disc (CD), unless another electronic data transfer method or format is acceptable to ENGINEER.
3. File Format:
    a. Files shall be in "portable document format" (PDF). Files shall be electronically searchable.
    b. Submit separate file for each separate document in the printed copy.
    c. Within each file, provide bookmarks for the following:
        1) Each chapter and subsection listed in the corresponding printed copy document's table of contents.
        2) Each figure.
        3) Each table.
        4) Each appendix.

B. Copies of Programming and Configuration Files:
1. Furnish on CD or portable USB "thumb drive" copy of all software programming, such as programmable logic controller programs, prepared specifically for the Project. Third-party, licensed, commercially available software is excluded from requirements of this Article; submit copies of commercially-available, licensed, third-party software, where required, in accordance with the Contract Documents.
2. Submit on CD or portable USB "thumb drive" copies of system configuration prepared specifically for the Project, such as plant monitoring system and SCADA display configurations.
3. Submit programming and configuration files concurrently with electronic copies of operation and maintenance data.

1.5 CONTENT

A. General:
1. Prepare each operations and maintenance manual specifically for the Project. Include in each manual all pertinent instructions, as-built drawings as applicable, bills of materials, technical bulletins, installation and handling requirements, maintenance and repair instructions, and other information required for complete, accurate, and comprehensive data for safe and proper operation, maintenance, and repair of materials and equipment furnished for the Project. Include in manuals specific information required in the Specification Section for the material or equipment, data required by Laws and Regulations, and data required by authorities having jurisdiction.
2. Completeness and Accuracy:
    a. Operation and maintenance manuals that include language stating or implying that the manual's content may be insufficient or stating that the manual's content is not guaranteed to be complete and accurate are unacceptable.
    b. Operations and maintenance manuals shall be complete and accurate.
    c. Operation and maintenance manuals shall indicate the specific alternatives and features furnished, and the specific operation and

maintenance provisions for the material or equipment furnished.

3. Submit complete, detailed written operating instructions for each material or equipment item including: function; operating characteristics; limiting conditions; operating instructions for start-up, normal and emergency conditions; regulation and control; operational troubleshooting; and shutdown. Also include, as applicable, written descriptions of alarms generated by equipment and proper responses to such alarm conditions.

B. Submit written explanations of safety considerations relating to operation and maintenance procedures.

C. Submit complete, detailed, written preventive maintenance instructions including all information and instructions to keep materials, equipment, and systems properly lubricated, adjusted, and maintained so that materials, equipment, and systems function economically throughout their expected service life. Instructions shall include:
   1. Written explanations with illustrations for each preventive maintenance task such as inspection, adjustment, lubrication, calibration, and cleaning. Include pre-startup checklists for each equipment item and maintenance requirements for long-term shutdowns.
   2. Recommended schedule for each preventive maintenance task.
   3. Lubrication charts indicating recommended types of lubricants, frequency of application or change, and where each lubricant is to be used or applied.
   4. Table of alternative lubricants.
   5. Troubleshooting instructions.
   6. List of required maintenance tools and equipment.

D. Submit complete bills of material or parts lists for materials and equipment furnished. Lists or bills of material may be furnished on a per-drawing or per-equipment assembly basis. Bills of material shall indicate:
   1. Manufacturer's name, address, telephone number, fax number, and Internet website address.
   2. Manufacturer's local service representative's or local parts supplier's name, address, telephone number, fax number, Internet website address, and e-mail addresses, when applicable.
   3. Manufacturer's shop order and serial number(s) for materials, equipment or assembly furnished.
   4. For each part or piece include the following information:
      a. Parts cross-reference number. Cross-reference number shall be used to identify the part on assembly drawings, Shop Drawings, or other type of graphic illustration where the part is clearly shown or indicated.
      b. Part name or description.
      c. Manufacturer's part number.
      d. Quantity of each part used in each assembly.
      e. Current unit price of the part at the time the operations and maintenance manual is submitted. Price list shall be dated.

E. Submit complete instructions for ordering replaceable parts, including reference numbers (such as shop order number or serial number) that will expedite the ordering process.

F. Submit manufacturer's recommended inventory levels for spare parts, extra stock materials, and consumable supplies for the initial two years of operation. Consumable supplies are items consumed or worn by operation of materials or equipment, and items used in maintaining the operation of material or equipment, including items such as lubricants, seals, reagents, and testing chemicals used for calibrating or operating the equipment. Include estimated delivery times, shelf life limitations, and special storage requirements.

G. Submit manufacturer's installation and operation bulletins, diagrams, schematics, and equipment cutaways. Avoid submitting catalog excerpts unless they are the only document available showing identification or description of particular component of the equipment. Where materials pertain to multiple models or types, mark the literature to indicate specific material or equipment supplied. Marking may be in the form of checking, arrows, or underlining to indicate pertinent information, or by crossing out or other means of obliterating information that does not apply to the materials and equipment furnished.

H. Submit original-quality copies of each approved and accepted Shop Drawing, product data, and other submittal, updated to indicate as-installed condition. Reduced drawings are acceptable only if reduction is to not less than one-half original size and all lines, dimensions, lettering, and text are completely legible on the reduction.

I. Submit complete electrical schematics and wiring diagrams, including complete point-to-point wiring and wiring numbers or colors between all terminal points.

J. Programmable Logic Controllers: If programmable logic controllers are furnished under the Contract:
   1. Submit complete logic listings in function block diagram format.
   2. Format Requirements:
      a. For function block diagram, label each function block with understandable tags or descriptive labels. Describe purpose and action of each function block.
      a. For sequential function chart, include extensive comments for each step to describe program step function.
      a. For instruction list and structured text, include extensive comments for each program line to describe program line function.
   3. Submit complete programmable logic controller listing of all input/output address assignments, tag assignments, and pre-set constant values, with functional point descriptions.
   4. Submit complete manufacturer's programming manuals.

K. Submit copy of warranty bond and service contract as applicable.

L. When copyrighted material is used in operations and maintenance manuals, obtain copyright holder's written permission to use such material in the operation and maintenance manual.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 78 39

PROJECT RECORD DOCUMENTS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. This Section includes requirements for Project record documents, to supplement the requirements of the General Conditions, as may be modified by the Supplementary Conditions.
   2. CONTRACTOR shall provide all labor, materials, equipment, and services to maintain and submit to ENGINEER Project record documents in accordance with the Contract Documents.

B. Maintenance of Record Documents:
   1. Maintain in CONTRACTOR's field office, in clean, dry, legible condition, complete sets of the following record documents: Drawings, Specifications, and Addenda; Shop Drawings, Samples, and other CONTRACTOR submittals, including records of test results, approved or accepted as applicable, by ENGINEER; Change Orders, Work Change Directives, Field Orders, copies of all interpretations and clarifications issued, photographic documentation, survey data, and all other documents pertinent to the Work.
   2. Provide files and racks for proper storage and easy access to record documents. File record documents in accordance with the edition of the Construction Specification Institute's *MasterFormat*™ used for organizing the Project Manual, unless otherwise accepted by ENGINEER.
   3. Promptly make record documents available for observation and review upon request of ENGINEER or OWNER. Requirements for review of record documents status as a condition precedent to progress payments is in Section 01 29 73, Schedule of Values, and Section 01 29 76, Progress Payment Procedures.
   4. Do not use record documents for any purpose other than serving as Project record. Do not remove record documents from CONTRACTOR's field office without ENGINEER's approval.

1.2 SUBMITTALS

A. Closeout Submittals: Submit the following:
   1. Record Documents:
      a. Submit the following Project record documents:
         1) Drawings.
         2) Project Manual including Specifications and Addenda (bound).

b. Prior to readiness for final payment, submit to ENGINEER one copy of Project's final record documents and obtain ENGINEER's acceptance of same. Submit complete record documents; do not make partial submittals.
c. Submit both printed record documents and electronic record documents, in accordance with Section 01 31 26, Electronic Communication Protocols.
d. Submit record documents with transmittal letter on CONTRACTOR letterhead in accordance with requirements in Section 01 33 00, Submittal Procedures.

2. Certifications:
a. Record documents submittal shall include certification, with original signature of official authorized to execute legal agreements on behalf of CONTRACTOR, reading as follows:

"[*Insert Contractor's corporate name*] has maintained and submitted Project record documentation in accordance with the General Conditions and Supplementary Conditions, Section 01 78 39, Project Record Documents, and other elements of Contract Documents, for the City of Canton, Water Reclamation Facility, Sludge Processing Modifications. We certify that each record document submitted is complete, accurate, and legible relative to the Work performed under our Contract, and that the record documents comply with the requirements of the Contract Documents.

[*Provide signature, print name, print signing party's corporate title, and date*]"

1.3 RECORDING CHANGES

A. Recording Changes – General:
1. At the start of the Project, label each record document to be submitted as, "PROJECT RECORD" using legible, printed letters. Letters on record copy of the Drawings shall be two inches high.
2. Keep record documents current consistent with the progress of the Work. Make entries on record documents within two working days of receipt of information required to record the change.
3. Do not permanently conceal the Work until required information has been recorded for Project record documents.
4. Accuracy of record documents shall be such that future searches for items shown on the record documents may rely reasonably on information obtained from ENGINEER-accepted record documents.
5. Marking of Entries:
a. Use erasable, colored pencils (not ink or indelible pencil) for marking changes, revisions, additions, and deletions to record documents.
b. Clearly describe the change by graphic line and make notations as required. Use straight-edge to mark straight lines. Writing shall be

legible and sufficiently dark to allow scanning of record documents into legible electronic files in portable document format (".PDF").

c. Date each entry on record documents.
d. Indicate changes by drawing a "cloud" around the change(s) indicated.
e. Mark initial revisions in red. In the event of overlapping changes, use different colors for subsequent changes.

B. Drawings:
1. Record changes on copy of the Drawings. Submittal of CONTRACTOR-originated or -produced drawings as a substitute for recording changes on a copy of the Drawings is unacceptable.
2. Record changes on plans, sections, elevations, schematics, schedules, and details as required for clarity, making reference dimensions and elevations (to Project datum) for complete record documentation.
3. Record actual construction including:
a. Depths of various elements of foundation relative to Project datum.
b. Horizontal and vertical location of Underground Facilities referenced to permanent surface improvements and project elevation datum. For each Underground Facility, including pipe fittings, show and indicate dimensions to not less than two permanent, visible surface improvements.
c. Location of exposed utilities and appurtenances concealed in construction, referenced to visible and accessible features of structure and, where applicable, to Project elevation datum.
d. Changes in structural and architectural elements of the Work, including changes in reinforcing.
e. Field changes of dimensions, arrangements, and details.
f. Changes made in accordance with Addenda, Change Orders, Work Change Directives, and Field Orders.
g. Changes in details on the Drawings. Submit additional details prepared by CONTRACTOR when required to document such changes.
4. Recording Changes for Schematic Layouts:
a. In some cases on the Drawings, arrangements of conduits, circuits, piping, ducts, and similar items are shown schematically and are not intended to portray physical layout. For such cases, the final physical arrangement shall be determined by CONTRACTOR subject to acceptance by ENGINEER.
b. Record on the Project record documents all revisions to schematics on the Drawings, including: piping schematics, ducting schematics, process and instrumentation diagrams, control and circuitry diagrams, electrical one-line diagrams, motor control center layouts, and other schematics when included in the Drawings. Show and indicate actual locations of equipment, lighting fixtures, in-place grounding system, and other pertinent data.
c. When dimensioned plans and dimensioned sections or elevations on the Drawings show the Work schematically, indicate on the record documents, by dimensions accurate to within one inch in the field,

centerline location of items of Work such as conduit, piping, ducts, and similar items

1) Clearly identify each item of the Work by accurate notations such as "cast iron drain", "rigid electrical conduit", "copper waterline", and similar descriptions.
2) Show by symbol or by note the vertical location of each item of the Work; for example, "embedded in slab", "under slab", "in ceiling plenum", "exposed", and similar designations. For piping not embedded, also indicate elevation dimension relative to Project elevation datum.
3) Descriptions shall be sufficiently detailed to be related to the Specifications.

d. ENGINEER may furnish written waiver of requirements relative to schematic layouts shown on plans, sections, and elevations when, in ENGINEER's judgment, dimensioned layouts of Work shown schematically will serve no useful purpose. Do not rely on such waiver(s) being issued.

5. Supplemental Drawings:
   a. In some cases, drawings produced during construction by ENGINEER or CONTRACTOR supplement the Drawings and shall be included with Project record documents submitted by CONTRACTOR. Supplemental record drawings shall include drawings or sketches that are part of Change Orders, Work Change Directives, and Field Orders and that cannot be incorporated into the Drawings because of space limitations.
   b. Supplemental drawings submitted with record drawings shall be integrated with the Drawings and include necessary cross-references between drawings. Supplemental record drawings shall be on sheets the same size as the Drawings.
   c. When supplemental drawings developed by CONTRACTOR using computer-aided drafting/design (CADD) software are to be included in record drawings, submit electronic files for such drawings in accordance with Section 01 31 26, Electronic Communication Protocols, as part of record drawing submittal. Label such files, "Supplemental Record Drawings", including with CONTRACTOR's name, Project name, and Contract designation.

C. Specifications and Addenda:
   1. Mark each Specifications Section to record:
      a. Manufacturer, trade name, catalog number, and Supplier of each material and equipment item actually provided.
      b. Changes made by Addendum, Change Orders, Work Change Directives, and Field Orders.

1.4 ELECTRONIC FILES FURNISHED BY ENGINEER

A. CADD files of the Drawings will be furnished by ENGINEER upon the following conditions:
   1. CONTRACTOR shall submit to ENGINEER a letter on CONTRACTOR letterhead requesting CADD files of the Drawings and indicating specific definition(s) or description(s) of how such files will be used, and specific description of benefits to OWNER (including credit proposal, if applicable) if the request is granted.
   2. CONTRACTOR shall execute ENGINEER's standard agreement for release of electronic files and shall abide by the provisions of such agreement for release of electronic files.
   3. Layering system incorporated in CADD files shall be maintained as transmitted by ENGINEER. CADD files transmitted by ENGINEER containing cross-referenced files shall not be bound by CONTRACTOR. Drawing cross-references and paths shall be maintained. If CONTRACTOR alters layers or cross-reference files, CONTRACTOR shall restore all layers and cross-references prior to submitting record documents to ENGINEER.
   4. CONTRACTOR shall submit record drawings to ENGINEER in same CADD format that files were furnished to CONTRACTOR.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 78 43

SPARE PARTS AND EXTRA MATERIALS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. This Section includes administrative and procedural requirements for furnishing spare parts, extra materials, maintenance supplies, and special tools required for maintenance (collectively, "spare parts and extra materials") required by the Contract Documents.
   2. CONTRACTOR shall furnish spare parts, extra materials, and associated information, for materials and equipment furnished in accordance with the Contract Documents. Furnish such items in accordance with the requirements of this Section and the Specifications sections in which such items are indicated.
   3. CONTRACTOR shall be fully responsible for loss and damage to spare parts and extra materials until such items are received by OWNER's facility manager.
   4. Promptly replace spare parts and extra materials furnished by OWNER to CONTRACTOR for use in remedying defective Work.

B. List of Spare Parts and Extra Materials:
   1. With the Shop Drawings and product data submittals for each Specifications section, submit a complete listing of spare parts and extra materials required for maintenance for two years of operation, together with unit prices in current United States funds, and source(s) of supply for each.
   2. Also include listing of spare parts and extra materials, with pricing and sources, in the operations and maintenance data submitted in accordance with Section 01 78 23, Operations and Maintenance Data.

1.2 SUBMITTALS

A. Maintenance Material Submittals: Submit the following:
   1. Spare Parts and Extra Materials:
      a. Furnish to OWNER in accordance with requirements of this Section, and the Specifications section in which the spare parts and extra materials are specified.
   2. Transfer Documentation: For each delivery of spare parts and extra materials, submit to ENGINEER the following:
      a. Submit, on CONTRACTOR's letterhead, a letter of transmittal for spare parts and extra materials furnished under each Specifications section. Letter of transmittal shall accompany spare parts and extra materials. Do

not furnish letter of transmittal separate from associated spare parts and extra materials.

b. Furnish three original, identical, signed letters of transmittal for each delivery of spare parts and extra materials furnished under each Specifications section. Upon delivery of specified quantities and types of spare parts and extra materials to OWNER, designated person from OWNER will countersign each original letter of transmittal indicating OWNER's receipt of spare parts and extra materials in the quantity, type, and quality required by the Contract Documents. OWNER will retain one fully-signed original, CONTRACTOR shall submit one fully-signed original to ENGINEER. CONTRACTOR shall retain one fully-signed original for CONTRACTOR's records.

c. Letter of transmittal shall include the following:
   1) Information required for letters of transmittal in Section 01 33 00, Submittal Procedures.
   2) Transmittal shall list spare parts and extra materials furnished under each Specifications Section. List each individual part, material, equipment item, tool, and product and the associated quantity furnished.
   3) Include space for countersignature by OWNER as follows: space for signature, space for printed name, and date.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Packaging and Labeling of Spare Pars and Extra Materials:
   1. Furnish spare parts and extra materials in manufacturer's unopened cartons, boxes, crates, or other original, protective covering suitable for preventing corrosion and deterioration for maximum length of storage normally anticipated by manufacturer.
   2. Packaging of spare parts and extra materials shall be clearly marked and identified with name of manufacturer, applicable material or equipment, part number, part description, and part location in the equipment or system.
   3. Protect and package spare parts and extra materials for maximum shelf life normally anticipated by manufacturer.

B. Storage Prior to Delivery to Owner:
   1. Prior to furnishing spare parts and extra materials to OWNER, store spare parts and extra materials in accordance with the Contract Documents and manufacturers' recommendations.

C. Procedure for Delivery to Owner:
   1. Deliver spare parts and extra materials to OWNER's permanent storage rooms at the Site or area(s) at the Site designated by OWNER.
   2. When spare parts and extra materials are delivered, CONTRACTOR and OWNER will mutually inventory the spare parts and extra materials delivered

to verify compliance with the Contract Documents regarding quantity, part numbers, and quality.

3. Additional procedures for delivering spare parts and extra materials to OWNER, if required, will be developed by ENGINEER and complied with by CONTRACTOR.
4. CONTRACTOR shall reimburse OWNER for all costs and expenses incurred by OWNER, including professional services, for delivery of inadequate, incorrect, or defective spare parts and extra materials. OWNER may withhold such amounts from payments due CONTRACTOR via set-offs in accordance with the Contract Documents.

D. Delivery Time and Eligibility for Payment:
   1. Deliver to OWNER spare parts and extra materials prior to date of Substantial Completion for materials and equipment associated therewith.
   2. Do not deliver spare parts and extra materials before commencing startup for associated material or equipment.
   2. Spare parts and extra materials are not eligible for payment until delivered to OWNER and CONTRACTOR's receipt of OWNER's countersignature on letter of transmittal.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 79 23

INSTRUCTION OF OPERATIONS AND MAINTENANCE PERSONNEL

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall furnish services of Supplier's operation and maintenance training specialists to instruct OWNER's and facility manager's personnel in recommended operating and maintenance procedures for materials and equipment furnished, in accordance with the Contract Documents.
   2. Supplier shall provide a combination of classroom and field training at the Site, unless otherwise required elsewhere in the Contract Documents.
   3. OWNER or facility manager reserves the right to record training sessions on video for OWNER's later use in instructing OWNER's or facility manager's personnel.

B. Scheduling of Training Sessions:
   1. General:
      a. CONTRACTOR shall coordinate training services with start-up and initial operation of materials and equipment on days and times, and in manner, acceptable to OWNER, in accordance with the Contract Documents.
      b. Training may be required outside of normal business hours to accommodate schedules of operations and maintenance personnel. Furnish training services at the required days and times at no additional cost to OWNER.
   2. Prerequisites to Training:
      a. Training of facility operations and maintenance personnel shall commence after preliminary operation and maintenance data has been submitted and accepted by ENGINEER, and Work required in Section 01 75 11, Checkout and Startup Procedures.
      b. At option of OWNER or ENGINEER, training may be allowed to take place before, during, or after equipment startup.
   3. Training Schedule Submittal:
      a. Training Schedule Required: CONTRACTOR shall prepare and submit proposed training schedule for review and acceptance by ENGINEER and OWNER. Proposed training schedule shall show and indicate all training required in the Contract Documents, and shall demonstrate compliance with specified training requirements relative to number of hours of training for various elements of the Work, number of training sessions, and scheduling.

c. Timing of Training Schedule Submittal: Submit initial training schedule not less than 60 days before scheduled start of first training session. Submit final training schedule, incorporating revisions in accordance with ENGINEER's comments, not later than 30 days prior to starting the first training session.
d. OWNER reserved the right to modify personnel availability for training in accordance with process or emergency needs at the facility.

1.2 QUALITY ASSURANCE

A. Qualifications:
1. Manufacturer's Instructors:
a. Shall be factory-trained by manufacturer of material or equipment.
b. Manufacturer's instructors shall be proficient and experienced in performing training of the type required.
c. Instructors shall be proficient in spoken and written English language.
d. Qualifications of instructors are subject to acceptance by ENGINEER. If ENGINEER does not accept qualifications of proposed instructor, furnish services of replacement instructor with acceptable qualifications.
2. Attendance is mandatory for the following:
a. CONTRACTOR's project manager.
b. CONTRACTOR's Site superintendent.
c. Project manager of Subcontractors responsible for furnishing materials and equipment for which training of operations and maintenance personnel is required.
d. Manufacturers and other Suppliers invited by CONTRACTOR.
f. Facility manager's staff responsible for training coordination, and staff responsible for scheduling operations and maintenance personnel.
3. If additional information must be developed to adequately cover agenda items, reconvene conference as soon as possible.
4. CONTRACTOR shall prepare minutes summarizing the discussions of conference, decisions made, and agreements and disagreements, and submit the minutes to each conference attendee.

1.3 SUBMITTALS

A. Action Submittals: Submit the following:
1. Training Schedule: Detailed schedule of training sessions, demonstrating compliance with number of training sessions, hours required in the Contract Documents, and complying with the Contract Times. Submit training schedule submittals in accordance with time frames specified in this Section.

B. Informational Submittals: Submit the following:
1. Lesson Plan: Acceptable lesson plan for training on each material or equipment item, in accordance with Table 01 79 23-A and the Contract Documents. Lesson plan shall comply with requirements of this Section as may be

supplemented by Specifications Sections where materials and equipment are specified. Include with lesson plan copy of handouts that will be used during training sessions. Furnish lesson plan submittals in accordance with time frames specified in this Section.

2. Qualifications:
    a. Credentials of manufacturer's proposed operations and maintenance instructor(s). Credentials shall demonstrate compliance with requirements of this Section and shall include brief resume' and specific details of instructor's operating, maintenance, and training experience relative to the specific material and equipment for which instructor will provide training.

C. Closeout Submittals: Submit the following:
    1. Trainee sign-in sheets for each training session. Submit to OWNER's training coordinator with copy to ENGINEER.

1.4 LESSON PLAN

A. Supplier's lesson plan shall describe specific instruction topics, system components for which training will be furnished, and training procedures. Handouts, if any, to be used in training shall be included with the lesson plan. Describe in lesson plan "hands-on" demonstrations planned for training sessions.

B. Submit acceptable lesson plan not less than 14 days prior to starting associated training.

C. Indicate in lesson plan estimated duration of each training segment.

D. Lesson plan shall include the following:
    1. Material and Equipment Overview (required for all types of operations and maintenance training):
        a. Describe material and equipment's operating (process) function and performance objectives.
        b. Describe material and equipment's fundamental operating principles and dynamics.
        c. Identify equipment's mechanical, electrical, and electronic components and features. Group related components into subsystems and describe function of subsystem and subsystem's interaction with other subsystems.
        d. Identify all support materials and equipment associated with operation of subject equipment, such as air intake filters, valve actuators, motors, and other appurtenant items and equipment.
        e. Identify and describe safety precautions and potential hazards related to operation.
        f. Identify and describe in detail safety and control interlocks.
    2. Operations Personnel Training:

a. Material and Equipment Overview: As described in Paragraph 1.4.D.1 of this Section.
b. Operation:
    1) Describe operating principles and practices.
    2) Describe routine operating, startup, and shutdown procedures.
    3) Describe abnormal or emergency startup, operating, and shutdown procedures that may apply.
    4) Describe alarm conditions and responses to alarms.
    5) Describe routine monitoring and recordkeeping procedures.
    6) Describe recommended housekeeping procedures.
c. Troubleshooting:
    1) Describe how to determine if corrective maintenance or an operating parameter adjustment is required.

3. Mechanical Maintenance Training:
    a. Material and Equipment Overview: As described in Paragraph 1.4.D.1 of this Section.
    b. Material and Equipment Preventive Maintenance:
        1) Describe preventative maintenance inspection procedures required to:
            a) Inspect materials and equipment in operation.
            b) Identify potential trouble symptoms and anticipate breakdowns.
            c) Forecast maintenance requirements (predictive maintenance).
        2) Define recommended preventative maintenance intervals for each component.
        3) Describe lubricant and replacement part recommendations and limitations.
        4) Describe appropriate cleaning practices and recommend intervals.
        5) Identify and describe use of special tools required for maintenance of materials and equipment.
        6) Describe component removal, installation, and disassembly and assembly procedures.
        7) Perform “hands-on” demonstrations of preventive maintenance procedures.
        8) Describe recommended measuring instruments and procedures, and provide instruction on interpreting alignment measurements, as appropriate.
        9) Define recommended torquing, mounting, calibrating, and aligning procedures and settings, as appropriate.
        10) Describe recommended procedures to check and test equipment following corrective maintenance.
    c. Equipment Troubleshooting:
        1) Define recommended systematic troubleshooting procedures.
        2) Provide component-specific troubleshooting checklists.
        3) Describe applicable materials and equipment testing and diagnostic procedures to facilitate troubleshooting.
        4) Describe common corrective maintenance procedures with “hands-on” demonstrations.

4. Instrumentation/Controls and Electrical Maintenance Training:
    a. Materials nad Equipment Overview: As described in Paragraph 1.4.D.1 of this Section.
    b. As a minimum, the course shall cover the following topics.
        1) Overview of system's functional capabilities.
        2) Equipment overview including system component functions, operating principals and proper use.
        3) Loading and startup of the digital system hardware components.
        4) Use of system commands.
        5) Development of programs and control schemes.
        6) Development and use of system displays.
        7) Programming concepts and techniques.
        8) Use of bulk storage device for system backup.
        9) System overview description including the power subsystems and logic components of the processor bus.
        10) Description of the maintenance and troubleshooting aids of the system including software diagnostic programs.
        11) Description of all bus operations.
        12) Description of peripheral and process interface devices.
    c. Preventative Maintenance and Troubleshooting of Other Electrical Systems: In accordance with requirements for Paragraph 1.4.D.3 of this Section.

1.5 TRAINING AIDS

A. Manufacturer's instructor shall incorporate training aids as appropriate to assist in the instruction. Furnish handouts of text, tables, graphs, and illustrations as required. Other appropriate training aids include:
    1. Audio-visual aids, such as videos, Microsoft PowerPoint presentations, overhead transparencies, posters, drawings, diagrams, catalog sheets, or other items.
    2. Equipment cutaways and samples, such as spare parts and damaged equipment.
    3. Tools, such as repair tools, customized tools, and measuring and calibrating instruments.

B. Handouts:
    1. Manufacturer's instructor shall distribute and use descriptive handouts during training. Customized handouts developed especially for training for the Project are encouraged.
    2. Photocopied handouts shall be good quality and completely legible.
    3. Handouts should be coordinated with the instruction, with frequent references made to the handouts.
    4. Provide not less than 10 copies of each handout for each training session.

C. Audio-visual Equipment: Training provider shall provide audio-visual equipment required for training sessions. If suitable equipment is available at the Site, OWNER

may make available OWNER's audio-visual equipment; however, do not count on OWNER providing audio-visual equipment. Audio-visual equipment that training provider shall provide, as required, includes:

1. Laptop computer, presentation software, and suitable projector.
2. As required, extension cords and spare bulb for projector.
3. Portable projection screen.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 TRAINING DELIVERY

A. Training Delivery – General:
   1. Instructors shall be fully prepared for the training sessions. Training delivery shall be communicative, clear, and proceed according to lesson plan accepted by ENGINEER, with lesson content appropriate for trainees. If OWNER or ENGINEER deems that training delivery does not to comply with the Contract Documents, training shall be postponed, rescheduled, and re-performed in acceptable manner at no additional cost to OWNER.
   2. Trainee Sign-in Sheets: In format acceptable to OWNER, furnish sign-in sheet for trainees for each session. Sign-in sheets shall include the Project name, equipment or system for which training was furnished, and type of training (e.g., operations, mechanical maintenance, instrumentation/controls maintenance, or other), and name of each trainee. Upon completion of training, submit copy of each sign-in sheet as indicated in Article 1.3 of this Section.

B. "Hands-on" Demonstrations:
   1. Manufacturer's instructor shall present "hands-on" demonstrations of operations and maintenance of materials and equipment for each training session, in accordance with lesson plan accepted by ENGINEER.
   2. CONTRACTOR and manufacturer shall furnish tools necessary for demonstrations.

3.2 TRAINING SCHEDULE

A. Manufacturer shall furnish not less than the hours of training and number of sessions indicated in Table 01 79 23-A of this Section. Travel time and expenses are responsibility of manufacturer and are excluded from required training time indicated in the Contract Documents.

B. Shifts and Training Sessions Required:
   1. Operations at the Site take place 24 hours per day, divided into three shifts as follows: day, evening, and night shift.
   2. Training Sessions per Shift:
      a. Operators: Maximum training per day is four hours; sessions longer than four hours shall be spread over multiple, preferably consecutive, days. Provide identical training sessions as follows:
         1) One during day shift.
         2) One session during evening shift.
         3) One session during night shift.
      b. Mechanical Maintenance: Provide one training session during weekday shift for indicated equipment. Maximum training per day is four hours; sessions longer than four hours shall be spread over multiple, preferably consecutive, days.
      c. Instrument/Controls and Electrical Maintenance: Provide one training session during weekday shift for indicated equipment. Maximum training per day is four hours; sessions longer than four hours will be spread over multiple, preferably consecutive, days.

TABLE 01 79 23-A, TRAINING SUMMARY TABLE

Material or Equipment	Specification Section	Total Training Time (hours)	Training Sessions Required		
			Operations	Mechanic Maint.	Instrument/ Controls & Electrical Maint.
HVAC Equipment and Controls	23 05 93	6	1 (2 hrs.)	1 (2 hrs.)	1 (2 hrs.)
Electrical Power Distribution Systems (Arc Flash)	26 05 73	2	1 (2 hrs.)	1 (2 hrs.)	1 (2 hrs.)
Switchboards	26 24 13	2	1 (2 hrs.)	--	1 (2 hrs.)
Instrumentation and Controls for Process Systems	40 60 05	8	2 (4 hrs. ea.)	--	2 (4 hrs. ea.)
Polymer Blending and Feed Equipment	46 33 33	8	2 (4 hrs. ea.)	2 (4 hrs. ea.)	2 (4 hrs. ea.)
Dewatering Centrifuge	46 76 33	24	2 (4 hrs. ea.)	2 (4 hrs. ea.)	2 (4 hrs. ea.)
Booster Pumping System	22 11 23	2	1 (2 hrs.)	1 (2 hrs.)	1 (2 hrs.)
Total		**94 - 98**	34-38	26	34

+ + END OF SECTION + +

SECTION 02 41 00

DEMOLITION

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified and required for demolition, removal, and disposal Work.
   2. The Work under this Section includes, but is not necessarily limited to:
      a. Demolition and removal of existing materials and equipment as shown or indicated in the Contract Documents. The Work includes demolition of structural concrete, foundations, walls, doors, windows, structural steel, metals, roofs, masonry, attachments, appurtenances, piping, electrical and mechanical systems and equipment, paving, curbs, sidewalks, gutters, fencing and similar existing facilities.
      b. Demolition and removal of the above-grade piping and utilities in, the building(s) and structures shown or indicated for demolition.
      c. Remove from slabs, foundations, walls, and footings that are to be demolished all utilities and appurtenances embedded in such construction.
   3. Demolitions and removals specified under other Sections shall comply with requirements of this Section.
   4. Perform demolition Work within areas shown or indicated.
   5. Pay all costs associated with transporting and, as applicable, disposing of materials and equipment resulting from demolition.

B. Coordination:
   1. Comply with Section 01 14 16, Coordination with Owner's Operations.
   2. Review procedures under this and other Sections and coordinate the Work that will be performed with or before demolition and removals.

1.2 QUALITY ASSURANCE

A. Qualifications:
   1. Electrical Removals: Entity and personnel performing electrical removals shall be electrician legally qualified to perform electrical construction and electrical work in the jurisdiction where the Site is located.
   2. Plumbing Removals: Entity and personnel performing plumbing removals shall be plumber legally qualified to perform plumbing construction and plumbing work in the jurisdiction where the Site is located.

B. Regulatory Requirements:
   1. Demolition, removal, and disposal Work shall be in accordance with 29 CFR 1926.850 through 29 CFR 1926.860 (Subpart T - Demolition), and all other Laws and Regulations.
   2. Comply with requirements of authorities having jurisdiction.

1.3 SUBMITTALS

A. Informational Submittals: Submit the following:
   1. Procedure Submittals:
      a. Demolition and Removal Plan: Not less than ten days prior to starting demolition Work, submit acceptable plan for demolition and removal Work, including:
         1) Plan for coordinating shut-offs, capping, temporary services, and continuing utility services.
         2) Other proposed procedures as applicable.
         3) Equipment proposed for use in demolition operations.
         4) Recycling/disposal facility(ies) proposed, including facility owner, facility name, location, and processes. Include copy of appropriate permits and licenses, and compliance status.
         5) Planned demolition operating sequences.
         6) Detailed schedule of demolition Work in accordance with the accepted Process Schedule.
   2. Notification of Intended Demolition Start: Submit in accordance with Paragraph 3.1.A of this Section.
   3. Qualifications Statements:
      a. Name and qualifications of entity performing electrical removals, including copy of licenses required by authorities having jurisdiction.
      b. Name and qualifications of entity performing plumbing removals, including copy of licenses required by authorities having jurisdiction.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 PREPARATION

A. Notification:
   1. At least 48 hours prior to commencing demolition or removal, notify ENGINEER in writing of planned start of demolition Work. Do not start removals without permission of ENGINEER.

B. Protection of Surrounding Areas and Facilities:
   1. Perform demolition and removal Work in manner that prevents damage and injury to property, structures, occupants, the public, and facilities. Do not

interfere with use of, and free and safe access to and from, structures and properties.

2. Closing or obstructing of roads, drives, sidewalks, and passageways adjacent to the Work is not allowed unless indicated otherwise in the Contract Documents. Conduct the Work with minimum interference to vehicular and pedestrian traffic.
3. Provide temporary barriers, lighting, sidewalk sheds, and other necessary protection.
4. Repair damage to facilities that are to remain.

C. Existing Utilities: In addition to requirements of the General Conditions, Supplementary Conditions, and Division 01 Specifications, do the following:
1. Should uncharted or incorrectly charted Underground Facilities be encountered, CONTRACTOR responsibilities shall be in accordance with the General Conditions as may be modified by the Supplementary Conditions. Cooperate with utility owners in keeping adjacent services and facilities in operation.
2. Sanitary Sewer: Before proceeding with demolition, locate and cap all sewer lines and service laterals discharging from the building or structure being demolished.
3. Storm Water: Existing storm water system shall remain in place until demolitions of existing building or structure is completed. Upon completing demolition, cut and cap storm sewer laterals at locations shown on the Drawings. Remove existing storm water piping and related structures between points of cutting, and backfill, restore to grade, and stabilize the area over the removed facilities.
4. Water Piping: Before proceeding with demolition, locate and cap all potable and non-potable waterlines and service laterals serving the building or structure being demolished.
5. Other Utilities: Before proceeding with demolition, locate and cap as required all other utilities, such as fuel and gas; heating, ventilating, and air conditioning; electric; and communications; and service laterals serving the building or structure being demolished.
6. Shutdown of utility services shall be coordinated by CONTRACTOR, assisted by OWNER as required relative to contacting utility owners.

3.2 DEMOLITION – GENERAL

A. Locate construction equipment used for demolition Work and remove demolished materials and equipment to avoid imposing excessive loading on supporting and adjacent walls, floors, framing, facilities, and Underground Facilities.

B. Pollution Controls:
1. Use water sprinkling, temporary enclosures, and other suitable methods to limit emissions of dust and dirt to lowest practical level. Comply with Section 01 57 05, Temporary Controls, and Laws and Regulations.
2. Do not use water when water may create hazardous or objectionable conditions such as icing, flooding, or pollution.

3. Clean adjacent structures, facilities, properties, and improvements of dust, dirt, and debris caused by demolition Work, in accordance with the General Conditions and Section 01 74 05, Cleaning.

C. Comply with Section 01 73 29, Cutting and Patching.

D. Building or Structure Demolition:
   1. Demolish concrete and masonry in small sections.
   2. Remove structural framing members and lower to ground using hoists, cranes, or other suitable methods. Do not throw or drop to the ground.
   3. Break up and remove foundations and slabs-on-grade unless otherwise shown or indicated as remaining in place.

E. Salvage and Ownership:
   1. Refer to Section 01 11 13, Summary of Work, for requirements on salvage, ownership, and handling of equipment and materials removed during demolition and removal Work.
   2. Materials and equipment to remain OWNER's property shall be carefully removed and appropriately handled by CONTRACTOR to avoid damage and invalidation of warranties in effect, and shall be cleaned and stored at the Site (or other site specified in the Contract Documents) at place designated by ENGINEER or OWNER.

F. Finishing of Surfaces Exposed by Removals: Unless otherwise shown or indicated in the Contract Documents, surfaces of walls, floors, ceilings, and other areas exposed by removals, and that will remain as finished surfaces, shall be repaired and re-finished with materials that match existing adjacent surface, or as otherwise approved by ENGINEER.

3.3 STRUCTURAL REMOVALS

A. Remove structures to lines and grades shown or indicated, unless otherwise directed by ENGINEER. Where limits are not shown or indicated, limits shall be four inches outside item to be installed. Removals beyond limits shown or indicated shall be at CONTRACTOR's expense and such excess removals shall be reconstructed to satisfaction of ENGINEER without additional cost to OWNER.

B. Recycling and Reuse of Demolition Materials:
   1. All concrete, brick, tile, masonry, roofing materials, reinforcing steel, structural metals, miscellaneous metals, plaster, wire mesh, and other items contained in or upon building or structure to be demolished shall be removed, transported, and disposed of away from the Site, unless otherwise approved by ENGINEER.
   2. Do not use demolished materials as fill or backfill adjacent to structures, in pipeline trenches, or as subbase under structures or pavement.

C. After removing concrete and masonry walls or portions thereof, slabs, and similar construction that ties in to the Work or to existing construction, neatly repair the junction point to leave exposed only finished edges and finished surfaces.

D. Where parts of existing structures are to remain in service following demolition, remove the portions shown or indicated for removal, repair damage, and leave the building or structure in proper condition for the intended use.
   1. Remove concrete and masonry to the lines shown or indicated by sawing, drilling, chipping, and other suitable methods. Leave the resulting surfaces true and even, with sharp, straight corners that will result in neat joints with new construction and be satisfactory for the purpose intended.
   2. Do not damage reinforcing bars beyond the area of concrete and masonry removal. Do not saw-cut beyond the area to be removed.
   3. Reinforcing bars that are exposed at surfaces of removed concrete and masonry that will not be covered with new concrete or masonry shall be removed to 1.5 inches below the final surface. Repair the resulting hole, with repair mortar for concrete and grout for masonry, to be flush with the surface.
   4. Where existing reinforcing bars are shown or indicated to extend into new construction, remove existing concrete so that reinforcing bars are clean and undamaged.

E. Where equipment or material anchored to concrete or masonry are removed and anchors are not to be re-used, remove the anchors to not less than 1.5 inches beneath surface of concrete or masonry member. Repair the resulting hole, using repair mortar for concrete and grout for masonry, to be flush with the surface. Alternately, when the anchor is stainless steel, the anchor may be cut flush with the surface of the concrete or masonry, when so approved by ENGINEER.

E. Jambs, sills and heads of windows, passageways, doors, or other openings (as applicable) cut-in to the Work or to existing construction shall be dressed with masonry, concrete, or metal to provide smooth, finished appearance.

F. Where anchoring materials, including bolts, nuts, hangers, welds, and reinforcing steel, are required to attach the Work to existing construction, provide such materials under this Section, unless specified elsewhere in the Contract Documents.

3.4 MECHANICAL REMOVALS

A. Mechanical demolition and removal Work includes dismantling and removing existing piping, ductwork, pumps, equipment, tanks, and appurtenances as shown, indicated, and required for completion of the Work. Mechanical removals include cutting and capping as required, except that cutting of existing piping and ductwork to make connections is included under Section 01 14 16, Coordination with Owner's Operations; Section 01 73 29, Cutting and Patching; and applicable Sections of Division 40, Process Integration.

B. Demolition and Removals of Piping, Ductwork, and Similar Items:
   1. Purge piping and tanks (as applicable) of chemicals or fuel (as applicable) and make safe for removal and capping. Remove to the extent shown or indicated existing process, water, waste and vent, chemical, gas, fuel, and other piping. Remove piping to the nearest solid piping support, and provide caps on ends of remaining piping. Where piping to be demolished passes through existing walls to remain, cut off and cap pipe on each side of the wall.
   2. Caps, Closures, Blind Flanges, and Plugs:
      a. Provide closure pieces, such as blind flanges and caps, where shown or required to complete the Work.
      b. Where used in this Section, the term "cap" means the appropriate type closure for the piping or ductwork being closed, including caps, blind flanges, and other closures.
      c. Caps shall be compatible with the piping or ductwork to which the cap is attached, fluid-tight and gastight, and appropriate for the fluid or gas conveyed in the pipe or duct.
      d. Unless otherwise shown or indicated, caps shall be mechanically fastened, fused, or welded to pipe or duct. Plug piping with means other than specified in this Section only when so shown or indicated in the Contractor Documents or when allowed by ENGINEER.
   3. When Underground Facilities are altered or removed, properly cut and cap piping left in place, unless otherwise shown or indicated.
   4. Remove waste and vent piping, and ductwork to extent shown and cap as required. Where demolished vent piping, stacks, and ductwork passes through existing roofing, patch the roof with the same or similar materials. Completed patch shall be watertight and comply with roofing manufacturer's recommendations.
   5. Modifications to potable water piping and other plumbing and heating system work shall comply with Laws and Regulations. All portions of potable water system that have been modified or opened shall be hydrostatically tested and disinfected in accordance with the Contract Documents, and Laws and Regulations. Hydrostatically test other, normally-pressurized, plumbing piping and heating piping.

C. Equipment Demolition and Removals:
   1. To the extent shown or indicated, remove existing process equipment; pumps; storage tanks; hoisting and conveying equipment; heating, ventilating, and air conditioning equipment; generators; and other equipment.
   2. Where required, disassemble equipment to avoid imposing excessive loading on supporting walls, floors, framing, facilities, and Underground Facilities. Disassemble equipment as required for access through and egress from building or structure. Disassembly shall comply with Laws and Regulations. Provide required means to remove equipment from building or structure.
   3. Remove control panels, operator stations, and instruments associated with equipment being removed, unless shown or indicated otherwise.
   4. Remove fuel appurtenances as applicable, including fuel storage tanks. Dispose of tank contents in accordance with Laws and Regulations.

5. Remove equipment supports as applicable, anchorages, base, grout, and piping. Remove anchorage systems in accordance with the "Structural Removals" Article in this Section. Remove small-diameter piping back to header unless otherwise indicated.
6. Remove access platforms, ladders, and stairs related to equipment being removed, unless otherwise shown or indicated.

3.5 ELECTRICAL REMOVALS

A. Electrical demolition Work includes removing existing transformers, distribution switchboards, control panels, motors, starters, conduit and raceways, cabling, poles and overhead cabling, panelboards, lighting fixtures, switches, and miscellaneous electrical equipment, as shown, specified, or required.

B. Remove existing electrical equipment and fixtures to avoid damaging systems to remain, to keep existing systems in operation, and to maintain integrity of grounding systems.

C. Remove or modify motor control centers and switchgear as shown or indicated. Modified openings shall be cut square and dressed smooth to dimensions required for installation of equipment.

D. Disconnect and remove motors, control panels, and other electrical gear where shown or indicated. Motors, microprocessors and electronics, other electrical gear to be reused shall be stored in accordance with Section 01 66 00, Product Storage and Handling Requirements.

E. Cables in conduits to be removed shall be removed back to the power source or control panel, unless otherwise shown or indicated. Verify the function of each cable before disconnecting and removing.

F. Conduits, raceways, and cabling shall be removed where shown or indicated. Abandoned conduits concealed in floor, ceiling slabs, or in walls shall be cut flush with the slab or wall (as applicable) at point of entrance, suitably capped, and the area repaired in a flush, smooth manner acceptable to ENGINEER. Exposed conduits, junction boxes, other electrical appurtenances, and their supports shall be disassembled and removed. Repair all areas of the Work to prevent rusting on exposed surfaces.

G. Conduits in Underground Facilities not scheduled for reuse shall be suitably capped watertight where each enters building or structure to remain.

H. Where shown or indicated, remove direct burial cable. Openings in buildings for entrance of direct burial cable shall be patched with repair mortar or other material approved by ENGINEER for this purpose, and made watertight.

I. Existing poles and overhead cables shall be removed or abandoned as shown and specified. Existing substation(s) and poles owned by electric utility will be removed by the electric utility. Completely remove from the Site poles not owned by electric utility and shown or indicated for removal. Make necessary arrangements with electric utility for removal of utility company's transformers and metering equipment after new electrical system has been installed and energized.

J. Lighting fixtures, wall switches, receptacles, starters, and other miscellaneous electrical equipment, not designated as remaining as OWNER's property, shall be removed and properly disposed off-Site as required.

3.6 DISPOSAL OF DEMOLITION DEBRIS

A. Remove from the Site all debris, waste, rubbish, and material resulting from demolition operations and equipment used in demolition Work. Comply with the General Conditions, Supplementary Conditions, and Section 01 74 05, Cleaning.

B. Transportation and Disposal:
   1. Non-hazardous Material: Properly transport and dispose of non-hazardous demolition debris at appropriate landfill or other suitable location, in accordance with Laws and Regulations. Non-hazardous material does not contain Asbestos, PCBs, Petroleum, Hazardous Waste, Radioactive Material, or other material designated as hazardous in Laws and Regulations.
   2. Hazardous Material: When handling and disposal of hazardous materials is included in the Work, properly transport and dispose of hazardous materials in accordance with the Contract Documents and Laws and Regulations.

C. Submit to ENGINEER information required in this Section on proposed facility(ies) where demolition material will be recycled. Upon request, ENGINEER or OWNER, shall be allowed to visit recycling facility(ies) to verify adequacy and compliance status. During such visits, recycling facility operator shall cooperate and assist ENGINEER and OWNER.

+ + END OF SECTION + +

SECTION 03 00 05

CONCRETE

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install concrete, reinforcing, and related materials.
   2. The Work includes:
      a. Providing concrete consisting of portland cement, fine and coarse aggregates, water, and approved admixtures; combined, mixed, transported, placed, finished, and cured.
      b. Fabricating and placing reinforcing, including ties and supports.
      c. Design, erection, and removal of formwork.
      d. Building into the concrete all sleeves, frames, anchorage devices, inserts, and other items required to be embedded in concrete.
      e. Providing openings in concrete as required to accommodate Work under this and other Sections, and work under other contracts.

B. Coordination:
   1. Review installation procedures under other Sections and coordinate installation of items to be installed in the concrete Work.
   2. Notify other contractors in advance of placing concrete to provide other contractors with sufficient time for installing items included in their contracts that are to be installed in the concrete Work.

C. Classifications of Concrete:
   1. Class “A” concrete shall be steel-reinforced and includes all concrete unless otherwise shown or indicated.
   2. Class “B” concrete shall be placed without forms or with simple forms, with little or no reinforcing and includes the following:
      a. Duct banks.
      b. Unreinforced encasements.
      c. Curbs and gutters.
      d. Sidewalks.
      e. Thrust blocks.

D. Related Sections:
   1. Section 05 05 33, Anchor Systems.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. ACI 224R, Control of Cracking in Concrete Structures.
   2. ACI 301, Specifications for Structural Concrete for Buildings.
   3. ACI 304R, Guide for Measuring, Mixing, Transporting and Placing Concrete.
   4. ACI 305R, Specification for Hot Weather Concreting.
   5. ACI 306R, Cold Weather Concreting.
   6. ACI 309R, Guide for Consolidation of Concrete.
   7. ACI 318, Building Code Requirements for Structural Concrete and Commentary.
   8. ACI 347, Guide to Formwork for Concrete.
   9. ACI SP-66, ACI Detailing Manual.
   10. ASTM A82/A82M, Specification for Steel Wire, Plain, for Concrete Reinforcement.
   11. ASTM A185/A185M, Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
   12. ASTM A615/A615M, Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
   13. ASTM C31/C31M, Practice for Making and Curing Concrete Test Specimens in the Field.
   14. ASTM C33/C33M, Specification for Concrete Aggregates.
   15. ASTM C39/C39M, Test Method for Compressive Strength of Cylindrical Concrete Specimens.
   16. ASTM C42/C42M, Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
   17. ASTM C94/C94M, Specification for Ready-Mixed Concrete.
   18. ASTM C138/C138M, Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete.
   19. ASTM C143/C143M, Test Method for Slump of Hydraulic-Cement Concrete.
   20. ASTM C150/C150M, Specification for Portland Cement.
   21. ASTM C172, Practice for Sampling Freshly Mixed Concrete.
   22. ASTM C231, Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
   23. ASTM C260, Specification for Air-Entraining Admixtures for Concrete.
   24. ASTM C309, Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
   25. ASTM C494/C494M, Specification for Chemical Admixtures for Concrete.
   26. ASTM C1064/C1064M, Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
   27. ASTM D1752, Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.
   28. CRSI 1MSP, Manual of Standard Practice.

1.3 QUALITY ASSURANCE

A. Laboratory Trial Batch:
   1. Employ independent testing laboratory experienced in design and testing of concrete materials and mixes to perform material evaluation tests and to design concrete mixes.
   2. Each concrete mix design specified shall be verified by laboratory trial batch, unless indicated otherwise.
   3. Perform the following testing on each trial batch:
      a. Aggregate gradation for fine and coarse aggregates.
      b. Slump.
      c. Air content.
      d. Compressive strength based on three cylinders each tested at seven days and at 28 days.
   4. Submit for each trial batch the following information:
      a. Project identification name and number (if applicable).
      b. Date of test report.
      c. Complete identification of aggregate source of supply.
      d. Tests of aggregates for compliance with the Contract Documents.
      e. Scale weight of each aggregate.
      f. Absorbed water in each aggregate.
      g. Brand, type, and composition of cementitious materials.
      h. Brand, type, and amount of each admixture.
      i. Amounts of water used in trial mixes.
      j. Proportions of each material per cubic yard.
      k. Gross weight and yield per cubic yard of trial mixtures.
      l. Measured slump.
      m. Measured air content.
      n. Compressive strength developed at seven days and 28 days, from not less than three test cylinders cast for each seven day and 28-day test, and for each design mix.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. List of concrete materials and concrete mix designs proposed for use. Include results of tests performed to qualify the materials and to establish the mix designs. Do not start laboratory trial batch testing until this submittal is approved by ENGINEER.
      b. Laboratory Trial Batch Reports: Submit laboratory test reports for concrete cylinders, materials, and mix design tests.
      c. Concrete placement drawings showing the location and type of all joints.
      d. Drawings for fabricating, bending, and placing concrete reinforcing. Comply with ACI SP-66. For walls and masonry construction, provide elevations to a minimum scale of 1/4-inch to one foot. Show bar schedules, stirrup spacing, adhesive dowels, splice lengths, diagrams of

bent bars, arrangements, and assemblies, as required for fabricating and placing concrete reinforcing.

2. Product Data:
   a. Manufacturer's specifications with application and installation instructions for proprietary materials and items, including admixtures and bonding agents.
3. Samples:
   a. Samples: Submit samples of materials as specified and as otherwise requested by ENGINEER, including names, sources, and descriptions.

B. Informational Submittals: Submit the following:
1. Delivery Tickets: Copies of all delivery tickets for each load of concrete delivered to or mixed at the Site. Each delivery tickets shall contain the information in accordance with ASTM C94/C94M along with project identification name and number (if any), date, mix type, mix time, quantity and amount of water introduced.
2. Site Quality Control Submittals:
   a. Report of testing results for testing of field concrete cylinders for each required time period. Submit within 24 hours after completion of associated test. Test report shall include results of all testing required at time of sampling.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Transportation, Delivery, and Handling:
1. Deliver concrete reinforcing products to Site bundled, tagged, and marked. Use metal tags indicating bar size, lengths, and other information corresponding to markings on approved Shop Drawings.
2. Materials used for concrete shall be clean and free from foreign matter during transportation and handling, and kept separate until measured and placed into concrete mixer.
3. Implement suitable measures during hauling, piling, and handling to ensure that segregation of coarse and fine aggregate particles does not occur and grading is not affected.
4. Deliver grout materials from manufacturers in unopened containers that bear intact manufacturer labeling.
5. Comply with Section 01 65 00, Product Delivery Requirements.

B. Storage:
1. Store formwork materials above ground on framework or blocking. Cover wood for forms and other accessory materials with protective, waterproof covering. Provide for adequate air circulation or ventilation under cover.
2. Store concrete reinforcing materials to prevent damage and accumulation of dirt and excessive rust. Store on heavy wood blocking so that reinforcing does not come into contact with the ground. Space framework or blocking supports to prevent excessive deformation of stored materials.
3. Store concrete joint materials on platforms or in enclosures or covered to prevent contact with ground and exposure to weather and direct sunlight.

4. For storage of concrete materials, provide bins or platforms with hard, clean surfaces.
5. Comply with Section 01 66 00, Product Storage and Handling Requirements.

PART 2 – PRODUCTS

2.1 CONCRETE MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I.

B. Aggregates: ASTM C33/C33M.
   1. Fine Aggregate: Clean, sharp, natural sand free of loam, clay, lumps, and other deleterious substances. Dune sand, bank run sand, and manufactured sand are unacceptable.
   2. Coarse Aggregate:
      a. Clean, uncoated, processed aggregate containing no clay, mud, loam, or foreign matter.
      b. Coarse aggregate shall comply with the following:
         1) Crushed stone, processed from natural rock or stone.
         2) Washed gravel, either natural or crushed. Slag, pit gravel, and bank-run gravel are not allowed.
      c. Coarse Aggregate Size: ASTM C33/C33M, No. 67, unless otherwise approved by ENGINEER.

C. Water: Clean, potable.

D. Admixtures:
   1. Air-Entraining Admixture: ASTM C260.
   2. Water-Reducing Admixture: ASTM C494/C494M, Type A.
   3. Water Reducing and Set-Adjusting Admixtures: ASTM C494/C494M, Types D and E.
   4. High Range Water-Reducing Admixture: ASTM C494/C494M, Type F/G.
   5. Use only admixtures that have been tested and approved in the mix designs.
   6. Do not use calcium chloride or admixtures containing chloride ions.
   7. Hydration Control Admixtures, ASTM C494, Type D may be used to extend the time of proper workability. That time period will be agreed upon at the pre-installation meeting:
      a. Eucon DS or Stasis by The Euclid Chemical Company
      b. MasterSet Delvo by BASF

2.2 CONCRETE MIX

A. General:
   1. Normal weight: 145 pounds per cubic foot.
   2. Use air-entraining admixture in all concrete. Provide not less than four percent, nor more than eight percent, entrained air for concrete exposed to

freezing and thawing, and provide from three to five percent entrained air for other concrete.

B. Proportioning and Design of Class "A" Concrete Mix:
   1. Minimum compressive strength at 28 days: 4,500 psi.
   2. Maximum water-cement ratio by weight: 0.42.
   3. Minimum cement content: 564 pounds per cubic yard.

C. Proportioning and Design of Class "B" Concrete Mix:
   1. Minimum compressive strength at 28 days: 3 ,000 psi.
   2. Maximum water-cement ratio by weight: 0.50.
   3. Minimum cement content: 517 pounds per cubic yard.

D. Slump Limits:
   1. Proportion and design mixes to result in concrete slump at point of placement of not less than two inches and not more than four inches.
   2. When using high-range water reducers, slump prior to addition of admixture shall not exceed three inches. Slump after adding admixture shall not exceed nine inches at point of placement.

E. Adjustment of Concrete Mixes:
   1. Concrete mix design adjustments may be requested by CONTRACTOR when warranted by characteristics of materials, Site conditions, weather, test results, or other, similar circumstances.
   2. Submit for ENGINEER's approval laboratory test data for adjusted concrete mix designs, including compressive strength test results.
   3. Implement adjusted mix designs only after ENGINEER's approval.
   4. Adjustments to concrete mix designs shall not result in additional costs to OWNER.

2.3 FORM MATERIALS

A. Provide form materials with sufficient stability to withstand pressure of placed concrete without bow or deflection. CONTRACTOR shall be responsible for designing the formwork system to resist all applied loads including pressures from fluid concrete and construction loads.

B. Smooth Form Surfaces: Acceptable panel-type to provide continuous, straight, smooth, as-cast surfaces in accordance with ACI 301.

C. Unexposed Concrete Surfaces: Material to suit project conditions.

D. Provide 3/4-inch chamfer at all external corners. Chamfer is not required at re-entrant corners unless otherwise shown or indicated.

E. Form Ties:
   1. Provide factory-fabricated, removable, or snap-off metal form ties, that prevent form deflection and prevent spalling of concrete surfaces upon

removal. Materials used for tying forms are subject to approval of ENGINEER.

2. Unless otherwise shown or indicated, provide ties so that portion remaining within concrete after removal of exterior parts is at least 1.5 inches from outer surface of concrete. Unless otherwise shown or indicated, provide form ties that, upon removal, will leave a uniform, circular hole not larger than one-inch diameter in the concrete surface.
3. Ties for exterior walls, below-grade walls, and walls subject to hydrostatic pressure shall be provided with waterstops.
4. Wire ties are unacceptable.

2.4 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A615/A615M, Grade 60 deformed bars.

B. Welded Wire Fabric: ASTM A185/A185M.

C. Steel Wire: ASTM A82/A82M.

D. Provide supports for reinforcing including bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing in place.
   1. Use wire bar-type supports complying with CRSI MSP1 recommendations, except as specified in this Section. Do not use wood, brick, or other unacceptable materials.
   2. For slabs on grade, use precast concrete blocks, four inches square minimum with compressive strength equal to or greater than the surrounding concrete, or supports with sand plates or horizontal runners where base materials will not support chair legs.
   3. For all concrete surfaces where legs of supports are in contact with forms, provide supports having either hot-dip galvanized, plastic-protected, or stainless steel legs in accordance with CRSI MSP1.
   4. Provide precast concrete supports over waterproof membranes.

E. Adhesive Dowels:
   1. Dowels:
      a. Dowel reinforcing bars shall comply with ASTM A615, Grade 60.
   2. Adhesive:
      a. For requirements for adhesive, refer to Section 05 05 33, Anchor Systems.

2.5 RELATED MATERIALS

A. Membrane-Forming Curing Compound: ASTM C309, Type I.

B. Epoxy Bonding Agent:
   1. Two-component epoxy resin bonding agent.
   2. Products and Manufacturers: Provide one of the following:
      a. Sikadur 32, Hi-Mod LPL, by Sika Corporation.

b. Eucopoxy LPL, by the Euclid Chemical Company.
c. Or equal.

C. Epoxy-Cement Bonding Agent:
1. Three-component blended epoxy resin-cement bonding agent.
2. Products and Manufacturers: Provide one of the following:
a. Sika Armatec 110 EpoCem, by Sika Corporation.
b. Duralprep A.C., by Euclid Chemical Company.
c. Or equal.

D. Preformed Expansion Joint Filler:
1. Provide preformed expansion joint filler complying with ASTM D1752, Type I (sponge rubber) or Type II (cork).

E. Joint Sealant and Accessories:
1. One-component Polyurethane Sealant:
a. Products and Manufacturers: Provide one of the following:
1) Sikaflex-1a by Sika Corporation.
2) Or equal.
2. Joint Cleaner: As recommended by calking and sealant manufacturer.
3. Joint Primer and Sealer: As recommended for compatibility with calking and sealant by calking and sealant manufacturer.
4. Bond Breaker Type: Polyethylene tape or other plastic tape as recommended for compatibility with calking and sealant by calking and sealant manufacturer, to be applied to sealant-contact surfaces where bond to substrate or joint filler must be avoided for proper performance of calking and sealant. Provide self-adhesive tape where applicable.
5. Sealant Backer Rod: Compressible rod stock polyethylene foam, polyethylene jacketed polyurethane foam, butyl rubber foam, neoprene foam or other flexible, permanent, durable nonabsorptive material as recommended for compatibility with calking and sealant by calking and sealant manufacturer. Provide size and shape of rod that will control joint depth for sealant placement, break bond of sealant at bottom of joint, form optimum shape of sealant bead on back side, and provide highly-compressible backer to minimize possibility of sealant extrusion when joint is compressed.

2.6 GROUT

A. Non-shrink Grout:
1. Pre-packaged, non-metallic, cementitious grout requiring only the addition of water at the Site.
2. Minimum 28-day Compressive Strength: 7,000 psi.
3. Products and Manufacturers: Provide one of the following:
a. NS Grout by Euclid Chemical Company.
b. MasterFlow 100, by BASF, Inc.
c. EZ-Cure Contractor's Grout, by Five Star Products, Inc.
d. Or equal.

2.7 REPAIR MORTAR

A. Product Description: Repair mortar shall be prepackaged, cement-based product specifically formulated for repairing concrete surface defects.

B. Products and Manufacturers: Provide one of the following:
   1. SikaTop 122 Plus, SikaTop 123 Plus, or SikaTop 111 Plus, by Sika Corporation.
   2. Emaco S 466 CI, S 477 CI, S 488 CI, by BASF Construction Chemicals.
   3. DuralTop Gel, DuralTop Flowable Mortar by Euclid Chemical Company.
   4. Or equal.

C. Materials:
   1. Provide a two-component, polymer-modified, Portland cement, fast-setting, trowel-grade mortar. Repair mortar shall be enhanced with penetrating corrosion inhibitor, and shall have the following properties:

Physical Property	**Value**	**ASTM Standard**
Minimum Compressive Strength at One Day	2,000 psi	C109
Minimum Compressive Strength at 28 Days	6,000 psi	C109
Minimum Bond Strength at 28 Days	1,800 psi	C882*
* Modified for use with repair mortars.		

   2. Where the least dimension of the placement in width or thickness exceeds four inches, extend repair mortar by adding aggregate as recommended by repair mortar manufacturer.

PART 3 – EXECUTION

3.1 INSPECTION

A. CONTRACTOR shall examine the substrate and the conditions under which the Work will be performed and notify ENGINEER in writing of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 FORMWORK

A. Construct formwork in accordance with ACI 347 such that concrete members and structures are of correct size, shape, alignment, elevation, and position.

B. Provide openings in formwork to accommodate the Work of other trades. Accurately place and securely support items required to be built into formwork.

C. Clean and adjust forms prior to placing concrete. Apply form release agents or wet forms as required. Re-tighten forms during and after concrete placing, when required, to eliminate cement paste leaks.

D. Removing Formwork:
   1. Comply with ACI 301 and ACI 347, except as otherwise indicated in the Contract Documents.
   2. Do not remove formwork and shoring until supported concrete members have acquired minimum of 90 percent of specified compressive strength. Results of suitable quality control tests of field-cured specimens may be submitted to ENGINEER for review as evidence that concrete has attained sufficient strength for removal of supporting formwork and shoring prior to removal times indicated in the Contract Documents.
   3. Removal time for formwork is subject to ENGINEER's acceptance.
   4. Repair form tie-holes following in accordance with ACI 301.

3.3 REINFORCING, JOINTS, AND EMBEDDED ITEMS

A. Comply with the applicable recommendations of Laws and Regulations and standards referenced in this Section, including CRSI MSP1, for details and methods of placing and supporting reinforcing.

B. Clean reinforcing to remove loose rust and mill scale, earth, ice, and other materials which act to reduce or destroy bond between reinforcing material and concrete.

C. Position, support, and secure reinforcing against displacement during formwork construction and concrete placing. Locate and support reinforcing by means of metal chairs, runners, bolsters, spacers, and hangers, as required.
   1. Place reinforcing to obtain minimum concrete coverages as shown on the Drawings and as required in ACI 318. Arrange, space, and securely tie bars and bar supports together with 16-gage wire to hold reinforcing accurately in position during concrete placing. Set with ties so that twisted ends are directed away from exposed concrete surfaces.
   2. Do not secure reinforcing to formwork using wire, nails or other ferrous metal. Metal supports subject to corrosion shall not be in contact with formed or exposed concrete surfaces.

D. Provide sufficient quantity of supports of strength required to carry reinforcing. Do not place reinforcing more than two inches beyond the last leg of continuous bar support. Do not use supports as bases for runways for concrete conveying equipment and similar construction loads.

E. Splices: Provide standard reinforcing splices by lapping ends, placing bars in contact, and tying tightly with wire. Comply with requirements shown or indicated for minimum lap of spliced bars, as shown on the Drawings.

F. Install welded wire fabric in lengths as long as practical, lapping adjoining sections a minimum of one full mesh.

G. Do not place concrete until reinforcing is inspected and ENGINEER indicates that conditions are acceptable for placing concrete. Concrete placed in violation of this paragraph will be rejected. Notify ENGINEER in writing at least two working days prior to proposed concrete placement.

H. Joints:
   1. Provide construction, isolation, expansion, and control joints as indicated or required. Locate construction joints so as to not impair the strength and appearance of the structure. Place isolation and control joints in slabs-on-grade to stabilize differential settlement and random cracking.
   2. In walls, locate joints at a maximum spacing of 40 feet and approximately 12 feet from corners.
   3. In foundation slabs and slabs-on-grade, locate joints at intervals of approximately 40 feet.
   4. In mats and structural slabs and beams, locate joints in compliance with ACI 224R.
   5. Locations of joints shall be in accordance with the Contract Documents and as approved by ENGINEER in the Shop Drawings.
   6. Where construction joints are indicated to be roughened, intentionally roughen surfaces of previously-placed concrete to amplitude of 1/4-inch.

I. Installation of Embedded Items: Set and build into the Work anchorage devices and embedded items required for other Work that is attached to, or supported by, cast-in-place concrete. Use setting diagrams, templates, and instructions provided under other Sections and, when applicable, other contracts for locating and setting. Refer to Paragraph 1.1B of this Section. Do not embed in concrete uncoated aluminum items. Where aluminum items are in contact with concrete surfaces, coat aluminum to prevent direct contact with concrete.

J. Adhesive Dowels:
   1. Adhesive dowels shall be reinforcing bar dowels set in an adhesive in hole drilled into hardened concrete. Comply with adhesive system manufacturer's installation instructions regarding hole diameter, drilling method, embedment depth required to fully develop required tensile strength, and hole cleaning and preparation instructions. Unless more-stringent standards are required by adhesive system manufacturer, comply with the following.
   2. Drill holes to adhesive system manufacturer's recommended diameter and depth to develop required tensile strength. Where indicated on the drawings, hole depths greater than required for tensile development shall be provided. Hammer-drill holes. Cored holes are not allowed.
   3. Embedment depths shall be based on concrete compressive strength of 2,000 psi when embedded in existing concrete, and 4,000 psi when embedded in new concrete.
   4. Determine location of existing reinforcing steel in vicinity of proposed holes prior to drilling. Adjust location of holes to be drilled to avoid drilling through or damaging existing reinforcing bars only when approved by ENGINEER.

5. Before setting adhesive dowel, hole shall be free of dust and debris using method recommended by adhesive system manufacturer. Hole shall be brushed, with manufacturer-approved brush and blown clean with clean, dry, oil-free compressed air to remove dust and loose particles. Hole shall be dry as defined by adhesive system manufacturer.
6. Inject adhesive into hole through injection system mixing nozzle and necessary extension tubes, placed to bottom of hole. Withdraw discharge end as adhesive is placed, but keep end of tube immersed to prevent forming air pockets. Fill hole to depth that ensures that excess material is expelled from hole during dowel placement.
7. Twist dowels during insertion into partially-filled hole to guarantee full wetting of bar surface with adhesive. Insert bar slowly to avoid developing air pockets.

3.4 CONCRETE PLACING

A. Site Mixing: Site mixing will only be allowed with the ENGINEER's approval.

B. Ready-Mixed Concrete: Comply with ASTM C94/C94M.

C. Concrete Placing:
1. Place concrete in a continuous operation within planned joints or sections in accordance with ACI 304R.
2. Do not begin placing concrete until work of other trades affecting concrete is completed.
3. Wet concrete and subgrade surfaces to saturated surface dry condition immediately prior to placing concrete.
4. Deposit concrete as near its final location as practical to avoid segregation due to re-handling or flowing.
5. Avoid separation of the concrete mixture during transportation and placing. Concrete shall not free-fall for distance greater than four feet during placing.
6. Complete concrete placing within 90 minutes of addition of water to the dry ingredients. The use of hydration control admixtures can extend this time period. Approval from the ENGINEER is required.

D. Consolidate placed concrete in accordance with ACI 309R using mechanical vibrating equipment supplemented with hand rodding and tamping, such that concrete is worked around placing and other embedded items and into all parts of formwork. Insert and withdraw vibrators vertically at uniformly-spaced locations. Do not use vibrators to transport concrete within the formwork. Vibration of formwork or placing is not allowed.

E. Protect concrete from physical damage or reduced strength due to weather extremes during mixing, placing, and curing.
1. In hot weather comply with ACI 305R.
2. In cold weather comply with ACI 306R.

3.5 QUALITY OF CONCRETE WORK

A. Make concrete solid, compact, smooth, and free of laitance, cracks, and cold joints.

B. Concrete in contact with earth, water, or exposed directly to the elements shall be watertight.

C. Cut out and properly replace to extent directed by ENGINEER, or repair to satisfaction of ENGINEER, surfaces that contain cracks or voids, are unduly rough, or are in defective in any way. Patches or plastering are unacceptable.

D. Repair, removal and replacement of defective concrete directed by ENGINEER shall be at no additional cost to OWNER.

3.6 CURING

A. Begin initial curing as soon as free water has disappeared from exposed surfaces. Where possible, keep continuously moist for not less than 72 hours. Continue curing by using moisture-retaining cover or membrane-forming curing compound. Cure formed surfaces by moist curing until formwork is removed. Provide protection, as required, to prevent damage to exposed concrete surfaces. Total curing period shall not be less than seven days. Curing methods and materials shall be compatible with scheduled finishes.

3.7 FINISHING

A. Slab Finish:
   1. After placing concrete slabs, do not work the surface further until ready for floating. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently. Use a wood float only. Check and level surface plane to a tolerance not exceeding 1/4-inch in ten feet when tested with a ten foot straightedge placed on the surface at not less than two different angles. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, re-float the surface to a uniform, smooth, granular texture. Slab surfaces shall receive a float finish. Provide additional trowel finishing as required in this Section.
   2. After floating, begin first trowel finish operation using power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over the surface.
   3. Consolidate concrete surface by the final hand troweling operation. Finish shall be free of trowel marks, uniform in texture and appearance, and with a surface plane tolerance not exceeding 1/8-inch in ten feet when tested with a ten-foot straightedge. Grind smooth surface defects that would telegraph through applied floor covering system.
   4. Use trowel finish for the following:
      a. Interior exposed slabs, unless otherwise shown or indicated.
      b. Apply non-slip broom finish, after troweling, to exterior concrete slab and elsewhere as shown.

B. Apply liquid sealer/densifier to exposed interior concrete floor areas when cured and dry, in accordance with manufacturer's instructions.

C. Formed Finish:
   1. Provide smooth form concrete finish at exposed surfaces. Use largest practical form panel sizes to minimize form joints. All surfaces shall be considered as exposed, unless buried or covered with permanent structural or architectural material. After removing forms, patch form tie holes and defects in accordance with ACI 301. Remove fins exceeding 1/8-inch in height. Where surface will be coated or will receive further treatment, remove all fins flush with concrete surface.
   2. Provide rough form finish at all unexposed surfaces. After removing forms, patch form tie holes and defects in accordance with ACI 301. Remove fins exceeding 1/2-inch in height.

3.8 GROUT PLACING

A. Place grout as shown and indicated, and in accordance with grout manufacturer's instructions and recommendations. If grout manufacturer's instructions conflict with the Contract Documents, notify ENGINEER and not proceed until obtaining ENGINEER's clarification.

B. Dry-packing is not allowed, unless otherwise indicated.

C. Manufacturers of proprietary grout materials shall make available upon 72 hours notice the services of qualified, full-time, factory-trained employee to aid in ensuring proper use of grout materials at the Site.

D. Placing grout shall comply with temperature and weather limitations described in Article 3.4 of this Section.

3.9 CONCRETE REPAIR

A. Surface Preparation:
   1. Initial Surface Preparation: Remove by chipping, abrasive blasting, or hydro blasting all laitance, foreign material, and unsound concrete from entire area to be repaired. Further roughen surface as specified in this Section. Where non-shrink grout or repair mortar is used, perform additional surface preparation, if any, recommended by product manufacturer.
   2. Wetting Procedure: Where repair concrete or cement grout is used, and bonding agent is not required, or where repair mortar or non-shrink grout manufacturer recommends wet or saturated surface, perform the following:
      a. Continuously apply water for at least four hours to surface being repaired. Where large surface areas are to be repaired, use fog-spray nozzles, mounted on stands, in sufficient number so that entire surface to be repaired is contacted by fog spray cloud.
      b. Prevent concrete from drying until after repair is completed. Re-wet

surfaces not yet repaired using water sprays at least a daily; should more than four days elapse without re-wetting surfaces not yet repaired, repeat the original saturating procedure.

c. Remove standing water in areas to be repaired before placing repair material. Provide means to remove excess water from structure.

3. Preparation for Epoxy Bonding Agent: Where repair material manufacturer recommends use of epoxy-bonding agent, conform to recommendations of both repair material manufacturer and bonding agent manufacturer.

B. Environmental Conditions: Comply with manufacturers' instructions for installing all products. Comply with all temperature and environmental limitations, and be prepared to provide supplementary heat and temporary shelter when necessary during installation and curing.

C. Care shall be taken to fully consolidate repair material, completely filling all portions of space to be filled.

D. Bring surface being repaired into alignment with adjacent surfaces, providing uniform, even surface. Surface repaired shall match adjacent existing surfaces in texture and shall receive coatings or surface treatments, if any, provided for the existing surface adjacent to repaired surface.

E. Curing:

1. Curing of repair mortar and non-shrink grout shall be in accordance with manufacturer's recommendations, except that minimum cure period shall be three days.

3.10 REPAIR OF SURFACE DEFECTS

A. Surface defects are depressions in a concrete surface that do not extend all the way through the concrete. Surface defects can result from removal of an embedded item, removal of an intersecting concrete member, physical damage, or unrepaired rock pockets created during original placement.

B. Preparation: Perform the following in addition to requirements of Article 3.9.A of this Section:

1. Remove by chipping all loose, damaged concrete to sound material.
2. Where existing reinforcing is exposed, remove concrete to minimum of one-inch around exposed bars. If existing bars are cut through, cracked, or cross sectional area is reduced by more than 25 percent from original, immediately notify ENGINEER.
3. Score-cut perimeter of area to be repaired to minimum depth of 1/2-inch and maximum depth that will not cut existing reinforcing steel. Chip out existing concrete to the score line so that minimum thickness of repair mortar will be 1/2-inch.

C. Repair Material:
   1. Completely fill the surface defect with specified repair material, in accordance with material manufacturer's instructions and the Contract Documents.

3.11 PATCHING OF HOLES IN CONCRETE

A. Fill openings less than four inches in their least dimension with non-shrink grout.

B. Openings greater than four inches and less than 12 inches in their least dimension shall be coated with an epoxy bonding agent prior to filling with non-shrink grout.

C. Openings greater than 12 inches in their least dimension shall be coated with an epoxy bonding agent prior to filling with Class A concrete. See details for filling openings greater than 12 inches.

3.12 REPAIR OF LINED HOLES

A. This Article applies to openings with embedded material over all or a portion of inside surface of hole. Where indicated on the Drawings, remove embedded materials and repair the hole in accordance with Article 3.11 of this Section, as modified in this Article 3.12.

B. Where embedded material is allowed to remain, remove embedded material to at least two inches into the hole, as measured from the plane surface of concrete wall or slab, as applicable. Embedded material left in place shall be roughened or abraded for proper bonding to repair material. Completely remove substances that interfere with proper bonding.

C. Completely remove embedded items not securely and permanently anchored into concrete.

3.13 FIELD QUALITY CONTROL

A. Site Testing Services:
   1. OWNER will employ testing laboratory to perform field quality control testing for concrete. ENGINEER will direct the testing requirements.
   2. Testing laboratory will provide all labor, material, and equipment required for sampling and testing concrete, including: scale, glass tray, cones, rods, molds, air tester, thermometer, and other incidentals required.
   3. CONTRACTOR shall provide curing and necessary cylinder storage in accordance with Section 01 45 29.13, Testing Laboratory Services Furnished by Contractor.

B. Quality Control Testing During Construction:
   1. Perform sampling and testing for field quality control during concrete placing, as follows:
      a. Sampling Fresh Concrete: ASTM C172.

b. Slump: ASTM C143/C143M; one test for each concrete load at point of discharge.
c. Concrete Temperature: ASTM C1064/C1064M; one for every two concrete loads at point of discharge, and when a change in the concrete is observed. Test each load when time from batching to placement exceeds 75 minutes.
d. Air Content: ASTM C231; one for every two concrete load at point of discharge, and when a change in the concrete is observed.
e. Unit Weight: ASTM C138/C138M; one for every two concrete loads at point of discharge, and when a change in the concrete is observed.
f. Compression Test Specimens:
    1) In accordance with ASTM C31/C31M, make one set of compression cylinders for each 50 cubic yards of concrete, or fraction thereof, of each mix design placed each day. Each set shall be four standard cylinders, unless otherwise directed by ENGINEER.
    2) Cast, store, and cure specimens in accordance with ASTM C31/C31M.
g. Compressive Strength Tests:
    1) In accordance with ASTM C39/C39M; one specimen tested at seven days, and three specimens tested at 28 days.
    2) Concrete that does not comply with strength requirements will be considered as defective Work.
h. Within 24 hours of completion of test, testing laboratory will transmit certified copy of test results to CONTRACTOR and ENGINEER.
i. When there is evidence that strength of in-place concrete does not comply with the Contract Documents, CONTRACTOR shall employ the services of concrete testing laboratory to obtain cores from hardened concrete for compressive strength determination. Cores and tests shall comply with ASTM C42/C42M and the following:
    1) Obtain at least three representative cores from each concrete member or suspect area of concrete at locations directed by ENGINEER.
    2) Strength of concrete for each series of cores will be acceptable if average compressive strength is at least 85 percent of specified compressive strength and no single core is less than 75 percent of required 28-day required concrete compressive strength.
    3) Testing laboratory shall submit test results to ENGINEER on same day that tests are completed. Include in test reports Project name and number (if any), date of sampling and testing, CONTRACTOR name, name of concrete testing laboratory, exact location of test core in the Work, type or class of concrete represented by core sample, nominal maximum size aggregate, design compressive strength, compression breaking strength, and type of break (corrected for length-diameter ratio), direction of applied load to core with respect to horizontal plane of concrete as placed, and moisture condition of the core at time of testing.
j. Fill core holes solid with non-shrink grout in accordance with this Section and finish to match adjacent concrete surfaces.

k. If results of core tests are unacceptable or if it is impractical to obtain cores, perform static load test and evaluations complying with ACI 318 and ACI 350, as directed by ENGINEER.

2. OWNER will employ testing laboratory to perform field quality testing of adhesive dowels at the Site.
   a. Testing shall comply with ASTM E488.
   b. After adhesive system manufacturer's recommended curing period and prior to placing connecting reinforcing, proof-test for pullout ten percent of adhesive dowels installed. If one or more dowels fail the test, CONTRACTOR shall pay the cost to test all dowels installed in the work.
   c. Test dowels to 60 percent of specified yield strength. ENGINEER will direct which dowels are to be tested.
   d. Apply test loads with hydraulic ram.
   e. Displacement of dowels shall not exceed D/10, where D is nominal diameter of dowel.
   f. Dowels that fail shall be reinstalled and retested at CONTRACTOR's expense.

+ + END OF SECTION + +

SECTION 05 05 33

ANCHOR SYSTEMS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install anchor systems.
   2. This Section includes all anchor systems required for the Work, but not specified under other Sections.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before anchor systems Work.
   2. Notify other contractors in advance of installing anchor systems to provide other contractors with sufficient time for installing items included in their contracts to be installed with or before anchor systems Work.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. ACI 318, Building Code Requirements for Structural Concrete.
   2. ACI 355.2, Qualification of Post-Installed Mechanical Anchors in Concrete.
   3. ANSI B212.15, Cutting Tools - Carbide-tipped Masonry Drills And Blanks For Carbide-tipped Masonry Drills.
   4. ASTM A194/A194M, Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
   5. ASTM A276, Specification for Stainless Steel Bars and Shapes.
   6. ASTM A493, Specification for Stainless Steel Wire and Wire Rods for Cold Heading and Cold Forging.
   7. ASTM A563, Specification for Carbon and Alloy Steel Nuts.
   8. ASTM B633, Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
   9. ASTM D695, Test Method for Compressive Properties of Rigid Plastics.
   10. ASTM E329, Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.
   11. ASTM E488, Test Methods for Strength of Anchors in Concrete and Masonry Elements.
   12. ASTM F593, Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
   13. ASTM F594, Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.

14. ASTM F1554, Specification for Anchor Bolts, Steel, 36, 55 and 105-ksi Yield Strength.
15. FS A-A-1922A, Shield, Expansion (Caulking Anchors, Single Lead).
16. FS A-A-1923A, Concrete Expansion Anchors.
17. FS A-A-1925A, Shield, Expansion (Nail Anchors).
18. FS A-A-55614, Shield, Expansion (non-drilling expansion anchors).
19. ICC-ES AC01, Acceptance Criteria for Expansion Anchors in Masonry Elements.
20. ICC-ES AC193, Acceptance Criteria for Mechanical Anchors in Concrete Elements.
21. ICC-ES AC308, Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements.
22. ISO 3506-1, Mechanical Properties of Corrosion-Resistant Stainless Steel Fasteners -- Part 1: Bolts, Screws and Studs.

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Testing Laboratory: Shall comply with ASTM E329 and shall be experienced in tension testing of post-installed anchoring systems.
   2. Post-installed Anchor Installer:
      a. Mechanical Anchors: Installer shall be experienced and trained by post-installed anchor system manufacturer in proper installation of manufacturer's products. Product installation training by distributors or manufacturer's representatives is unacceptable unless the person furnishing the training is qualified as a trainer by the anchor manufacturer.
      b. Adhesive Anchors: Installation shall be performed by personnel certified under an applicable certification program. Certification shall include written and performance tests in accordance with the ACI/CRSI Adhesive Anchors Installer Certification Program, or equivalent. Description of equivalent programs shall be submitted for ENGINEER's approval and acceptance by the building official having jurisdiction.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Listing of all anchor systems products intended for use in the Work including product type, intended location in the Project, and embedded lengths.
   2. Product Data:
      a. Manufacturer's specifications, load tables, dimension diagrams, acceptable base material conditions, acceptable drilling methods, and acceptable bored hole conditions.

b. When required by ENGINEER, copies of valid ICC ES reports that presents load-carrying capacities and installation requirements for anchor systems.

3. Samples:
   a. Representative Samples of anchor systems proposed for use in the Work. Review will be for type and finish only. Compliance with all other requirements is CONTRACTOR's exclusive responsibility.

B. Informational Submittals: Submit the following:
   1. Certificates:
      a. For each type of anchor bolt or threaded rod, submit copies of laboratory test reports and other data required to demonstrate compliance with the Contract Documents.
      b. Post-installed anchor system manufacturer's certification that installer received training in the proper installation of manufacturer's products required for the Work.
      c. For each adhesive anchor installer, submit ACI/CRSI Adhesive Anchor Installer Certification.
   2. Manufacturer's Instructions:
      a. Installation instructions for each anchor system product proposed for use, including bore hole cleaning procedures and adhesive injection, cure and gel time tables, and temperature ranges (storage, installation and in-service).

1.5 DELIVERY, STORAGE AND HANDLING

A. Storage and Protection:
   1. Keep materials dry during delivery and storage.
   2. Store adhesive materials within manufacturer's recommended storage temperature range.
   3. Protect anchor systems from damage at the Site. Protect products from corrosion and deterioration.

PART 2 – PRODUCTS

2.1 SYSTEM PERFORMANCE

A. General:
   1. At locations where conditions dictate that Work specified in other Sections is to be of corrosion resistant materials, provide associated anchor systems of stainless steel materials, unless other corrosion-resistant anchor system material is specified. Provide anchor systems of stainless steel materials where stainless steel materials are required in the Contract Documents.
   2. Stainless Steel Nuts:
      a. For anchor bolts and adhesive anchors, provide ASTM A194/A194M, Grade 8S (Nitronic 60) stainless steel nuts for stainless steel anchors

used for anchoring equipment, gates, and weirs, and other locations, if any, where the attachment will require future removal for operation or maintenance. Provide lock washer or double nuts on each anchorage device provided for equipment, as required by equipment manufacturer.

b. For other locations, provide for each anchorage device a nut as specified or as required by anchor manufacturer. When ASTM A194/A194M, Grade 8S (Nitronic 60) nuts are not required for anchor bolts and adhesive anchors as specified in this Section, provide anti-seizing compound where stainless steel rods are used with stainless steel nuts of the same type.

3. Materials that can contact potable water or water that will be treated to become potable shall be listed in NSF/ANSI 61.

B. Design Criteria

1. Size, Length, and Load-carrying Capacity: Comply with the Contract Documents. When size, length or load-carrying capacity of anchor system is not otherwise shown or indicated, provide the following:

a. Anchor Bolts: Provide size, length, and capacity required to carry design load based on values and requirements of Paragraph 3.2.A of this Section. For conditions outside limits of critical edge distance and spacing in Paragraph 3.2.A of this Section, minimum anchor bolt embedment as shown or indicated in Paragraph 3.2.A of this Section apply and capacity shall be based on requirements of Laws and Regulations, including applicable building codes.

b. Adhesive Anchors, or Expansion Anchors: Provide size, length, type, and capacity required to carry design load. Anchor capacity shall be based on the procedures required by the building code in effect at the Site. Where Evaluation Service Reports issued by the ICC Evaluation Service are required in this Section, anchor capacities shall be based on design procedure required in the applicable ICC Evaluation Service Report.

1) General: Determine capacity considering reductions due to installation and inspection procedures, embedment length, strength of base fastening materials, spacing, and edge distance, as indicated in the manufacturer's design guidelines. For capacity determination, concrete shall be assumed to be in the cracked condition, unless calculations demonstrate that the anchor system will be installed in an area that is not expected to crack under any and all conditions of design loading.

2) Concrete Adhesive Anchors: Unless otherwise shown or indicated in the Contract Documents or approved by ENGINEER, provide minimum embedment depth of the greater of the following: required to develop tensile strength of anchor, or a minimum embedment of 10 anchor diameters; and minimum anchor spacing and edge distance of 12 anchor diameters.

3) Concrete Masonry Adhesive Anchors: Unless otherwise shown or indicated in the Contract Documents or approved by ENGINEER,

provide minimum anchor spacing and edge distance as indicated in anchor manufacturer's instructions.

4) Concrete Expansion Anchors: Unless otherwise shown or indicated in the Contract Documents or approved by ENGINEER, provide minimum embedment depth of six anchor diameters, and minimum anchor spacing and edge distance of seven anchor diameters.
5) Concrete Masonry Expansion Anchors: Unless otherwise shown or indicated in the Contract Documents or approved by ENGINEER, provide minimum anchor spacing and edge distance as indicated in anchor manufacturer's instructions.
6) Concrete Undercut Anchors: Unless otherwise shown or indicated in the Contract Documents, or approved by ENGINEER, provide minimum anchor spacing and edge distance as tabulated in anchor manufacturer's instructions.

2. Design Loads: Comply with the Contract Documents. When design load of supported material, equipment, or system is not otherwise shown or indicated, provide the following:
   a. Equipment Anchors: Use design load recommended by equipment manufacturer. When equipment can be filled with fluid, use loads that incorporate equipment load and load imposed by fluid.
   b. Pipe Hangers and Supports: Use full weight of pipe, and fluid contained in pipe that are tributary to the support plus the full weight of valves and accessories located between the hanger or support being anchored and the next hanger or support.
   c. Hangers and Supports for Electrical Systems, and HVAC, Plumbing, and Fire Suppression Systems and Piping: Use the full weight of supported system that is tributary to the support plus the full weight of accessories located between the hanger or support being anchored and the next hanger or support. When piping or equipment is to be filled with fluid, anchor systems shall be sized to support such loads in addition to the weight of the equipment, piping, or system, as applicable.
   d. Delegated Design: When anchor systems are used for supporting materials, equipment, or systems delegated to a design professional retained by CONTRACTOR, Subcontractor, or Supplier, provide anchor system suitable for loads indicated in delegated design documents and consistent with the design intent expressed in the Contract Documents.

C. Application:
   1. Anchor Bolts:
      a. Where anchor bolt is shown or indicated, use cast-in-place anchor bolt unless another anchor type is approved by ENGINEER.
      b. Provide anchor bolts as shown or indicated, or as required to secure structural element to appropriate anchor surface.
   2. Concrete Adhesive Anchors:
      a. Use where adhesive anchors are shown or indicated for installation in concrete.

b. Suitable for use where subject to vibration.
c. Suitable for use in exterior locations or locations subject to freezing.
d. Suitable for use in submerged, intermittently submerged, or buried locations.
e. Do not use in overhead applications, unless otherwise shown or approved by ENGINEER.
f. Do not use for pipe hangers, unless otherwise shown or approved by ENGINEER.

3. Concrete Masonry Adhesive Anchors:
   a. Use where adhesive anchors are shown or indicated for installation in grout-filled or hollow masonry units.
   b. Suitable for use where subject to vibration.
   c. Suitable for use in exterior locations or locations subject to freezing.
   d. Do not use for pipe hangers, unless otherwise shown or approved by ENGINEER.
4. Concrete Wedge Expansion Anchors:
   a. Use where expansion anchors are shown or indicated for installation in concrete.
   b. Do not use where subject to vibration.
   c. Do not use in exterior locations or locations subject to freezing.
   d. Do not use in submerged, intermittently submerged, or buried locations.
   e. Suitable for use in overhead applications.
5. Grout-filled Concrete Masonry Wedge Expansion Anchors:
   a. Use where expansion anchors are shown or indicated for installation on the interior face of grout-filled unit masonry.
   b. Do not use where subject to vibration.
   c. Do not use in exterior locations or locations subject to freezing.
6. Hollow Concrete Masonry Sleeve Expansion Anchors:
   a. Use where expansion anchors are shown or indicated for installation in hollow concrete unit masonry or solid brick.
   b. Do not use for attaching safety-related systems, such as piping conveying hazardous or potentially hazardous materials, or fire suppression systems.
   c. Do not use where subject to vibration.
   d. Do not use in exterior locations or locations subject to freezing.
7. Drop-in Expansion Anchors:
   a. Use drop-in expansion anchors installed in concrete where light-duty anchors are required to support piping or conduit two-inch diameter or smaller.
   b. Do not use for attaching safety-related systems, such as piping conveying hazardous or potentially hazardous materials, or fire suppression systems.
   c. Do not use where subject to vibration.
   d. Do not use at submerged, intermittently submerged, or buried locations.
   e. Do not use in exterior locations or locations subject to freezing.
   f. Suitable for use in overhead applications.

8. Concrete Undercut Anchors:
    a. Use where undercut anchors are shown or indicated for installation in concrete.
    b. Suitable for use where subject to vibration.
    c. Do not use in submerged, intermittently submerged, or buried locations.
    d. Do not use in exterior locations or locations subject to freezing.
    e. Suitable for use in overhead applications.
9. Drive-In Expansion Anchors:
    a. Use drive-in expansion anchors installed in concrete, precast concrete, grouted masonry units, or brick, where light-duty anchors are required to support piping or conduit one-inch diameter and smaller.
    b. Do not use for attaching safety-related systems, such as piping conveying hazardous or potentially hazardous materials, or fire suppression systems.
    c. Do not use in overhead applications.
10. For Use in Precast Concrete Planks:
    a. To support piping, ductwork or conduit, use low-profile drop-in anchors, hollow concrete masonry adhesive anchors, or through-bolts.

2.2 MATERIALS

A. Anchor Bolts:
1. Interior Dry Non-corrosive Locations: Provide straight threaded carbon steel rods complying with ASTM F1554, Grade 36, with heavy hex nuts complying with ASTM A563 Grade A, unless otherwise shown or indicated on the Drawings. Hooked anchor bolts are unacceptable.
2. Exterior, Buried, Submerged Locations, or When Exposed to Wastewater: Provide stainless steel straight threaded rods complying with ASTM F593, AISI Type 316, Condition A, with ASTM F594, AISI Type 316, stainless steel nuts. Provide ASTM A194/A194M, Grade 8S (Nitronic 60) stainless steel nuts where required. Other AISI types may be used when approved by ENGINEER. Hooked bolts are unacceptable.
3. Equipment: Provide anchor bolts complying with material requirements of this Section and equipment manufacturer's requirements relative to size, embedment length, and anchor bolt projection. Anchor bolts shall be straight threaded rods with washers and nuts as specified in this Section. Hooked bolts are unacceptable.
4. Anchoring of Structural Elements: Provide anchor bolts of size, material, and strength shown or indicated in the Contract Documents.

B. Concrete Adhesive Anchors:
1. General:
    a. Adhesive anchors shall consist of threaded rods anchored into hardened concrete using an adhesive system.
2. Products and Manufacturers: Provide one of the following:
    a. HIT-RE 500-V3 Injection Epoxy Adhesive Anchoring System, by Hilti Fastening Systems, Inc.

b. HIT-HY 200-A and HIT-HY 200-R Adhesive Anchoring System, by Hilti Fastening Systems, Inc
c. SET-XP Adhesive anchoring system, by Simpson Strong-Tie Company, Inc.
d. Or equal.

3. Adhesive:
   a. Adhesive system shall use two-component adhesive mix.
   b. Adhesives shall have a current evaluation report by ICC Evaluation Service for use in both cracked and uncracked concrete with seismic recognition for SDC A through F as tested and assessed in accordance with ICC-ES AC308, which incorporates the requirements of ACI 355.4-11
   c. Adhesives shall have minimum bond strength in accordance with Table 05 05 33-A:

TABLE 05 05 33-A:
ADHESIVE BOND STRENGTH [1,2]

Bond Strength (psi)					
Rod Diameter	**Uncracked Concrete**	**Cracked Concrete**	**Dowel Size**	**Uncracked Concrete**	**Cracked Concrete**
1/2-inch	1670	880	#4	1500	1080
5/8-inch	1670	750	#5	1460	1090
3/4-inch	1670	665	#6	1415	1015
7/8inch	1525	610	#7	1370	835
1-inch	1360	595	#8	1330	760
-	-	-	#9	1560	850
1.25-inch	1070	595	#10	1240	475

Table Notes:
1. Bond strengths listed for hammer-drilled, dry hole.
2. Bond strengths listed for maximum short term concrete temperature of 130 degrees F and maximum long term concrete temperature of 110 degrees F.

4. Anchor:
   a. Provide continuously-threaded, AISI Type 316 stainless steel adhesive anchor rod. Threaded rods shall comply with the concrete adhesive anchor manufacturer's specifications as included in the ICC Service Evaluation Report for the anchor submitted. Nuts shall have specified proof load stresses equal to or greater than the minimum tensile strength of the stainless steel threaded rod used. Provide ASTM A194/A194M, Grade 8S (Nitronic 60) stainless steel nuts where required.

C. Concrete Masonry Adhesive Anchors:
   1. General:
      a. Grout-filled concrete masonry adhesive anchors shall consist of threaded rods anchored into grout-filled concrete block masonry using an adhesive system.

b. Hollow concrete masonry adhesive anchors shall consist of threaded rods with a cylindrical mesh steel or plastic screen tube anchored into hollow concrete block masonry using an adhesive system.

2. Products and Manufacturers: Provide one of the following:
   a. HIT-HY 70 Hybrid Adhesive Anchor System, by Hilti Fastening Systems, Inc.
   b. Acrylic-Tie Adhesive, by Simpson Strong-Tie Company, Inc.
   c. Or equal.
3. Adhesive:
   a. Adhesive system shall use two-component adhesive mix.
   b. Hybrid adhesives shall comply with the following:
      1) ASTM D695 compressive yield strength greater than 7,200 psi on a seven-day cure.
   c. Adhesives shall have current ICC Evaluation Service Report for use in grout-filled concrete masonry, tested and assessed in accordance with ICC-ES AC 58 and ICC-ES AC 60.
4. Anchor:
   a. Provide stainless steel adhesive anchor rod complying with ASTM F593, AISI Type 316, Condition CW, with ASTM F594, AISI Type 316 stainless steel nuts. Provide ASTM A194/A194M, Grade 8S (Nitronic 60) stainless steel nuts where required.
5. Mesh Screen Tube (for hollow masonry applications):
   a. Provide with mesh size, length, and diameter as specified by adhesive anchor manufacturer.

D. Concrete Wedge Expansion Anchors:
1. General:
   a. Concrete wedge expansion anchors shall consist of stud, wedge, nut, and washer.
2. Products and Manufacturers: Provide one of the following:
   a. Kwik Bolt TZ Wedge Anchor, by Hilti Fastening Systems, Inc.
   b. Strong Bolt 2 Wedge Anchor, by Simpson Strong-Tie Company, Inc.
   c. Or equal.
3. Anchors shall comply with physical requirements of FS A-A-1923A, Type 4. Provide concrete wedge expansion anchors suitable for use in cracked and uncracked concrete in accordance with ACI 318 Chapter 17. Demonstrate suitability of cracked concrete wedge anchors in accordance with ACI 355.2 prequalification tests.
4. Interior Dry Non-corrosive Locations: Provide carbon steel anchors complete with nuts and washers, zinc plated, in accordance with ASTM B633.
5. Other Locations: Provide expansion anchors complete with nuts and washers, AISI Type 304 stainless steel anchor body, in accordance with ASTM A276 or ASTM A493.
6. Concrete wedge expansion anchors shall have a current ICC Evaluation Service Report for use in both cracked and uncracked concrete with seismic recognition in seismic design Categories A through F when tested and assessed in accordance with ICC-ES AC193.

E. Grout-filled Masonry Wedge Expansion Anchors:
   1. General:
      a. Grout-filled masonry wedge expansion anchors shall each consist of stud, wedge, nut, and washer.
   2. Product and Manufacturers: Provide one of the following:
      a. Kwik-Bolt 3 Expansion Anchors, by Hilti Fastening Systems, Inc.
      b. Wedge-All Wedge Anchors, by Simpson Strong-Tie Company, Inc.
      c. Or equal.
   3. Anchors shall comply with physical requirements of FS A-A-1923A, Type 4. Anchors shall be non-bottom bearing type with single-piece steel expansion clip providing 360-degree contact with base material and shall not require oversized holes for installation.
   4. Provide carbon steel anchors complete with nuts and washers, zinc plated, in accordance with ASTM B633.
   5. Grout-filled masonry wedge expansion anchors shall have a current ICC Evaluation Service report for use in fully-grouted concrete masonry construction when tested and assessed in accordance with ICC-ES AC01.

F. Hollow Concrete Masonry Sleeve Expansion Anchors:
   1. General:
      a. Sleeve expansion anchors shall each consist of an externally threaded stud with full length expanding sleeve.
   2. Products and Manufacturers: Provide one of the following:
      a. HLC Sleeve Anchors, by Hilti Fastening Systems, Inc.
      b. Dynabolt Sleeve Anchors, by ITW Red Head.
      c. Or equal.
   3. Anchors shall comply with physical requirements of FS A-A-1922A. Anchors shall be non-bottom bearing type with single-piece steel expansion sleeve providing 360-degree contact with base material, and shall not require oversized holes for installation.
   4. Interior Dry Non-corrosive Locations: Provide carbon steel anchors complete with nuts and washers, zinc plated, in accordance with ASTM B633.
   5. Other Locations: Provide expansion anchors complete with nuts and washers, Type 304 stainless steel, in accordance with ASTM A276 or ASTM A493.

G. Drop-in Expansion Anchors:
   1. General:
      a. Drop-in expansion anchors shall each consist of an internally threaded, deformation-controlled expansion anchor with pre-assembled expander plug.
   2. Products and Manufacturers: Provide one of the following:
      a. HDI Drop-In Anchors, by Hilti Fastening Systems, Inc.
      b. Drop-In Anchor, by Simpson Strong-Tie Company, Inc.
      c. Or equal.
   3. Provide carbon steel anchors complete with nuts and washers, zinc plated, in accordance with ASTM B633, complying with physical requirements of FS

A-A-55614, Type I. Anchors shall be flush or shell type. Provide low-profile anchors for use in precast concrete planks.

H. Concrete Undercut Anchors:
   1. General:
      a. Each concrete undercut anchor shall consist of threaded stud, thick-walled expansion sleeve, expander coupler, and nut and washer. Anchors shall be pre-set type or through-set type, as shown on the Drawings.
   2. Products and Manufacturers: Provide one of the following:
      a. HDA Undercut Anchor, by Hilti Fastening Systems, Inc.
      b. DUC Ductile Undercut Anchor, by USP Structural Connectors.
      c. Or equal
   3. Provide concrete undercut expansion anchors in accordance with ACI 318 Chapter 17. Demonstrate suitability of cracked concrete undercut anchors in accordance with ACI 355.2 prequalification tests.
   4. Installed anchor shall exhibit form fit between bearing elements and the undercut in the concrete.
   5. Interior Dry Non-Corrosive Locations: Provide carbon steel anchors, complete with nuts and washers, zinc plated, in accordance with ASTM B633.
   6. Other Locations: Provide stainless steel anchors, complete with nuts and washers, manufactured of AISI Type 316 stainless steel or materials complying with ISO 3506-1 and having corrosion resistance equivalent to AISI Type 316 stainless steel.
   7. Concrete undercut anchors shall have a current ICC Evaluation Service Report for use in both cracked and uncracked concrete for seismic recognition for seismic design Categories A through F when tested and assessed in accordance with ICC-ES AC193.

I. Drive-In Expansion Anchors:
   1. General:
      a. Drive-In expansion anchors shall each consist of stainless steel drive pin and expanding alloy body.
   2. Products and Manufacturers: Provide one of the following:
      a. Metal HIT Anchor, by Hilti Fastening Systems, Inc.
      b. Zinc Nailon Anchor, by Simpson Strong-Tie Company, Inc.
      c. Or equal.
   3. Provide Type 304 stainless steel drive pin with zinc alloy body. Anchor shall comply with physical requirements of FS A-A-1925A, Type 1.

J. Unless approved by ENGINEER, do not use power-actuated fasteners or other types of bolts and fasteners not specified in this Section.

K. Anti-Seizing Compound:
   1. Products and Manufacturers: Provide one of the following:
      a. Pure Nickel Never-Seez, by Bostik.
      b. Nickel-Graf, by Anti-Seize Technology.

c. Or equal.

2. Provide pure nickel anti-seizing compound.

PART 3 – EXECUTION

3.1 INSPECTION

A. Examine conditions under which materials will be installed and advise ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Anchor Bolts:

1. Provide anchor bolts as shown or indicated in the Contract Documents, or as required to secure structural element to the appropriate anchor surface.
2. Locate and accurately set anchor bolts using templates or other devices as required, prior to placing concrete. Wet setting of anchor bolts is unacceptable.
3. Protect threads and shank from damage during installation and subsequent construction operations.
4. Unless otherwise shown or approved by ENGINEER anchor bolts shall comply with Table 05 05 33-B:

TABLE 05 05 33-B:
SINGLE ANCHOR ALLOWABLE LOADS ON ANCHOR BOLTS [1]

Bolt Diameter (inch)	F1554 Grade 36 F593 Type 316, Condition A				F1554 Grade 55			
	Minimum Embedment (inch)	Minimum Edge Distance and Spacing[2] (inch)	Shear[3,4] (lb)	Tension[3] (lb)	Minimum Embedment (inch)	Minimum Edge Distance and Spacing[2] (inch)	Shear[3] (lb)	Tension[3] (lb)
1/2	6	9	1,262	2,420	8.5	12.75	1,660	3,190
5/8	7.5	11.25	2,010	3,860	10.5	15.75	2,640	5,080
3/4	9	13.5	2,974	5,720	13	19.5	3,910	7,520
7/8	10.5	15.75	4,106	7,890	15	22.5	5,400	10,390
1	12	18	5,386	10,360	17	25.5	7,090	13,450
1 1/8	13.5	20.25	6,787	13,052	19	28.5	8,930	16,580
1 1/4	15	22.5	8,617	16,572	21	31.5	11,340	20,040

Table Notes:

1. Table is based on ACI 318, Chapter 17, f'_c = 4000 psi. Table 05 05 33-B is not applicable to anchor bolts embedded in grouted masonry.
2. Critical edge distance and spacing are indicated in the table. Capacity of anchor bolts for other combination of edge distances and spacing shall be evaluated in accordance with ACI 318, Chapter 17.
3. Values for shear and tension listed are not considered to act concurrently. Interaction of tension and shear will be evaluated by ENGINEER in accordance with ACI 318, Chapter 17.

B. Adhesive Anchors, Undercut Anchors, and Expansion Anchors – General:
   1. Prior to drilling, locate existing reinforcing steel in vicinity of proposed holes. If reinforcing conflicts with proposed hole location, obtain ENGINEER's approval of alternate hole locations to avoid drilling through or damaging existing reinforcing bars.

C. Adhesive Anchors:
   1. Installation conditions shall comply with all requirements of the approved product Evaluation Service Report (ESR), including "Conditions of Use." Comply with manufacturer's written installation instructions and the following.
   2. Drill holes to adhesive system manufacturer's recommended drill bit diameter to the specified depth. Drill holes in hammering and rotation mode with carbide-tipped drill bits that comply with the tolerances of ANSI B212.15. Core-drilled holes are unacceptable.
   3. Before setting adhesive anchor, hole shall be made free of dust and debris by method recommended by adhesive anchor system manufacturer. Hole shall be brushed with adhesive system manufacturer-approved brush and blown clean with clean, dry, oil-free compressed air to remove all dust and loose particles. Hole shall be dry as defined by adhesive system manufacturer.
   4. Before injecting adhesive, obtain ENGINEER's concurrence that hole is dry and free of oil and other contaminants.
   5. Prior to injecting adhesive into the drilled hole, dispense, to a location appropriate for such waste, an initial amount of adhesive from the mixing nozzle, until adhesive is uniform color.
   6. Inject adhesive into hole through injection system-mixing nozzle and necessary extension tubes, placed to bottom of hole. Discharge end shall be withdrawn as adhesive is placed but kept immersed to prevent formation of air pockets. Fill hole to depth that ensures that excess material is expelled from hole during anchor placement.
   7. Twist anchors during insertion into partially-filled hole to guarantee full wetting of rod surface with adhesive. Insert rod slowly to avoid developing air pockets.
   8. Provide adequate curing in accordance to adhesive system manufacturer's requirements prior to continuing with adjoining Work that could place load on installed adhesive anchors. Do not begin adjoining Work until adhesive anchors are successfully tested or when allowed by ENGINEER.
   9. Limitations:
      a. At time of anchor installation, concrete shall have compressive strength (f'c) of not less than 2,500 psi.
      b. At time of anchor installation, concrete shall have age of not less than 21 days.
      c. Installation Temperature: Comply with manufacturer's instructions for installation temperature requirements. Provide temporary protection and other measures, such as heated enclosures, necessary to ensure that

base material temperature complies with anchor systems manufacturer's requirements during installation and curing of adhesive anchor system.

d. Oversized Holes: Advise ENGINEER immediately if size of drilled hole is larger than recommended by anchor system manufacturer. Cost of corrective measures, including but not limited to redesign of anchors due to decreased anchor capacities, shall be paid by CONTRACTOR.

e. Embedment depths shall be based on installation in normal-weight concrete with compressive strength of 2,500 psi when embedded in existing concrete, and 4,000 psi when embedded in new concrete.

D. Expansion Anchors:

1. Comply with expansion anchor manufacturer's written installation instructions and the following:
2. Drill holes using anchor system manufacturer's recommended drill bit diameter and to the specified depth. Drill holes in hammering and rotation mode with carbide-tipped drill bits complying with tolerances of ANSI B212.15. Core drilled holes are unacceptable.
3. Before installing anchor, hole shall be made free of dust and debris by method recommended by anchor system manufacturer. Hole shall be brushed with anchor system manufacturer-approved brush and blown clean with clean, dry, oil-free compressed air to remove all dust and loose particles.
4. Before installing anchor, obtain ENGINEER's concurrence that hole is dry and free of oil and other contaminants.
5. Protect threads from damage during anchor installation. Drive anchors not less than four threads below surface of the attachment. Set anchors to anchor manufacturer's recommended torque using a torque wrench.

E. Concrete Undercut Anchors:

1. Comply with undercut anchor manufacturer's written installation instructions and the following.
2. Protect threads from damage during anchor installation.
3. Drill hole to anchor manufacturer's specified depth and diameter using a drill bit matched to the specific anchor.
4. Before setting the undercut anchor, hole shall be free of dust and debris using method recommended by undercut anchor system manufacturer. Hole shall be blown clean with clean, dry, oil-free compressed air to remove all dust and loose particles.
5. Insert the anchor by hand until anchor reaches bottom of hole.
6. Set anchor in accordance with manufacturer's instructions using anchor manufacturer's specified setting tool.
7. Verify that the setting mark is visible on the threaded rod above the sleeve.
8. Anchor shall be set to manufacturer's recommended torque, using a torque wrench.

F. Anti-Seizing Compound:
   1. Provide anti-seizing compound in accordance with anti-seizing compound manufacturer's installation instructions, at locations indicated in Paragraph 2.1.B of this Section.
   2. Do not use anti-seizing compound at locations where anchor bolt or adhesive anchor will contact potable water or water that will be treated to become potable.

3.3 CLEANING

A. After embedding concrete is placed, remove protection and clean bolts.

3.4 FIELD QUALITY CONTROL

A. Site Tests:
   1. OWNER will employ testing agency to perform field quality tensile testing of production adhesive anchors at the Site, unless otherwise specified.
      a. Testing shall comply with ASTM E488.
      b. Test at least ten percent of each type of adhesive anchors. If one or more adhesive anchors fail the test, CONTRACTOR shall pay cost of testing all anchors of the same type installed in the Work. CONTRACTOR shall be responsible for retesting costs.
      c. ENGINEER will direct which adhesive anchors are to be tested and indicate test load to be used
      d. Apply test loads with hydraulic ram.
      e. Anchors that fail to reach the specified test load, or if the displacement exceeds D/10, where D is nominal diameter of anchor being tested, shall be considered as defective and shall be re-tested at no additional cost to OWNER.
   2. Mechanical Anchors:
      a. Responsibility:
         1) OWNER will employ testing agency to perform field quality control tensile testing of mechanical anchors at the Site.
         2) CONTRACTOR shall demonstrate competence in installing mechanical anchors by performing field quality control tests.
      b. Perform field quality control tests on test anchors at location directed by ENGINEER. Test anchors shall not be part of the finished Work.
      c. Test not less than one installation of each type of mechanical anchor used in the Work.
         1) ENGINEER will indicate test loads to be used.
         2) Testing shall comply with ASTM E488.
         3) Apply test loads with hydraulic ram.
      d. Anchors that fail to reach the specified test load shall be considered as defective and shall be re-tested at no additional cost to OWNER.
      e. Testing agency shall submit test results to CONTRACTOR and ENGINEER within 24 hours of completion of test.

3. Correct defective Work by removing and replacing or correcting, as directed by ENGINEER.
4. CONTRACTOR shall pay for all corrections and subsequent testing required to confirm competence in the installation of post-installed mechanical anchors.
5. Testing agency shall submit test results to CONTRACTOR and ENGINEER within 24 hours of completion of test.

B. Manufacturer's Services:
1. Provide at the Site services of qualified adhesive manufacturer's representative during initial installation of adhesive anchor systems to train CONTRACTOR's personnel in proper installation procedures. Manufacturer's representative shall observe to confirm that installer demonstrates proper installation procedures for adhesive anchors and adhesive material.

+ + END OF SECTION + +

SECTION 05 12 00

STRUCTURAL STEEL FRAMING

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install structural steel framing, including surface preparation and shop priming.
   2. Structural steel framing is the Work defined in AISC 303, Section 2, and as shown or indicated in the Contract Documents. The Work also includes:
      a. Providing openings in and attachments to structural steel framing to accommodate the Work under this and other Sections, and providing for structural steel framing items such as anchorage devices, studs, and all items required for which provision is not specifically included under other Sections.
      b. Providing openings in and attachments to structural steel framing to accommodate the work under other contracts, and assisting other contractors in building on or attaching to the structural steel framing items such as anchorage devices, studs, and all items required for which provision is not specifically included under other contracts.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before structural steel framing Work.
   2. Notify other contractors in advance of installing structural steel to provide other contractors with sufficient time for installing items included in their contracts to be installed with or before structural steel framing Work.

C. Related Sections:
   1. Section 03 00 05, Concrete.
   2. Section 05 05 33, Anchor Systems.
   3. Section 41 22 23, Hoists.
   4. Section 09 91 00, Painting.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. AISC 303, Code of Standard Practice for Steel Buildings and Bridges.
   2. AISC 325, Steel Construction Manual.
   3. AISC 360, Specification for Structural Steel Buildings.
   4. ASME B46.1, Surface Texture (Surface Roughness, Waviness and Lay).

5. ASTM A6/A6M, Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
6. ASTM A36/A36M, Specification for Carbon Structural Steel.
7. ASTM A53/A53M, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
8. ASTM A108, Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
9. ASTM A194/A194M, Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
10. ASTM A325, Specification for Structural Bolts, Steel, Heat-Treated, 120/105 ksi Minimum Tensile Strength.
11. ASTM A500/A500M, Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
12. ASTM A563, Specification for Carbon and Alloy Steel Nuts.
13. ASTM A572/A572M, Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
14. ASTM A992/A992M, Specification for Structural Steel Shapes.
15 ASTM A1085, Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS).
16. ASTM F436, Specification for Hardened Steel Washers.
17. ASTM F593, Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
18. ASTM F959, Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners.
19 ASTM F1852, Specification for "Twist off" Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
20. AWS D1.1/D1.1M, Structural Welding Code-Steel.
21. CMAA 74, Specifications for Top Running & Under Running Single Girder Electric Traveling Cranes Utilizing Under Running Trolley Hoist.
22. ISO 2859-1, Sampling Procedures for Inspection by Attributes -- Part 1: Sampling Schemes Indexed by Acceptance Quality Limit (AQL) for Lot-by-Lot Inspection.
23. ISO 4017, Hexagon Head Screws -- Product Grades A and B.
24. RCSC Specification for Structural Joints Using ASTM A325 or ASTM A490 Bolts.

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Steel Fabricator:
      a. Structural steel fabricating plant shall possess current certificate from AISC stating that the fabrication facility complies with requirements of the AISC Certification program and is designated an AISC Certified Plant, Category BU at time of bid. Fabricating plant shall maintain this certification throughout time of fabrication for this Project.

2. Welders and Welding Processes:
    a. Qualify welding processes and welding operators in accordance with AWS D1.1/D1.1M, Section 5, Qualification.
    b. Each welder employed on or to be employed for the Work shall possess current AWS certification in the welding process with which welder will be working. Certifications shall be current and valid throughout the Work.
3. Surveyor:
    a. Engage a registered professional land surveyor legally qualified to practice in the same jurisdiction as the Site, and experienced in providing surveying services of the kind indicated.
    b. Responsibilities include but are not necessarily limited to:
        1) Performing or supervising performance of field survey work to check lines and elevations of concrete and masonry bearing surfaces, and locations of anchorage devices and similar devices, before steel erection proceeds.
        2) Notifying CONTRACTOR and ENGINEER in writing when surveyed Work does not comply with the Contract Documents.
        3) Submit to CONTRACTOR field survey reports.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
1. Shop Drawings:
    a. Complete details and schedules for fabrication and shop assembly of members and details, schedules, procedures, and diagrams showing proposed sequence of erection. Shop Drawings shall not be reproductions of Contract Drawings.
    b. Include complete information for fabrication of the structure's components, including but not limited to location, type, and size of bolts, details of blocks, copes and cuts, connections, camber, holes, member sizes and lengths, and other pertinent data. Clearly indicate welds using standard AWS notations and symbols, and clearly show or indicate size, length, and type of each weld.
    c. Setting drawings, templates, and directions for installing anchorage devices.
2. Product Data:
    a. Manufacturer's specifications and installation instructions for products listed below.
        1) High-strength bolts of each type, including nuts and washers.
        2) Welding electrodes and rods.
        3) Load indicator bolts and washers.
    b. Hollow structural section cavity connector manufacturer specifications, load tables, dimension diagrams, and acceptable base material conditions. Clearly indicate allowable strength design safety factors when ultimate load carrying capacities are submitted for approval.

3. Samples:
    a. Representative Samples of hollow section steel cavity connectors proposed for use. Review will be for type and finish only. Compliance with other requirements is CONTRACTOR's responsibility.

B. Informational Submittals: Submit the following:
    1. Certificates.
        a. Fabricator's AISC quality certification.
        b. Welders' certifications.
        c. Certified reports of laboratory tests on previously-manufactured, identical materials, and other data as necessary, to demonstrate compliance with the Contract Documents for the materials listed below:
            1) Structural steel of each type, including certified mill reports indicating chemical and physical properties.
            2) High-strength bolts of each type, including nuts and washers.
    2. Supplier Instructions:
        a. Installation data, handling, and storage instructions.
    3. Source Quality Control Submittals:
        a. When performed or when required by ENGINEER, submit results of source quality control testing and inspections performed at the mill or shop.
    4. Field Quality Control Submittals:
        a. Written field survey reports for all bearing surfaces surveyed, verifying tolerance requirements, areas out of tolerance, and corrective measures required.
    5. Qualifications Statements.
        a. Land surveyor.

1.5 DELIVERY, STORAGE AND HANDLING

A. Storage:
    1. Protect steel members and packaged materials from corrosion and deterioration.
    2. Do not store materials in or on the building or structure in manner that may cause distortion or damage to structural steel members, building, or supporting structures.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Steel Types:
    1. W-Shapes and WT-Shapes: ASTM A992/A992M.
    2. S-shapes and Channels: ASTM A572/A572M, Grade 50.

3. Hollow Structural Sections: ASTM A1085 or ASTM A500/A500M, Grade C.
4. Angles, Plates, and Bars: ASTM A36/A36M.
5. Steel Pipe: ASTM A53/A53M, Grade B.

B. Anchorages, Fasteners, and Connectors:
   1. Anchorage Devices: Refer to Section 05 05 33, Anchor Systems.
   2. High-Strength Threaded Fasteners: Heavy hexagonal structural bolts, heavy hexagon nuts, and hardened washers, as follows:
      a. Unless otherwise indicated, fasteners shall be quenched and tempered medium-carbon steel bolts, nuts and washers, complying with ASTM A325, Type I, nuts complying with ASTM A563C, A563DH or A194/A194M 2H, and hardened washers complying with ASTM F436.
      b. Tension control bolts, when used, shall comply with ASTM F1852.
      c. Compressible washer-type direct-tension indicators, when used, shall comply with ASTM F959, Type 325.
   3. Hollow Structural Section (HSS) Cavity Connectors: High-strength fastening system for hollow structural sections, as follows:
      a. General:
         1) Each connector shall be hexagon-headed, expansion anchor for connecting structural steel tubes.
         2) Use hollow structural section cavity connectors only in the sizes and at locations shown or indicated in the Contract Documents.
      b. Products and Manufacturers: Provide one of the following:
         1) Hollo-Bolt, by Lindapter International.
         2) BoxBolt, by Key Safety, Inc.
         3) Or equal.
      c. Materials:
         1) Body/shoulder and wedge manufactured from mild steel bars.
         2) Core bolt manufactured with high tensile steel ISO 4017.
         3) Finish: Hot-dip galvanized.
      d. Test bolts at time of manufacture in accordance with ISO 2859-1. Do not ship bolts that do not successfully pass the test.
   4. Threaded Rod: Provide threaded rods with heavy hexagon nuts, and hardened washers, as follows:
      a. Interior and Dry Locations: Provide threaded carbon steel rods complying with ASTM A36, with heavy hex nuts complying with ASTM A563A, unless otherwise shown or indicated on the Drawings.
      b. Exterior, Buried, or Submerged Locations, or When Exposed to Wastewater: Provide stainless steel threaded rods complete with washers complying with ASTM F593, AISI Type 316, Condition A, with ASTM A194/A194M, Grade 8S (nitronic 60) stainless steel nuts. Other AISI types may be used when approved by ENGINEER.

C. Electrodes for Welding: E70XX complying with AWS D1.1/D1.1M.

2.2 FABRICATION

A. Shop Fabrication and Assembly:
   1. General:
      a. Fabricate and assemble structural assemblies in the shop to greatest extent possible. Fabricate items of structural steel in accordance with AISC 325, the Contract Documents, and as shown on approved Shop Drawings. Provide camber in structural members as shown or indicated.
      b. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence that will expedite erection and minimize handling of materials for storage and minimize handling at the Site.
      c. Where finishing is required, complete the assembly, including welding of units, before commencing finishing operations. Provide finish surfaces of members exposed-to-view in the completed Work that are free of markings, burrs, and other defects.

B. Connections:
   1. Shop Connections:
      a. Unless otherwise shown or indicated, shop connections may be welded or high-strength bolted connections. Welds shall be 3/16-inch minimum.
      b. Shop-welded connections shall be detailed to eliminate or minimize eccentricity in the connection.
      d. End-connection angles fastened to webs of beams and girders, and the thickness of angles, size, and extent of fasteners or shop welds, shall comply with tables of "Framed Beam Connections" in AISC 325. Connections shall be two-sided, unless otherwise shown or indicated.
   2. Field Connections:
      a. Field connections, unless otherwise shown or indicated, shall be made with high-strength bolts, and shall be bearing-type connections.
      b. Use field welding only where shown or indicated or where approved by ENGINEER.
   3. High-Strength Bolted Construction:
      a. Provide high-strength threaded fasteners in accordance with RCSC Specifications for Structural Joints using ASTM A325 or ASTM A490 Bolts.
      b. Bolted connections shown or indicated as "SC" shall comply with slip-critical connection requirements in RCSC Specifications for Structural Joints Using ASTM A325 or ASTM A490 Bolts.
         1) Faying surfaces shall have a Class A surface condition.
         2) Slip-critical bolts shall be fully pre-tensioned to 70 percent of minimum specified tensile strength of the bolt using one of the following methods:
            a) Turn of nut with matchmarking.
            b) Twist-off tension control bolt (ASTM F1852).
            c) Direct tension indicator washer (ASTM F959).

c. Minimum bolt diameter shall be 3/4-inch, unless otherwise shown or indicated.

4. Welded Construction: Comply with AWS D1.1/D1.1M for procedures, appearance, and quality of welds, and methods used in correcting defective welding Work.
   a. Assemble and weld built-up sections by methods that produce true alignment of axes without warp.

C. Bracing:
   1. Bracing for which stress is not shown or indicated shall have minimum two-bolt connection, or shop-welded connection of equivalent strength.
   2. Vertical bracing and knee braces connecting to columns shall be on the centerline of columns, unless otherwise shown or indicated.
   3. Knee braces shall be at 45-degree angle, unless otherwise shown or indicated.
   4. Gussets shall be not less than 3/8-inch thick, unless otherwise shown or indicated.

D. Columns: Column shafts shall have finished bearing surface roughness not greater than 500 micro-inch in accordance with ASME B46.1, and ends shall be square within tolerances for milled ends in accordance with ASTM A6/A6M at the base and at splice lines.

E. Structural Tubing: Properly seal structural tubing to protect internal surfaces.

F. Monorail:
   1. Hoist beam splices shall be smooth and positive, and shall keep the track in perfect alignment horizontally and vertically. Top joint plate shall keep the splice from spreading and develop full strength at the splice. Locate splice as close as possible to track support.
   2. Coordinate monorail Work with equipment and materials under Section 41 22 23, Hoists.

G. Holes and Appurtenances for Other Work:
   1. Provide holes required for securing other work to structural steel framing, and for passage of other work through steel framing members, as shown on the approved Shop Drawings. If large block-outs are required and approved, reinforce the webs to develop specified shears. Provide threaded nuts welded to framing and other specialty items as shown or indicated to receive other work.
   2. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame-cut holes or enlarge holes by burning. Drill holes in bearing plates.

2.3 FINISHING

A. Surface Preparation and Shop Priming: Structural steel shall be primed in the shop. For surface preparation and shop priming requirements refer to Section 09 91 00, Painting.

2.4 SOURCE QUALITY CONTROL

A. Inspection and Testing at the Mill or Shop:
   1. Perform fabricator's standard procedures for source quality control, including inspections and testing.
   2. Materials and fabrication procedures shall be subject to inspection and tests in mill and shop, conducted by a qualified inspection laboratory. Such inspections and tests do not relieve CONTRACTOR of responsibility for providing the Work in accordance with the Contract Documents.

PART 3 – EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which the Work will be performed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 ERECTION

A. General: Comply with AISC 303, AISC 360, and the Contract Documents.

B. Checking of Lines and Elevations: Before proceeding with structural steel erection, furnish services of a qualified surveyor to check lines and elevations of concrete and masonry bearing surfaces, and locations of anchorage devices and similar devices. Immediately report discrepancies to ENGINEER. Do not proceed with erection until defective Work that will support structural steel is corrected, including agreeing with ENGINEER upon compensating adjustments (if any) to structural steel Work.

C. Temporary Shoring and Bracing: Provide temporary shoring and bracing members with connections of sufficient strength to bear imposed loads. Remove temporary members and connections when permanent members are in place and final connections are made. Provide temporary guy-lines to achieve proper alignment of structures as erection proceeds.

D. Temporary Planking: Provide temporary planking and working platforms as necessary to effectively complete the Work. Provide sufficient planking to comply with Laws and Regulations, and provide tightly-planked substantial floor within two stories or 30 feet, whichever is less, below each tier of steel beams on which work is performed.

E. Anchorage Devices:
   1. Provide anchorage devices, including anchor bolts, and other connectors required for securing structural steel to foundations and other in-place construction.
   2. Provide templates and other devices necessary for presetting anchorage devices to accurate locations.
   3. Refer to Section 05 05 33, Anchor Systems, for anchorage requirements.

F. Setting Bases and Bearing Plates:
   1. Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean bottom surface of base and bearing plates.
   2. Set loose and attached base plates and bearing plates for structural members on steel wedges or other adjusting devices.
   3. Tighten anchorage devices after supported members are positioned and plumbed. Do not remove wedges or shims, but if protruding, cut off flush with edge of base or bearing plate prior to packing with grout.
   4. Place grout between bearing surfaces and bases or plates in accordance with Section 03 00 05, Concrete. Finish exposed surfaces, protect installed materials, and allow to cure in accordance with grout manufacturer's instructions, and as otherwise required.
   5. Do not use leveling plates or wood wedges.

G. Field Assembly:
   1. Set structural frames accurately to the lines and elevations shown and indicated. Align and adjust the various members forming part of a complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
   2. Level and plumb individual members of structure within tolerances as specified in AISC 325.
   3. Splice members only where shown or indicated.

H. Connections:
   1. Comply with AISC 325 for bearing, adequacy of temporary connections, alignment, and the removal of paint on surfaces adjacent to field welds.
   2. Do not enlarge inadequate holes in members by burning or by using drift pins, except in secondary bracing members. Ream holes that must be enlarged to admit bolts.
   3. Hollow Structural Section Cavity Connectors:
      a. Comply with manufacturer's written installation instructions and the following.
      b. Cavity Connectors shall be torqued in accordance with manufacturer's instructions.

I. Gas Cutting: Do not use gas-cutting torches for correcting fabrication defects in structural framing. Cutting will be allowed only on secondary members that are not under stress, as approved by ENGINEER. Finish gas-cut sections equal to a sheared appearance, when allowed.

J. Monorail Beams:
   1. Provide crane stops and other required items. Set runway girders straight and level, and to tolerances specified in CMAA 74.

K. Touch-up Painting:
   1. Unless otherwise specified, comply with touch-up painting requirements in Section 09 91 00, Painting.
   2. Immediately after erection, clean field welds, bolted connections, and damaged or abraded areas of shop-applied paint. Apply paint to exposed areas with the same paint or coating material applied in the shop. Apply by brush or spray to provide not less than the dry film thickness specified in Section 09 91 00, Painting.

3.3 FIELD QUALITY CONTROL

A. Site Tests and Inspections: Materials and erection procedures shall be subject to inspection and tests at the Site conducted by qualified inspection laboratory. Such inspections and tests do not relieve CONTRACTOR of responsibility for providing the Work in accordance with the Contract Documents.
   1. OWNER will engage independent testing and inspection laboratory to inspect high-strength bolted connections and welded connections and to perform tests and prepare test reports.
      a. Testing laboratory shall conduct and interpret tests, prepare and state in each report of results whether test specimens comply with the Contract Documents and specifically indicate all deviations.
      b. High-strength Bolted Connections: Each high-strength bolted connection shall be visually inspected. Inspection shall identify whether the Work complies with Sections 9.1, 9.2 and 9.3 of RCSC Specifications for Structural Joints Using ASTM A325 or A490 Bolts.
         1) For connections that are slip-critical, inspector shall verify that the faying surfaces meet the requirements of section 3.2.2 of the RCSC Specification.
         2) For connections that are slip-critical or pre-tensioned, inspector shall verify proper pre-tensioning.
         3) For connections that are snug tight, bolt does not need to be inspected for bolt tension, but shall be visually inspected to verify that plies of connected elements are in snug contact.
         4) Where bolts or connections are defective, correct defective workmanship, remove and replace, or correct as required defective bolts and connections. CONTRACTOR shall pay for correcting defective Work and tests required to confirm integrity of corrected Work.

c. Welds: Each weld shall be visually inspected.
   1) Where visually defective welds are evident, further test welds using non-destructive methods. If welds are determined to be acceptable, OWNER will pay for non-destructive testing. When welds are defective, CONTRACTOR shall pay for non-destructive testing.
   2) Correct, or remove and replace, defective Work as directed by ENGINEER.
   3) CONTRACTOR shall pay for corrections and subsequent tests required to determine weld compliance with the Contract Documents.

+ + END OF SECTION + +

SECTION 05 50 13

MISCELLANEOUS METAL FABRICATIONS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish miscellaneous metal fabrications including surface preparation and shop priming.
   2. The Work also includes:
      a. Providing openings in miscellaneous metal fabrications to accom-modate the Work under this and other Sections, and attaching to miscellaneous metal fabrications all items such as sleeves, bands, studs, fasteners, and all items required for which provision is not specifically included under other Sections.
      b. Providing openings in and attachments to miscellaneous metal fabrications to accommodate the work under other contracts, and assisting other contractors in building on or attaching to miscellaneous metal fabrications items such as bands, fasteners, and studs, and providing all items required for which provision is not specifically included under other contracts.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate the Work to be installed with, or attached to miscellaneous metal fabrications Work.
   2. Notify other contractors in advance of installing miscellaneous metal fabrications Work to provide other contractors with sufficient time for installing items included in their contracts that are to be installed in conjunction with or before miscellaneous metal fabrications Work.
   3. Hot-dip Galvanizing: Coordinate with steel fabricator detailing for and fabrication of assemblies to be hot-dip galvanized, to minimize distortion during galvanizing process.

C. Related Sections:
   1. Section 03 00 05, Concrete.
   2. Section 05 05 33, Anchor Systems.
   3. Section 05 52 15, Aluminum Handrails and Railings.
   4. Section 05 53 16, Aluminum Grating.
   5. Section 09 91 00, Painting.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. ANSI A14.3, Ladders – Fixed –Safety Requirements.
   2. ASTM A36/A36M, Specification for Carbon Structural Steel.
   3. ASTM A53/A53M, Specification for Pipe Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
   4. ASTM A123/A123M, Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   5. ASTM A153/A153M, Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   6. ASTM A240/A240M, Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels and for General Applications.
   7. ASTM A384/A384M-02 Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies.
   8. ASTM A500, Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
   9. ASTM A572/A572M, Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
   10. ASTM A1085, Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS).
   11. ASTM A992/A992M, Specification for Structural Steel Shapes.
   12. ASTM B209, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
   13. ASTM B211, Specification for Aluminum and Aluminum-Alloy Bar, Rod and Wire.
   14. ASTM B308/B308M, Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
   15. ASTM B429, Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
   16. ASTM F593, Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
   17. AWS D1.1/D1.1M, Structural Welding Code – Steel.
   18. AWS D1.2/D1.2M, Structural Welding Code – Aluminum.
   19. AWS D1.6/D1.6M, Structural Welding Code – Stainless Steel.
   20. NAAMM, Metal Finishes Manual.

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Welding:
      a. Qualify welding processes and welding operators in accordance with AWS D1.1/D1.1M, D1.2/D1.2M, or D1.6/D1.6M, as applicable.
      b. When requested by ENGINEER, provide certification that each welder employed on or to be employed for the Work have satisfactorily passed AWS qualification tests. Ensure that all certifications are current.

B. Regulatory Requirements: Conform to the following:
   1. 29 CFR 1910, Occupational Health and Safety Standards.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Fabrication and erection details for assemblies of miscellaneous metal Work. Include plans, elevations, and details of sections and connections. Show anchorage and accessory items. Include setting drawings and templates for locating and installing miscellaneous metal items and anchorage devices.
   2. Product Data:
      a. Copies of manufacturer's specifications, load tables, dimension diagrams, anchor details, and installation instructions for products to be used in miscellaneous metal Work.
   3. Samples:
      a. Sets of representative Samples of materials including nosings, rungs, and other finished products as requested by ENGINEER. ENGINEER's review will be for color, texture, style, and finish only. Compliance with other requirements is exclusive responsibility of CONTRACTOR.

B. Informational Submittals: Submit the following:
   1. Test and Evaluation Reports:
      a. Mill test report that indicate chemical and physical properties of each type of material, when requested by ENGINEER.
   2. Qualifications Statements:
      a. Copies of welder's certifications, when requested by ENGINEER.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packing, Shipping, Handling and Unloading:
   1. Deliver products to Site to ensure uninterrupted progress of the Work. Deliver anchorage materials to be embedded in other construction in ample time to prevent delaying the Work.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Steel:
   1. W-Shapes and WT-Shapes: ASTM A992/A992M.
   2. S-Shapes and Channels: ASTM A572/A572M, Grade 50.
   3. Hollow Structural Sections: ASTM A1085 or ASTM A500/A500M, Grade C.
   4. Angles, Plates, Bars: ASTM A36/A36M.

5. Steel Pipe: ASTM A53/A53M, Grade B.

B. Aluminum:
   1. Aluminum Shapes: ASTM B308/B308M, Alloy 6061-T6, ASTM B 221, Alloy 6061-T6.
   2. Aluminum Tubes and Pipes: ASTM B429, Alloy 6061-T6.
   3. Aluminum Bars and Rod: ASTM B211, Alloy 6061-T6.
   4. Aluminum Plates: ASTM B209, Alloy 6061-T6.

C. Stainless Steel:
   1. Plates and Sheets: ASTM A240/A240M, Type 304L or Type 316 stainless steel.
   2. Submerged or Intermittently Submerged: Type 316 stainless steel.
   3. Non-submerged: Type 304L stainless steel.

D. Stainless Steel Fasteners: ASTM F593, Type 304 or Type 316, condition CW.

E. Zinc-coated Hardware: ASTM A153/A153M.

2.2 MISCELLANEOUS METAL ITEMS

A. Shop Assembly:
   1. Pre-assemble items in the shop to the greatest extent possible to minimize field-splicing and field-assembly of units at the Site. Disassemble units only to extent necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Aluminum Ladders:
   1. Fabricate ladders for locations shown or indicated with dimensions, spacing, details, and anchorages as shown and specified. Comply with OSHA 29 CFR 1910 and ANSI A14.3, except as otherwise shown or specified.
      a. Unless otherwise shown, provide 1.5-inch diameter continuous side rails, spaced at least 1.5 feet apart.
      b. Provide extruded square rungs, spaced maximum of 12 inches on centers, with non-slip surface on top of each rung. Adhesive strips for non-slip surfaces are not acceptable.
   2. Fit rungs in centerline of side rails, plug weld, and grind smooth on outer rail faces.
   3. Support each ladder at top and bottom and at intermediate points spaced not more than five feet on centers.
   4. Use welded or bolted brackets, designed for adequate support and anchorage, and to hold ladder clear of wall surface with minimum of seven inches between wall and centerline of rungs.
   5. Unless otherwise shown or approved by ENGINEER, extend rails 3.5 feet above top rung, and return rails to wall or structure, unless other secure handholds are provided. If adjacent structure does not extend above top rung, goose-neck extended rails back to structure to provide secure ladder access.

6. Use extruded aluminum conforming to alloy and temper 6061-T6.

C. Miscellaneous Framing and Supports:
   1. Provide miscellaneous metal framing and supports that are not part of structural steel framework and are required to complete the Work.
   2. Fabricate miscellaneous units to sizes, shapes, and profiles shown on the Drawings or, if not shown, of required dimensions to receive adjacent grating, plates, tanks, doors, and other work to be retained by the framing.
   3. Except as otherwise shown, fabricate from structural shapes, plates, and bars, of all-welded construction using mitered corners, welded brackets, and splice plates and minimum number of joints for field connection.
   4. Cut, drill, and tap units to receive hardware and similar items to be anchored to the Work.
   5. Furnish units with integrally welded anchors for casting into concrete or building into masonry. Furnish inserts if units are to be installed after concrete is placed.
      a. Except as otherwise shown, space anchors, 2.0 feet on centers, and provide units the equivalent of 1.25-inch by 1/4-inch by eight-inch strips.
      b. Galvanize exterior miscellaneous frames and supports.
      c. Where shown or indicated, galvanize miscellaneous frames and supports that are not to be installed outdoors.
   6. Miscellaneous steel framing and supports shall be hot-dip galvanized and finish-painted, unless otherwise shown or indicated.
   7. For railings, refer to Section 05 52 15, Aluminum Handrails and Railings.
   8. For grating requirements refer to Section 05 53 16, Aluminum Grating.
   9. Surface preparation and painting of galvanized surface shall conform to Section 09 91 00, Painting.

D. Fasteners and Hardware: Provide Type 316 stainless steel fasteners for aluminum fabrications and zinc-coated hardware for galvanized fabrications, unless otherwise shown or specified.

E. Anchors and Expansion Anchors: Refer to Section 05 05 33, Anchor Systems.

2.3 FINISHING

A. Surface Preparation and Shop Priming: Perform surface preparation and apply primer coat to miscellaneous metal fabrications in the shop. Conform to surface preparation and shop priming requirements in Section 09 91 00, Painting.

B. Galvanizing:
   1. Galvanizing of fabricated steel items shall comply with ASTM A123/A123M.
   2. Details of fabrication of steel items and assemblies to be hot-dip galvanized shall conform to recommendations of ASTM A384/A384M to minimize the potential for distortion.

C. Aluminum Finish: Provide an Architectural Class 1 anodized finish, AA-M32C22-A41, Clear, as specified in NAAMM Metal Finishes Manual.

2.4 SOURCE QUALITY CONTROL

A. Tests and Inspections:
   1. Materials and fabrication procedures shall be subject to inspection and tests in the mill, shop, and field, conducted by a qualified inspection agency. Such inspections and tests will not relieve CONTRACTOR of responsibility for providing materials and fabrication procedures complying with the Contract Documents.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine conditions under which the Work is to be performed and notify ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Install miscellaneous metal fabrications accurately in location, alignment, and elevation, plumb, level, true, and free of rack, measured from established lines and levels. Brace temporarily or anchor temporarily in formwork where fabrications are to be built into concrete, masonry, or other construction.

B. Anchor securely as shown and as required for the intended use, using concealed anchors where possible.

C. Fit exposed connections accurately together to form tight, hairline joints. Field-weld steel connections that are not to be exposed joints and cannot be shop-welded because of shipping size limitations. Comply with AWS D1.1/D1.1M, D1.2/D1.2M and D1.6/D1.6M, as applicable to the material being welded. Grind steel joints smooth and touch-up shop paint coat. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication, and are intended for bolted or screwed field connections.

D. Protection of Aluminum from Dissimilar Materials:
   1. Coat surfaces of aluminum that will contact dissimilar materials such as concrete, masonry, and steel, in accordance with Section 09 91 00, Painting.

+ + END OF SECTION + +

SECTION 05 52 15

ALUMINUM HANDRAILS AND RAILINGS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, tools, equipment, and incidentals as shown, specified, and required to furnish and install aluminum handrail and railing systems. The Work also includes:
      a. Providing openings in, and attachments to, aluminum handrail and railing systems to accommodate the Work under this and other Specification Sections. Provide all items for aluminum handrails and railings, including anchorages, fasteners, studs, and other items required for which provision for is not specifically included under other Sections.
      b. Provide openings in and attachments to aluminum handrails and railings to accommodate work under other contracts. Assist other contractors in building on or attaching to aluminum handrails and railings all items such as fasteners and other items required for which provision is not specifically included under other contracts.
   2. Aluminum handrails and railings Work shall include components and features shown and specified, and all components and features available from specified manufacturers required for providing complete aluminum handrail and railing system in accordance with the Contract Documents.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before aluminum handrails and railings Work.
   2. Notify other contractors in advance of installing aluminum handrail and railings to provide them with sufficient time to install items included in their contracts that are to be installed with or before aluminum handrails and railings Work.
   3. Aluminum handrail and railing locations shall conform with Laws and Regulations.

C. Related Sections:
   1. Section 05 05 33, Anchor Systems.
   2. Section 09 91 00, Painting.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. Aluminum Association (AA), Aluminum Design Manual.

2. ASTM B26/B26M, Specification for Aluminum-Alloy Sand Castings.
3. ASTM B117, Standard Practice for Operating Salt Spray (Fog) Apparatus.
4. ASTM B136, Standard Method for Measurement of Stain Resistance of Anodic Coatings on Aluminum.
5. ASTM B137, Standard Test Method for Measurement of Coating Mass per Unit Area on Anodically Coated Aluminum.
6. ASTM B241/B241M, Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube.
7. ASTM B244, Standard Test Method for Measurement of Thickness of Anodic Coatings on Aluminum and of Other Nonconductive Coatings on Nonmagnetic Basis Metals with Eddy-Current Instruments.
8. ASTM B247, Specification for Aluminum and Aluminum-Alloy Die Forgings, Hand Forgings, and rolled Ring Forgings.
9. ASTM B429, Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
10. ASTM F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
11. NAAMM/Architectural Metal Products Division (AMP), Pipe Railing Manual.
12. NAAMM/AMP AMP 501 Finishes for Aluminum.

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer:
      a. Manufacturer shall be able to document at least five years successful experience in fabricating aluminum handrail and railing systems of scope and type similar to that required.
   2. Installer Qualifications:
      a. Retain a single installer trained and with record of successful experience in installing aluminum handrail and railing systems.
      b. Installer shall have record of successfully installing aluminum handrail and railing systems in accordance with recommendations and requirements of manufacturer, or shall provide evidence of being acceptable to the manufacturer.
      c. Installer shall employ only tradesmen with specific skill and successful experience in the type of Work required.
      d. When requested by ENGINEER, submit name and qualifications of installer with the following information for at least three successful, completed projects:
         1) Names and telephone numbers of owner and architect or engineer responsible for each project.
         2) Approximate contract cost of the aluminum handrail and railing systems for which installer was responsible.
         3) Amount (linear feet) of aluminum handrail and railing installed.

B. Component Supply and Compatibility:
   1. Obtain all products included in this Section regardless of component manufacturer, from a single aluminum handrail and railing system manufacturer.
   2. Aluminum handrail and railing system manufacturer shall review and approve or prepare all Shop Drawings for all components furnished under this Section.
   3. Components shall be specifically constructed for specified service conditions and shall be integrated into overall assembly by aluminum handrails and railings manufacturer.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Drawings for fabrication and installation of aluminum handrail and railing systems with sizes of members, pipe wall thickness, information on components, and anchorage devices. Show all anchorages. Provide details drawn at scale of 1.5-inch equal to one foot.
      b. Indicate required location of posts.
      c. Indicate locations and details of all expansion joints, if any.
      d. Indicate locations and details of gaps across seismic joints, if any.
      e. Profile drawings of aluminum handrail and railing system components.
      f. Custom detail drawings. Details of forming, jointing, sections, connections, internal supports, trim and accessories. Provide details drawn at scale of 1.5-inch equal to one foot.
   2. Product Data:
      a. Manufacturer's specifications, standard detail drawings, and installation instructions for aluminum handrail and railing systems.
      b. Manufacturer's catalogs showing complete selection of standard and custom components and miscellaneous accessories for selection by ENGINEER.
   3. Samples:
      a. Full-size Sample, 2.0 feet long, of assembled railing system at post and rail intersections. Sample shall have all associated components including typical connections, mounted toeboard and sleeve, and handrail at wall return, complete with mounting brackets, all with specified controlled uniform metal finish.
      b. Samples will be reviewed for finish, color, joint tolerances, workmanship, and general component assembly only. Compliance with other requirements is the responsibility of the CONTRACTOR.

B. Informational Submittals: Submit the following:
   1. Qualifications Statements: Submit qualifications for the following:
      a. Manufacturer, when requested by ENGINEER.
      b. Installer, when requested by ENGINEER. Qualifications statement shall include record of experience with references specified.

C. Closeout Submittals: Submit the following:
   1. Maintenance Manuals: Furnish detailed maintenance manuals that include the following:
      a. Product name and number.
      b. Detailed procedures for routine maintenance and cleaning, including cleaning materials, application methods and precautions in use of products that may be detrimental to finish when improperly applied.
      c. Handrail and railings systems manufacturer's current catalog including individual parts.

1.5 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, and Unloading:
   1. Prior to shipping, completely inspect products to assure that components are complete and comply with requirements of Contract Documents and recommendations of manufacturer. Box or crate products as required to prevent damage during shipment.
   2. Deliver products to Site to ensure uninterrupted progress of the Work. Deliver anchorage products that are to be embedded in concrete in ample time to prevent delaying the Work.
   3. Inspect all boxes, crates, and packages upon delivery to Site and notify ENGINEER in writing of loss or damage to products. Promptly remedy loss and damage to new condition per manufacturer's instructions.
   4. Conform to Section 01 65 00, Product Delivery Requirements.

B. Storage and Protection:
   1. Keep products off ground using pallets, platforms, or other supports. Protect products from corrosion and deterioration.
   2. Conform to Section 01 66 00, Product Storage and Handling Requirements.

C. Handling of Products:
   1. Do not subject handrail and railing products to bending or stress.
   2. Do not damage edges or handle products in a manner that will cause scratches, warping, or dents.
   3. Protect handrails and railings by paper or coating as acceptable to handrail and railing manufacturer, against scratching, splashes of mortar, paint, and other marring during transportation, handling, and erection. Protect until completion of adjacent work.

PART 2 – PRODUCTS

2.1 SYSTEM PERFORMANCE

A. System Description: Aluminum handrail and railing system shall consist of 2 equally spaced horizontal rails with totally concealed mechanical fasteners, internally threaded tubular rivets and components fastened to posts spaced no

more than 4 feet on center and system of handrails supported from adjacent construction by mounting brackets spaced at no more than 4 feet on center.

B. Performance Criteria:
   1. Maintain the visual design concept shown, and the technical requirements specified, including modules, profiles, alignment of components and requirements for finish.
   2. Thermal Control: Provide adequate expansion within fabricated systems that allows for thermal expansion and contraction caused by material temperature change of 140 degrees F to -20 degrees F without warp or bow of system components. Distance between expansion joints shall be based on providing 1/4-inch wide joint at 70 degrees F, which accommodates movement of 150 percent of calculated amount of movement for specified temperature range.
   3. Where handrail and railing systems cross expansion joints in the building or structure, provide expansion joints in handrail and railings systems.
   4. For posts located at or near end of runs as shown, uniformly space intermediate posts at intervals not greater than maximum post spacing specified. Where posts are shown for handrails along both sides of walkways and other similar locations, locate posts opposite each other; do not stagger post locations.

2.2 MANUFACTURERS

A. Products and Manufacturers: Provide one of the following:
   1. Interna-Rail Component System by Wagner Collaborative Metal Works.
   2. Or Equal.

2.3 MATERIALS

A. Aluminum Forgings: ASTM B247.

B. Extruded or Drawn Aluminum Pipe and Tube:
   1. ASTM B429 or ASTM B241, Alloy 6061-T6, 6063-T6, or 6063-T5 as shown.
   2. Provide Schedule 40 pipe for rails and schedule 80 pipe for posts.
   3. Provide all rails and posts with minimum outside diameter of 1.900-inches.

C. Anchors and Fastenings:
   1. Type 304 stainless steel, conforming to ASTM F593; minimum 1/2-inch diameter.
   2. Provide minimum of four bolt fasteners per post where top or side mounted posts are shown. Components shall be in accordance with manufacturer's recommendations and as approved or accepted (as applicable) by ENGINEER on submittals.
   3. Anchors: As specified in Section 05 05 33, Anchor Systems.

D. Castings:
   1. Provide high strength aluminum alloy brackets, flanges, and fittings suitable for anodizing as specified.
   2. Aluminum alloy sand castings: ASTM B26/B26M.

E. Connector Sleeves: Schedule 40, 6 inches long by 1.61 inch diameter.

F. Brackets and Flanges: Provide manufacturer's complete selection of standard and custom brackets and flanges for railing system posts and for handrail supports.

G. Toe Boards:
   1. Provide extruded Alloy 6063-T5 or T52 aluminum alloy toe boards, unless railing is mounted on curbs or other construction of sufficient height and type to conform to OSHA 1910.23. Bars or plates are not acceptable.
   2. Unless otherwise specified, toeboards shall conform to requirements of OSHA 1910.23, Section (e).

H. System Components and Miscellaneous Accessories: Provide complete selection of manufacturer's standard and custom aluminum handrail and railing systems components and miscellaneous accessories required. Show type and location of all such items on Shop Drawings and other submittals as applicable.

2.4 FABRICATION

A. General: Unless otherwise shown or specified, provide typical non-welded construction details and fabrication techniques recommended in NAAMM/AMP Pipe Railing Manual and NAAMM/AMP AMP 501.

B. Fabricate handrail and railing systems true to line and level, with accurate angles surfaces and straight edges. Form bent metal corners to the radius shown without causing grain separation or otherwise impairing the Work. Form elbow bends and wall returns to uniform radius, free from buckles and twists, with smooth finished surfaces, or use prefabricated bends. Provide not less than four-inch outside radius.

C. Remove burrs from exposed edges.

D. Locate intermediate rails equally spaced between top rail and finished floor.

E. Close aluminum pipe ends by using prefabricated fittings.

F. Weep Holes:
   1. Fabricate joints that will be exposed to weather to exclude water.
   2. Provide 15/64-inch diameter weep holes at lowest possible point on each post in handrail and railing systems.
   3. Provide pressure relief holes at closed ends of handrail and railing systems.

G. Toe Boards:
   1. Provide manufacturer's standard toe board, which accommodates movement caused by thermal change specified without warping or bowing toe boards.
   2. Coordinate and cope toe board as required to accommodate flanges at posts.
   3. Toe boards shall follow curvature of railing. Where railing is shown to have curved contours at corners, or other locations, toe board shall likewise be curved to follow line of railing system.

H. Mechanically Fitted Component Pipe Handrail and Railing System:
   1. Use non-welded pipe handrail and railing system with posts, top and intermediate rails, and flush joints.
   2. Provide top and one intermediate horizontal rail, equally spaced.
   3. Use Type 304/305 stainless steel blind rivets, stainless steel through-bolts with lock nuts and Type 304/305 stainless steel self-tapping screws in assembling components of the Work.

2.5 FINISHES

A. General:
   1. Prepare surfaces for finishing in accordance with recommendation of aluminum producer and the finisher or processor.
   2. Adjust and control direction of mechanical finishes specified to achieve best overall visual effect in the Work.
   3. Color and Texture Tolerance: Provide uniform color and continuous mechanical texture for aluminum components. ENGINEER reserves the right to reject aluminum materials because of color or texture variations that are visually objectionable, but only where variation exceed range of variations established by manufacturer prior to fabrication, by means of range of Samples approved by ENGINEER.
   4. Anodize aluminum components.

B. Provide non-etching chemical cleaning by immersing aluminum in inhibited chemical solution, as recommended by coating applicator, to remove lard oil, fats, mineral grease, and other contamination detrimental to providing specified finishes.
   1. Clean and rinse with water between steps as recommended by aluminum manufacturer.

C. Exposed Aluminum Anodic Coating: Provide anodic coatings as specified that do not depend on dyes, organic or inorganic pigments, or impregnation processes to obtain color. Apply coatings using only the alloy, temperature, current density, and acid electrolytes to obtain specified colors in compliance with designation system and requirements of NAAMM/AMP Pipe Railing Manual and NAAMM/AMP AMP 501. Comply with the following:
   1. Provide Architectural Class I high density anodic treatment by immersing the components in tank containing solution of 15 percent sulfuric acid at 70 degrees F with 12 amperes per square foot of direct current for minimum of sixty minutes; AA Designation A41.

2. Physical Properties:
    a. Anodic Coating Thickness, ASTM B244: Minimum of 0.7-mils thick.
    b. Anodic Coating Weight, ASTM B137: Minimum of 32 mg/sq. in.
    c. Resistance to Staining, ASTM B136: No stain after five minutes dye solution exposure.
    d. Salt Spray, ASTM B117: 30,000 hours exposure with no corrosion or shade change.
3. Seal finished anodized coatings using deionized boiling water to seal pores and prevent further absorption.
4. Products and Manufacturers: Provide one of the following:
    a. Alumilite 215 Clear by Aluminum Company of America, Inc.
    b. Or equal.

2.6 SOURCE QUALITY CONTROL

A. Allowable Tolerances:
1. Limit variation of cast-in-place inserts, sleeves and field-drilled anchor and fastener holes to the following:
    a. Spacing: Plus-or-minus 3/8-inch.
    b. Alignment: Plus-or-minus 1/4-inch.
    c. Plumbness: Plus-or-minus 1/8-inch.
2. Minimum Handrails and Railings Systems Plumb Criteria:
    a. Limit variation of completed handrail and railing system alignment to 1/4-inch in 12.0 feet with posts set plumb to within 1/16-inch in 3.0 feet.
    b. Align rails so variations from level for horizontal members and from parallel with rake of stairs and ramps for sloping members do not exceed 1/4-inch in 12.0 feet.
3. Provide “pencil-line” thin butt joints.

PART 3 – EXECUTION

3.1 INSPECTION

A. Examine conditions under which Work is to be performed and notify ENGINEER, in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with installation until unsatisfactory conditions are corrected.

B. Verify to ENGINEER gauge of aluminum pipe railing posts and rails brought to the Site by actual measurement of on-Site material in presence of ENGINEER.

3.2 INSTALLATION

A. General:
1. Do not erect components that have become scarred, dented, chipped, discolored, otherwise damaged or defaced. Remove from Site railing and handrail system components that have holes, cuts, gouges, deep scratches, or

dents of any kind. Repairs to correct such Work will not be accepted. Remove and replace with new material.

2. Comply with installation and anchorage recommendations of NAAMM/AMP Pipe Railing Manual and NAAMM/AMP AMP 501 in addition to requirements specified and approved or accepted (as applicable) submittals.

B. Fastening to In-Place Construction:
   1. Remove protective plastic immediately before installing.
   2. Adjust handrails and railings prior to securing in place, to ensure proper matching at butting joints and correct alignment throughout their length. Plumb posts in each direction. Secure posts and rail ends to building or structure as follows:
      a. Anchor posts to concrete by means of 4-bolt floor flanges or side mount sleeve brackets anchored into the concrete using stainless adhesive anchors.
      b. Anchor posts to stair stringers with side mount sleeve brackets.
      c. Side-mount posts by fastening them securely in brackets attached to steel or concrete fascia as shown and in accordance with approved or accepted (as applicable) submittals.
   3. Use devices and fasteners recommended by handrail and railing systems manufacturer and as shown on approved or accepted (as applicable) submittals.

C. Cutting, Fitting and Placement:
   1. Perform cutting, drilling and fitting required for installation. Set the Work accurately in location, alignment, and elevation, plumb, level, true, and free of rack, measured from established lines and levels.
   2. Fit exposed connections accurately together to form tight hairline joints. Do not cut or abrade surfaces of units that have been finished after fabrication, and are intended for field connections.
   3. Make permanent field splice connections using stainless steel blind rivets and 6 inch minimum length connector sleeves. Tight press-fit field splice connectors and install in accordance with manufacturer's written instruction. Install two blind rivets per joint on 180-degree centers.
   4. Make splices as near as possible to posts, but not exceeding 12.0 inches from nearest post.
   5. Field welding is not allowed. Make splices using pipe splice lock employing a single allen screw to lock joint.
   6. Provide hinged gates as shown.
   7. Provide chain sections as shown. Provide one chain length with fastening accessories for top and each intermediate rail.
   8. Secure handrails to walls with wall brackets and end fittings as shown. Drill wall plate portion of the bracket to receive one bolt, unless otherwise shown for concealed anchorage. Locate brackets as shown or, if not shown, at no more than 4 feet on center. Provide flush type wall return fittings with same projection shown for wall brackets. Secure wall brackets and wall return fittings to building or structure. Refer to Section 05 05 33, Anchor Systems.

9. Securely fasten toe boards in place with not more than 1/4-inch clearance above floor level.

D. Fastening to Existing Construction:
   1. Provide heavy-duty floor flange and anchorage devices and fasteners where necessary for securing handrail and railing systems components to existing construction; including stainless steel threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts and other connectors as required. Refer to Section 05 05 33, Anchor Systems.
   2. Use devices and fasteners recommended by handrail and railing systems manufacturer and as shown on approved or accepted (as applicable) submittals.

E. Expansion Joints:
   1. Provide slip joint with internal sleeve extending 2.0-inch minimum, beyond joint on each side.
   2. Construct expansion joints as for field splices, except fasten internal sleeve securely to one side of rail only.
   3. Locate joints within six inches of posts.

F. Protection from Dissimilar Materials:
   1. Coat aluminum surfaces in contact with dissimilar materials such as concrete, masonry, and steel, in accordance with Section 09 91 00, Painting.
   2. Do not extend coating beyond contact surfaces. Remove coating where exposed-to-view in the finished Work.

3.3 CLEANING AND REPAIRING

A. Cleaning: Installer shall clean exposed surfaces of handrail and railing systems after completing installation. Comply with recommendations of both handrail and railing system manufacturer and finish manufacturer. Do not use abrasives or unacceptable solvent cleaners. Test cleaning techniques on an unused section of railing before employing cleaning technique.
   1. Remove stains, dirt, grease, and other substances by washing handrails and railings systems thoroughly using clean water and soap; rinse with clean water.
   2. Do not use acid solution, steel wool, or other harsh abrasives.
   3. If stain remains after washing, remove defective sections and replace with new material meeting requirements of this Section.

B. Handrails and railings shall be free from dents, burrs, scratches, holes, and other blemishes. Replace damaged or otherwise defective Work with new material that conforms with this Section at no additional cost to OWNER.

C. At Substantial Completion, replace adjacent work marred by the Work of this Section.

+ + END OF SECTION + +

SECTION 05 53 16

ALUMINUM GRATING

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install aluminum grating and frames.
   2. The Work includes:
      a. Providing grating, frames, and appurtenances.
      b. Providing openings in aluminum grating to accommodate the Work under this and other Sections, and attaching to aluminum grating all items such as sleeves, bands, studs, fasteners, and items required for which provision is not specifically included under other Sections.
      c. Providing openings in and attachments to aluminum grating to accommodate work under other contracts, and assisting other contractors in building on or attaching to aluminum grating items such as bands, fasteners, and studs and all items required for which provision is not specifically included under other contracts.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before aluminum grating Work.
   2. Notify other contractors in advance of installing aluminum grating to provide other contractors with sufficient time for installing items included in their contracts to be installed with or before aluminum grating Work.

C. Related Sections:
   1. Section 09 91 00, Painting.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. AA Aluminum Design Manual.
   2. ASTM B210, Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes.
   3. ASTM B221, Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
   4. NAAMM MBG 531, Metal Bar Grating Manual.
   5. NAAMM MBG 533, Welding Specifications for Fabrication of Steel, Aluminum and Stainless Steel Bar Grating.

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer: Shall have at least five years experience manufacturing products substantially similar to those required and shall be able to submit documentation of at least five installations in satisfactory operation for at least five years each.

B. Component Supply and Compatibility:
   1. Obtain all products and materials included in this Section regardless of component manufacturer from a single aluminum-grating manufacturer.
   2. Aluminum grating manufacturer shall review and approve or prepare all Shop Drawings and other submittals for all products and materials furnished under this Section.
   3. Components shall be suitable for the specified service conditions and be integrated into overall assembly by aluminum grating manufacturer.
   4. Provide only one type of aluminum grating exclusively throughout the Project.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Fabrication and erection of all Work. Include plans, elevations, and details of sections and connections. Show anchorage and accessory items.
      b. Setting drawings and templates for location and installation of anchorage devices.
   2. Product Data:
      a. Manufacturer's specifications, load tables, dimension diagrams, anchor details and installation instructions.
   3. Samples:
      a. Representative Samples of grating, appurtenances and other finished products requested by ENGINEER.
      b. ENGINEER'S review will be for type and finish only. Compliance with all other requirements is exclusive responsibility of CONTRACTOR.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Shipping, Handling and Unloading:
   1. Deliver materials to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices to be embedded in cast-in-place concrete in ample time to prevent delaying the Work.
   2. Comply with Section 01 65 00, Product Delivery Requirements.

B. Storage and Protection:
   1. Protect materials from corrosion and deterioration.

2. Do not store materials in contact with concrete or other materials that might cause corrosion, staining, scratching, or damage materials or finish.
3. Comply with Section 01 66 00, Product Storage and Handling Requirements.

PART 2 – PRODUCTS

2.1 SYSTEM PERFORMANCE

A. Aluminum Grating: Provide aluminum grating complying with the following:
   1. Grating Design Loads: Uniform live load shall be as shown or indicated in the Contract Documents.
   2. Maximum Clear Span Deflection for Uniform Live Loads: 1/120 of span, but not more than 1/4-inch.
   3. Maximum Fiber Stress: 12,000 psi.
   4. Do not install aluminum grating in areas subject to vehicular traffic.
   5. Minimum Size of Members:
      a. Minimum size of bearing bars shall be within standard mill tolerance as indicated in load tables in NAAMM MBG 531 for applicable loading and deflection requirements.
      b. Minimum dimensions of cross bars shall be as indicated in tables of Minimum Standard Cross Bars and Connecting Bars in NAAMM MBG 531.
   6. Banding bar shall be 1/4-inch thick minimum. Top of banding bar shall be flush with top of grating, unless otherwise shown or indicated. Banding bar shall be 1/4-inch shorter than the bearing bar height.
   7. Comply with requirements of AA Aluminum Design Manual.

2.2 MANUFACTURERS

A. Grating, Products and Manufacturers: Provide one of the following:
   1. Swaged-Locked I-Bar grating GIA, as manufactured by McNichols.
   2. Swage-Locked I-Bar Grating, by IKG Industries.
   3. Or equal.

2.3 MATERIALS

A. Bearing Bars: Aluminum alloy 6061-T6 or alloy 6063-T6, complying with ASTM B221.

B. Cross Bars or Bent Connecting Bars: Aluminum alloy 6061-T6 or alloy 6063-T6, complying with either ASTM B221 or ASTM B210.

C. Frames: Aluminum alloy 6061-T6 or alloy 6063-T6, complying with ASTM B221.

D. Stud anchors welded to steel supports and other fasteners shall be Type 316 stainless steel.

2.4 FABRICATION

A. Use materials of minimum depth and thickness specified and required to comply with performance criteria in the Contract Documents.

B. Provide grating as follows:
   1. Grating Type: Aluminum I-bar with swage-locked cross bars at right angles to bearing bars.
   2. Depth: As indicated.
   3. Bearing Bars: Aluminum I-bar spaced at 1-3/16-inch on centers.
   4. Cross-Bars: Swage-locked to bearing bars at maximum spacing of four inches on centers.
   5. Surface: Grooved.
   6. Finish: Mill for interior locations and anodized for exterior locations.

C. Provide cutouts in grating for passage of piping, electrical conduit, valve stems, columns, ducts, and similar work. Where more than two bearings bars are included in a cut out, provide banding bars of same dimensions as bearing bars around opening welded to grating component parts.

D. Gratings shall be accurately fabricated, free from warps, twists, and other defects that would affect grating appearance and grating serviceability.

E. Welding shall conform to requirements of NAAMM MBG 533. Welds shall be ground smooth at top surfaces and bearing surfaces.

F. Openings in and edges of gratings sections shall be banded with banding bars. Weld bands to intersecting members.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine conditions under which Work is to be performed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with installation until unsatisfactory conditions are corrected.

B. Check all dimensions at the Site after piping and equipment are in place and determine exact locations of openings and cutouts.

3.2 INSTALLATION

A. Fastening to In-Place Construction:
   1. Use anchorage devices and fasteners to secure aluminum grating to supporting members or prepared openings, as recommended by manufacturer.
   2. Weld Type 316 stainless steel stud bolts to receive saddle clip or flange block anchors to supporting steel members. Drill for machine bolts when supports are aluminum.

B. Cutting, Fitting, and Placing:
   1. Perform cutting, drilling and fitting required for installation. Set the Work accurately in location, alignment and elevation, plumb, level, true, and free of rack. Do not use wedges or shimming devices.
   2. Where gratings are penetrated by piping, electrical conduit, ducts, structural members, or similar protrusions, cut openings neatly and accurately to size and attach banding bar as specified.
   3. Divide panels into sections only to extent required for installation where aluminum grating is to be installed around previously installed piping, electrical conduit, ducts, structural members, or similar protrusions.

C. Clearance at ends or between sections of grating shall be a maximum of 1/4-inch.

D. Aluminum gratings shall be set with full and uniform end bearing on frames to preclude rocking movement; do not use wedges or similar shimming devices.

E. Protection of Aluminum from Dissimilar Materials: Coat aluminum surfaces in contact with dissimilar materials such as concrete, masonry, steel, or other metals, in accordance with Section 09 91 00, Painting.

+ + END OF SECTION + +

SECTION 09 91 00

PAINTING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, tools, equipment, and incidentals as shown, specified, and required to furnish and apply paint systems.
      a. CONTRACTOR is responsible for surface preparation and painting of all new and existing interior and exterior items and surfaces throughout the Project areas included under this and other Sections.
   2. Extent of painting includes the Work specified below. Painting shown in schedules may not provide CONTRACTOR with complete indication of all painting Work. Refer to Article 2.2 of this Section where all surfaces of generic types specified are specified for preparation and painting according to their status, intended function, and location, using the painting system for that surface, function, and location as specified, unless specifically identified on the Drawings as a surface not to receive specified painting system.
      a. All new and specifically identified existing surfaces and items except where the natural finish of the material is specified as a corrosion-resistant material not requiring paint; or is specifically indicated in the Contract Documents as a surface not to be painted. Where items or surfaces are not specifically mentioned, paint them the same as adjacent similar materials or areas.
      b. Mechanical and process items to be painted include:
         1) Piping, pipe insulation, pipe hangers, and supports, including electrical conduit.
         2) Heat exchangers.
         3) Tanks.
         4) Ductwork and insulation.
         5) Motors, mechanical equipment, and supports.
         6) Accessory items.
      c. Surface preparation and painting of all new and specifically identified existing items, both interior and exterior, and other surfaces, including items furnished by OWNER, are included in the Work, except as otherwise shown or specified.
      d. Removal of all substances, top coats, primers and all intermediate coats of paint and other protective or decorative coatings on those items and surfaces to remain that are identified to receive a painting system under this Section, to provide surfaces acceptable for application of painting specified.

B. Coordination:
   1. Review installation, removal, and demolition procedures under other Sections and coordinate them with the Work specified in this Section.
   2. Coordinate painting of areas that will become inaccessible once equipment, laboratory furniture, lockers and similar fixed items have been installed.
   3. Coordinate primers with finish paint materials to provide primers that are compatible with finish paint materials. Review other Sections and other contracts where primed surfaces are provided, to ensure compatibility of total painting system for each surface. CONTRACTOR is responsible for coordinating compatibility of all shop primed and field painted items in other Sections and in general contract and other contracts.
   4. Furnish information to ENGINEER on characteristics of finish materials proposed for use and ensure compatibility with prime coats used. Provide barrier coats over incompatible primers or remove and repaint as required. Notify ENGINEER in writing of anticipated problems using specified painting systems with surfaces primed by others. Reprime equipment primed in factory and other factory-primed items that are damaged or scratched.

C. Related Sections:
   1. Section 40 05 19, Ductile Iron Process Pipe.

D. Work Not Included: The following Work is not included as painting Work, or are included under other Sections or in other contracts:
   1. Shop Priming: Shop priming of structural metal, miscellaneous metal fabrications, other metal items and fabricated components such as shop-fabricated or factory-painted process equipment, plumbing equipment, heating and ventilating equipment, electrical equipment, and accessories shall conform to applicable requirements of this Section but are included under other Sections or in other contracts.
   2. Pre-finished Items:
      a. Items furnished with such finishes as baked-on enamel, porcelain, and polyvinylidene fluoride shall only be touched up at Site by CONTRACTOR using manufacturer's recommended compatible field-applied touchup paint.
      b. Items furnished with finishes such as chrome plating or anodizing.
   3. Concealed Surfaces: Non-metallic wall or ceiling surfaces in areas not exposed to view, and generally inaccessible areas, such as furred spaces, pipe chases, duct shafts, and elevator shafts.
   4. Concrete floors, unless specifically shown as a surface to be painted.
   5. Corrosion-Resistant Metal Surfaces: Where the natural oxide of item forms a barrier to corrosion, whether factory- or Site-formed, including such materials as copper, bronze, muntz metal, terne metal, and stainless steel.
   6. Operating Parts and Labels:
      a. Do not paint moving parts of operating units, mechanical and electrical parts such as valve and damper operators, linkages, sensing devices, interior of motors, and fan shafts.

b. Do not paint over labels required by governing authorities having jurisdiction at Site, or equipment identification, performance rating, nameplates, and nomenclature plates.
c. Cover moving parts and labels during the painting with protective masking. Remove all protective masking upon completion of Work. Remove all paint, coatings, and splatter that comes in contact with such labels.

7. Structural and miscellaneous metals covered with concrete need not receive primers, intermediate, or finish coats of paint.

E. Description of Colors and Finishes:
1. Color Selection:
a. Colors will be selected by OWNER from manufacturer's standard colors.
b. After approval by ENGINEER of Shop Drawings and prior to commencing painting Work, ENGINEER will furnish color schedules for surfaces to be painted based on color selections provided by OWNER.

F. Abbreviations and Symbols:
1. Abbreviations and symbols used in painting systems are explained in Article 2.2 of this Section and provide information on generic composition of required materials, manufacturers, number of coats and dry mil film thickness per coat (DMFTPC), and coverage for determining required number of gallons for the Work.

1.2 REFERENCES

A. Referenced Standards: Standards referenced in this Section are:
1. ASTM D16, Terminology for Paint, Related Coatings, Materials and Applications.
2. ASTM D2200, Pictoral Surface Preparation Standards for Painting Steel Surfaces.
3. ASTM D4258, Practice for Surface Cleaning Concrete for Coating.
4. ASTM D4259, Practice for Abrading Concrete.
5. ASTM D4262, Testing Method for pH of Chemically Cleaned or Etched Concrete Surfaces.
6. ASTM D4263, Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.
7. ASTM D4285, Test Method for Indicating Oil or Water in Compressed Air.
8. ASTM D4417, Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel.
9. National Association of Piping Fabricators, NAPF 500-03, Surface Preparation Standard For Ductile Iron Pipe and Fittings in Exposed Locations Receiving Special External Coatings And/or Special Internal Linings.

10. Ozone Transport Commission, (OTC), OTC Model Rule for Architectural and Industrial Maintenance Coatings.
11. SSPC SP 1, Solvent Cleaning.
12. SSPC SP 3, Power Tool Cleaning.
13. SSPC SP 6, Commercial Blast Cleaning.
14. SSPC SP 10, Near-White Blast Cleaning.
15. SSPC VIS 1, Visual Standard for Abrasive Blast Cleaned Steel.
16. SSPC Volume 2, Systems and Specifications.

1.3 DEFINITIONS

A. Coating terms defined in ASTM D16 apply to this section.

1.4 QUALITY ASSURANCE

A. Applicator Qualifications:
   1. Engage a single applicator that regularly performs installation of paint materials, with documented skill and successful experience in installing types of products required and that agrees to employ only trained, skilled tradesmen who have successful experience in installing types of products specified.
   2. Submit name and qualifications to ENGINEER along with following information for at least three successful, completed projects:
      a. Names and telephone numbers of owner and design professional responsible for project.
      b. Approximate contract cost of paint products.
      c. Amount of area painted.
   3. Submit to ENGINEER proof of acceptability of applicator by manufacturer.

B. Testing Agency Qualifications: Provide an independent testing agency for testing specified in this Section. Testing agency shall be selected by OWNER and paid for by CONTRACTOR. When requested, submit documentation demonstrating to satisfaction of ENGINEER, that testing agency has experience and capability to satisfactorily conduct testing required without delaying the Work, in accordance with ASTM E329.

C. Source Quality Control:
   1. Obtain materials from manufacturers that will provide services of a qualified manufacturer's representative at Site at commencement of painting Work, to advise on products, mock-ups, installation, and finishing techniques and, at completion of Work, to advise ENGINEER on acceptability of completed Work and during the course of the Work as may be requested by ENGINEER.
   2. Certify long-term compatibility of all coatings with surfaces.
   3. Do not submit products that decrease number of coats, surface preparation, or generic type and formulation of coatings specified. Products exceeding VOC limits and chemical content specified will not be approved.

4. ENGINEER may review manufacturers' recommendations concerning methods of installation and number of coats of paint for each painting system. CONTRACTOR shall prepare construction costs based on painting systems, number of coats, coverage's and installation methods specified.
5. Submit "or equal" products, when proposed, with direct comparison to products specified, including information on durability, adhesion, color and gloss retention, percent solids, VOC's grams per liter, and recoatability after curing.
6. "Or equal" manufacturers shall furnish same color selection as manufacturers specified, including intense chroma and custom pigmented colors in all painting systems.
7. Color Pigments: Provide pure, non-fading, applicable types to suit surfaces and services to be painted. Comply with:
    a. Areas subject to hydrogen sulfide fume exposure will be identified by ENGINEER. Through CONTRACTOR, paint manufacturer shall notify ENGINEER of colors that are not suitable for long-term color retention in such areas.
    b. Manufacturer shall identify colors that meet the requirements of authorities having jurisdiction at Site for use in locations subject to contact with potable water or water being prepared for use as potable water.
    c. Comply with paint manufacturer's recommendations on preventing coating contact with levels of carbon dioxide and carbon monoxide that may cause yellowing during application and initial stages of curing of paint.
8. Obtain each product from one manufacturer. Multiple manufacturing sources for the same system component are unacceptable.
9. Certify product shelf life history for each product source for materials manufactured by the same manufacturer, but purchased and stored at different locations or obtained from different sources.
10. Constantly store materials to be used for painting Work between 60 degrees F and 90 degrees F, and per paint manufacturer's written recommendations, for not more than six months. Certify to ENGINEER that painting materials have been manufactured within six months of installation and have not, nor will be, subjected to freezing temperatures.

D. Regulatory Requirements:
1. Comply with VOC content limits of OTC Model Rule for Architectural and Industrial Maintenance Coatings:
    a. Industrial Maintenance Coatings: 340 grams per liter.
    b. Interior and Exterior Non-Flat Coatings: 250 grams per liter.

E. Stepped-down Mock-ups:
1. Demonstrate installation of specified painting systems on actual wall surfaces and building components at locations selected by ENGINEER.
2. Provide 4-foot by 8-foot stepped-down sample area for each painting system. Prior to application of painting system, but after ENGINEER's

approval of the components of each painting system, apply a 4-foot wide sample of each operation and application step required by this Section and specified manufacturer's written application recommendations. Show each application step as a 2-foot long section that shall remain exposed to demonstrate work performed in that step. Continue application procedures until topcoat is provided. Topcoat shall be a minimum of two feet long. When completed, finished mock-up for each paint system shall reveal each step and each coat of paint required for paint system with 2-foot wide strips revealing Work performed to prepare surface and apply each coat. Lengthen overall mock-up as required to completely demonstrate each painting system. Use tinted shades differing from coat to coat for each component of each painting system.

3. ENGINEER may approve or disapprove each component of each painting system on an individual component basis.
4. Painting Work that does not meet standard approved on sample areas shall be removed and replaced.
5. Painting Work advanced without approved mock-ups shall stop, and mock-ups prepared for approval by ENGINEER.

1.5 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Product Data:
      a. Copies of manufacturer's technical information and test performance data, including paint analysis, VOC and chemical component content in comparison to maximum allowed by the Contact Documents, and application instructions for each product proposed for use.
   2. Samples:
      a. Copies of manufacturer's complete color charts for each coating system.
      b. Mock-ups specified for the Site.

B. Informational Submittals: Submit the following:
   1. Certificates:
      a. Certificate from paint manufacturer stating that materials meet or exceed Contract Documents requirements.
      b. CONTRACTOR shall provide notarized statement verifying that all painting systems are compatible with surfaces specified. All painting systems components shall be reviewed by an authorized technical representative of paint manufacturer for use as a compatible system. Verify that all painting systems are acceptable for exposures specified and that paint manufacturer is in agreement that selected systems are proper, compatible, and are not in conflict with paint manufacturer's recommended specifications. Show by copy of transmittal form that a copy of letter has been transmitted to paint applicator.
   2. Manufacturer's Instructions: Provide paint manufacturer's storage, handling, and application instructions prior to commencing painting Work at Site.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Product Delivery Requirements: Deliver products to Site in original, new, and unopened packages and containers, accurately and legibly and accurately labeled with the following:
   1. Container contents, including name and generic description of product.
   2. Manufacturer's stock number and date of manufacture.
   3. Manufacturer's name.
   4. Contents by volume, for major pigment and vehicle constituents.
   5. Grams per liter of volatile organic compounds.
   6. Thinning instructions, where recommended.
   7. Application instructions.
   8. Color name and number.

B. Product Storage Requirements:
   1. Store acceptable materials at Site.
   2. Store in an environmentally controlled location as recommended in paint manufacturer's written product information. Keep area clean and accessible. Prevent freezing of products.
   3. Store products that are not in actual use in tightly covered containers.
   4. Comply with health and fire regulations of authorities having jurisdiction at Site.

C. Product Handling Requirements:
   1. Handle products in a manner that minimizes the potential for contamination, or incorrect product catalyzation.
   2. Do not open containers or mix components until necessary preparatory work has been completed and approved by ENGINEER and painting Work will start immediately.
   3. Maintain containers used in storing, mixing, and applying paint in a clean condition, free of foreign materials and residue.

1.7 SITE CONDITIONS

A. Site Facilities:
   1. Supplemental heat sources, as required to maintain both ambient and surface temperatures within range recommended by paint manufacturer for paint system application, are not available at Site.
   2. Provision of supplemental heat energy sources, power, equipment, and operating, maintenance and temperature monitoring personnel is responsibility of CONTRACTOR.
   3. Do not use heat sources that emit carbon dioxide or carbon monoxide into areas being painted. Properly locate and vent such heat sources to exterior such that paint systems are unaffected by exhaust.

B. Existing Conditions:
   1. Existing surfaces to receive painting Work shall be surface-prepared to meet requirements of painting systems specified. Prior to commencing painting Work, perform adhesion tests on existing surfaces to be painted. Perform testing per ASTM D4541 or other method acceptable to ENGINEER. Number and location of tests shall be sufficient to determine condition of existing coatings and suitability of existing coatings to remain to provide acceptable substrate for new coatings. Submit testing plan prior to testing and provide ENGINEER a copy of adhesion test results.
   2. Provide abrasive blasting, scraping, or other abrading or surface film removal, or preparatory techniques accepted by ENGINEER.
   3. Before commencing painting in an area, surfaces to be painted and floors shall be cleaned of dust using commercial vacuum cleaning equipment equipped with high-efficiency particulate air (HEPA(filters and dust containment systems.

C. Environmental Requirements:
   1. Surfaces to be painted shall be at least 5 degrees F above dew point temperature and be dry to the touch. Apply paint only when temperature of surfaces to be painted, paint products, and ambient air temperatures are between 65 degrees F and 95 degrees F, unless otherwise permitted by paint manufacturer's published instructions.
   2. Apply paint system within shortest possible time consistent with manufacturer's recommended curing instructions for each coat. If chemical, salt, or other contamination contacts paint film between coats, remove contamination per SSPC SP 1 and restore surface before applying paint.
   3. Do not paint tanks or pipelines containing fluid without specific permission of ENGINEER and only under conditions where "sweating" of outside surface of vessel being painted is not likely to occur within 24 hours of paint application.
   4. Do not apply epoxy paints if ambient temperature is expected to go below 50 degrees F within twelve hours of application. Follow manufacturer's instructions when manufacturer's published recommendations require a higher minimum ambient temperature.
   5. Do not apply paint in snow, rain, fog, or mist; or when relative humidity exceeds 85 percent. Do not apply paint to damp or wet surfaces or when surfaces will reach dew point due to falling or rising temperatures and humidity conditions during course of paint application, unless otherwise permitted by paint manufacturer's published instructions.
   6. Do not paint unacceptably hot or cold surfaces until such surfaces can be maintained within temperature and dew point ranges acceptable to paint manufacturer. Arrange for surfaces to be brought within acceptable temperature and dew point ranges as part of painting Work.
   7. Moisture content of surfaces shall be verified to ENGINEER as acceptable prior to commencement of painting using methods recommended by paint manufacturer.

8. Painting may be continued during inclement weather only if areas and surfaces to be painted are enclosed and heated within temperature limits specified by paint manufacturer for application and drying.
9. Provide adequate illumination and ventilation where painting operations are in progress.

D. Protection:
1. Cover or otherwise protect finished work of other trades and surfaces not being painted concurrently, or not to be painted.
2. During surface preparation and painting, facility shall remain in operation. Use procedures that prevent contamination of process or cause or require facility shutdown.
3. Coordinate and schedule surface preparation and painting to avoid exposing personnel to hazards associated with painting Work. Provide required personnel safety equipment per requirements of authorities having jurisdiction at Site.
4. Submit protection procedures to be employed. Do not begin surface preparation and painting Work until ENGINEER accepts protection techniques proposed by CONTRACTOR.
5. When working with flammable materials, provide fire extinguishers and post temporary signs warning against smoking and open flame.

PART 2 - PRODUCTS

2.1 PAINTING SYSTEM MANUFACTURERS

A. Products and Manufacturers: Where referenced under painting systems provide products manufactured by the following:
1. Tnemec Company, Inc. (TCI).
2. The Carboline Company, part of StonCor Group, an RMP Company (TCC).
3. Sherwin-Williams Company (SWC).
4. Benjamin Moore & Company (BMC).
5. ICI Paints (ICI).
6. Righter Group Inc. (RGI)
7. Duron Inc. (DI)

2.2 PAINTING SYSTEMS

A. New and Existing Cast-In-Place Concrete Walls (except walls within height of chemical containment wall areas), Columns, Underside of Roof Slabs and Beams, Architectural Precast Concrete; Moderate Corrosion and Abrasion- Resistant, Non-Submerged, Interior:
1. Surface Preparation: Refer to Paragraphs 1.5.A.2, 3.2.A., 3.2.B.3., 3.2.B.5., 3.2.B.6., and 3.2.B.7 of this Section.

2. Filler, Surfacer and Patching Compound:
    a. Generic Components:
        1) Minimum 100 percent solids, epoxy modified cement; 40 grams per liter VOC, maximum.
    b. Products and Manufacturers: Provide one of the following:
        1) Series 218 MortarClad and Series 219 MortarCast (TCI); Carboguard 501/510 (TCC); Cor-Cote Epoxy Polymer Concrete or TPM 721 Repair and Leveling Mortar (SWC): One coat, hand troweled-in-place up to two inches deep for patching and applied 1/16-inch thick continuously over all surfaces specified to receive this painting system, 20 square feet per gallon (excluding patched areas); and provided in sufficient additional quantity to bring all surfaces to a smooth, uniform continuously coated plane, of thickness specified.
3. Primer/Intermediate:
    a. Generic Components:
        1) Minimum 42 percent solids, waterborne acrylic epoxy; 240 grams per liter VOC, maximum.
    b. Products and Manufacturers: Provide one of the following:
        1) Series 113 H.B. Tneme-Tufcoat (TCI); Sanitile 255 (TCC); Epo-Plex Multi-Mil (SWC): Two coats, 5.0 dry mils, per coat.
4. Finish: Gloss:
    a. Generic Components:
        1) Minimum 42 percent solids, waterborne acrylic or water-based epoxy; 285 grams per liter VOC, maximum.
    b. Products and Manufacturers: Provide one of the following:
        1) Series 114 Tneme-Tufcoat UR (TCI); Sanitile 255 (TCC); Waterborne Epoxy 3479 (SWC): One coat, 2.0 to 3.0 dry mils.

B. New and Existing Ferrous Metals, Structural Steel (With or Without Sprayed Fireproofing), Miscellaneous Ferrous Metals, Exterior Surfaces of Valves, Exterior Surfaces of Ferrous Piping, and Exterior Surfaces of All Ferrous Metal (Both Exposed and to be Later Covered With Insulation); Non-submerged, Interior:
1. Surface Preparation: Refer to Paragraphs 1.5.A.2., 3.2.A., 3.2.C.1., 3.2.C.2.
2. Shop Primer:
    a. Generic Components:
        1) Minimum 67 percent volume solids, build, two-component, cycloaliphatic amine-catalyzed epoxy or polyamido-amine epoxy coating; 250 grams per liter VOC, maximum.
    b. Products and Manufacturers: Provide one of the following:
        1) Series N69 Hi-Build Epoxoline (TCI); Carboguard 954 HB (TCC); Macropoxy HS Epoxy (SWC): One coat, 4.0 to 6.0 dry mils.
3. Field Primer and Touch-Up:
    a. Generic Components:
        1) Minimum 100 percent volume solids, high-build, two-component, polyamide-catalyzed epoxy; 8 grams per gallon VOC, maximum.

b. Products and Manufacturers: Provide one of the following:
1) Series 165 Epoxoline 100 (TCI); Carboguard 954 HB (TCC); Cor-Cote HP (SWC): One coat, 8.0 to 12.0 dry mils.

4. Finish: High-Gloss:
a. Generic Components:
1) Minimum 80 percent volume solids, high-build, chemical-resistant, high-gloss, modified, polyamine- or polyamidoamine-catalyzed epoxy finish; 25 grams per liter VOC, maximum.
b. Products and Manufacturers: Provide one of the following:
1) Series 280 Tneme-Glaze (TCI); Carboguard 890 LT (TCC); Cor-Cote HP (SWC):
a) Horizontal Surfaces: One coat, 6.0 to 12.0 dry mils.
b) Vertical Surfaces: One coat, 4.0 to 8.0 dry mils.

C. New and Existing PVC and CPVC Piping and Fiberglass Insulation Covering; Non-submerged, Interior:
1. Surface Preparation: Refer to Paragraphs 1.5.A.2., 3.2.A. and 3.2.F.
2. Primer:
a. Generic Components:
1) Minimum 37 percent volume solids single-component, self-cross linking acrylic primer-sealer; 226 grams per liter VOC, maximum.
b. Products and Manufacturers: Provide one of the following:
1) Series 115 Uni-Bond DF (TCI); Carbocrylic 3358 (TCC); DTM Acrylic Primer/Finish (SWC): One coat, 2.0 to 4.0 dry mils.
3. Finish: Satin:
a. Generic Components:
1) Minimum 37 percent volume solids, single component, self-cross linking acrylic; 226 grams per liter VOC, maximum.
b. Products and Manufacturers: Provide one of the following:
1) Series 116 Uni-Bond (TCI); Carbocrylic 3358 (TCC); DTM Acrylic Primer/Finish (SWC): One coat, 2.0 to 4.0 dry mils.

2.3 CALKING AND SEALANTS

A. Refer to Section 03 00 05, Concrete.

2.4 INSTRUMENTS

A. Instruments:
1. Provide one new dry-film thickness gauge for checking film thickness, one holiday detector to detect holidays or holes in the coating, and one set of visual standards to check surface preparation. Calibrate dry film thickness gauge at Site using Bureau of Standards standard shim blocks.
2. Products and Manufacturers: Provide the following:
a. Film Thickness Testers: Model FM-III manufactured by Mikrotest, or equal.

b. Holiday detector shall be Model M-1 as manufactured by Tinker & Rasor, or equal.
c. Visual Standards: ASTM D2200, Swedish Standards, SSPC VIS 1.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which painting Work is to be performed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of Work. Do not proceed with Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

B. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions otherwise detrimental to formation of a durable paint film capable of performing in accordance with claims made in paint manufacturer's product literature for surfaces and conditions encountered.

C. Do not paint over existing paint where there is no assurance that existing paint will provide an acceptable surface for long-term adherence and durability of painting systems specified or where paint manufacturer requires removal of all existing paint to recommend use of specified painting system.

3.2 SURFACE PREPARATION

A. General:
1. Test for moisture content of surfaces before commencement of painting Work. Test for moisture in concrete in compliance with ASTM D4263. Report results to ENGINEER before commencing Work.
2. Prepare existing surfaces to be painted as specified for new surfaces. Submit substitute methods of preparing existing surfaces, when proposed, with Shop Drawing submittal. ENGINEER's acceptance of substitute surface preparation methods does not relieve CONTRACTOR of performance required under the Contract Documents. To provide surfaces acceptable for application of painting system specified:
   a. Clean and roughen surfaces of existing paint and other decorative or protective toppings on surfaces to remain that are to receive a painting system under this Section.
   b. Where existing surfaces to be painted have corrosion, peeling paint, or unacceptably adhering coatings, remove all topcoats, primers, and intermediate coats of paint, and other protective or decorative coatings.
3. Perform preparation and cleaning procedures as specified herein and in strict accordance with paint manufacturer's approved instructions for each surface and atmospheric condition.
4. Remove hardware, hardware accessories, machined surfaces, plates, lighting fixtures, and similar items already in place that do not require field painting,

or provide effective surface-applied protection prior to surface preparation and painting.

5. Remove as necessary items that must be field-painted where adjacent surfaces cannot be completely protected from splatter or overspray. Following completion of painting of each space or area, the removed items shall be reinstalled by workers skilled in the trades involved.
6. Clean surfaces to be painted before applying painting system components. Remove oil and grease with clean cloths and cleaning solvents prior to mechanical cleaning.
7. Prepare surfaces that were improperly shop-painted and abraded or rusted shop-painted surfaces as specified.

B. Cast-In-Place Concrete, Precast Concrete and Masonry Surfaces:

1. Prepare surfaces of concrete unit masonry to be painted by removing all efflorescence, chalk, dust, dirt, grease, oils, and other contamination using soap and water. Surfaces shall be clean and dry at time of paint system application.
2. Concrete unit masonry that cannot be adequately cleaned using soap and water shall be acid etched with a commercial solution of 15 percent muriatic acid.
3. Prepare and clean cast-in-place concrete and precast concrete surfaces per ASTM D4259 to provide a uniform and continuous anchor profile of approximately one mil. Provide mechanical abrading and abrasive blasting per ASTM D4259. Use 40 to 80-mesh abrasive and clean, dry, compressed air. Compressed air cleanliness shall be per ASTM D4285. Pressure at blasting nozzle shall not exceed 80 pounds per square inch. Do not concentrate blast on surface; instead, move at a fairly rapid rate to provide a surface free of laitants and contaminants. Provide post-surface preparation cleaning per ASTM D4258 to remove loose material. Surface preparation shall open all surface air holes by removing laitance shoulders surrounding air holes. Vacuum surfaces to remove dust and sand, and wash with potable water.
4. Where paint system is for chemical containment barrier protection, repair cracks and expansion joints in concrete and provide 2-inch radiused cove base fillets at equipment pads and containment walls as part of complete chemical containment paint system Work. Use materials and techniques recommended by manufacturers of the paint and concrete repair products.
5. Remove from cast-in-place concrete fins, projections, and other surface irregularities that would protrude above level of finished intermediate fillers and surfacers. Remove by chipping and scarification by mechanical abrasion.
6. Using specified filler and surfacer, patch cast-in-place concrete and precast concrete surfaces as required to completely fill surface air holes and honeycombing. Level all protrusions, grind filler and surfacing compounds smooth, and level with adjacent surfaces.
7. Perform tests per ASTM D4262 and ASTM D4263 to verify alkalinity and moisture content of surfaces to be painted, and report findings to

ENGINEER. If, in ENGINEER's opinion, surfaces are sufficiently alkaline to cause blistering and burning of paint, correct the condition before applying paint. Provide suitable testing materials for alkalinity and moisture tests. Do not paint surfaces where the moisture content exceeds eight percent.

8. Where a concrete unit masonry block filler is specified, spot patch holes and cracks with a putty knife using specified block filler. Apply to large surfaces by airless spray and backroll uniformly using a roller with a synthetic nap cover. Follow with a rubber squeegee to provide a smooth finish.

C. Ferrous Metals:

1. Ferrous Metals Except Ductile and Cast Iron:
    a. Comply with paint manufacturer's recommendations for type and size of abrasive to provide a surface profile that meets manufacturer's painting system requirements for type, function, and location of surface. Verify that paint manufacturer-recommended profiles have been achieved on prepared surfaces. Report profiles to ENGINEER using Test Method C of ASTM D4417.
    b. Clean non-submerged ferrous surfaces including structural steel and miscellaneous metal to be shop-primed, of all oil, grease, dirt, mill scale, and other contamination by commercial blast cleaning complying with SSPC SP 6 at time of paint system application, using SSPC VIS 1 as a standard of comparison.
    c. Clean submerged ferrous surfaces including structural steel and miscellaneous metal to be shop-primed of all oil, grease, dirt, mill scale, and other contamination by near-white blasting complying with SSPC SP 10 at time of painting system application, using SSPC VIS 1 as a standard of comparison.
    d. Clean non-submerged, ferrous surfaces that have not been shop-coated of all oil, grease, dirt, loose mill scale, and other contamination by commercial blasting complying with SSPC SP 6 at the time of painting system application, using SSPC VIS 1 as a standard of comparison.
    e. Clean submerged ferrous surfaces that have not been shop-coated or that have been improperly shop-coated of all oil, grease, dirt, mill scale, and other contamination by near-white blasting complying with SSPC SP 10 at time of painting system application, using SSPC VIS 1 as a standard of comparison.
    f. Touch-up shop-applied prime coats that have damaged or have bare areas with primer recommended by paint manufacturer after commercial blasting complying with SSPC SP 6 at the time of painting system application, using SSPC VIS 1 as a standard of comparison, to provide a surface profile of not less than one mil.
    g. Power tool-clean per SSPC SP 3 to remove welding splatter and slag.
    h. Remove all rust and contamination on existing ferrous metals to sound surfaces by power tool-cleaning complying with SSPC SP 11 to provide a surface profile of not less than one mil.

2. Ductile and Cast Iron:
    a. Comply with paint manufacturer's recommendations and NAPF 500-03 for type and size of abrasive to provide a surface profile meeting paint manufacturer's requirements for type, function and location of surface. Verify that paint manufacturer-recommended profiles are achieved on prepared surfaces.
    b. Clean submerged and non-submerged ductile and cast iron surfaces to be shop-primed of all oil, grease, dirt, mill scale, and other contamination by solvent cleaning and abrasive blasting complying with NAPF 500-03-01, NAPF 500-03-04, and NAPF 500-03-05 at time of paint system application.
    c. Clean submerged ductile and cast iron that have not been shop-coated or that have been improperly shop-coated of all oil, grease, dirt, mill scale, and other contamination by solvent cleaning and abrasive blasting complying with NAPF 500-03-01, NAPF 500-03-04, and NAPF 500-03-05 at time of paint system application.
    d. Touch-up shop-applied prime coats that are damaged or have bare areas with primer recommended by paint manufacturer, after power tooling complying with NAPF 500-03 at the time of painting system application.
    e. Remove all contamination on existing ductile and cast iron to sound surfaces by power tool cleaning complying with NAPF 500-03-03.

D. Non-Ferrous Metal Surfaces: Prepare non-ferrous metal surfaces for painting by light whip blasting or by lightly sanding with 60- to 80-mesh sandpaper.

E. Galvanized (Zinc-Coated) Surfaces: Prepare galvanized surfaces for painting by lightly sanding with 60- to 80-mesh sandpaper or by light whip blasting.

F. PVC and CPVC Piping and Fiberglass: Lightly sand and clean surfaces to be painted. Fiberglass surfaces shall be prepared by solvent washing to remove wax and other contaminants, before abrading surfaces with 60- to 80-mesh sandpaper to provide an anchor pattern with scratches no further apart than 1/16-inch.

3.3 PROTECTION OF PROPERTY AND STRUCTURES

A. Protect property and structures adjacent to the Work from waste residues resulting from cleaning, surface preparation and paint application.

B. Use shrouding, vacuum blasting, or other approved methods for cleaning and surface preparation of exterior surfaces.

C. During blast cleaning and surface preparation of interior and exterior surfaces, control discharge of dust and grit, using shrouding, negative-pressure containment/dust collection systems, or other means to protect adjacent property and structures and prevent dust/grit from escaping. Similarly control removal and temporary storage of residues to protect adjacent property and structures.

D. For painting of exterior surfaces, use rollers, shrouding or other approved methods as required to protect adjacent property and structures from wind-blown paint residues.

E. Submit proposed procedures for cleaning, surface preparation and paint application describing methods for protecting adjacent property and structures from residues. Do not proceed with cleaning, surface preparation or painting until proposed procedures are approved by ENGINEER.

3.4 MATERIALS PREPARATION

A. General:
   1. Mix and prepare paint products in strict accordance with paint manufacturer's product literature.
   2. Do not mix painting materials produced by different manufacturers, unless otherwise permitted by paint manufacturer's instructions.
   3. Where thinners are required, they shall be produced by paint system manufacturer unless otherwise permitted by paint manufacturer's product literature and submitted to and accepted by ENGINEER with Shop Drawings.

B. Mixing:
   1. For products requiring constant agitation, use methods in compliance with manufacturer's product literature to prevent settling during paint application.
   2. Mix in containers placed in suitably sized non-ferrous or oxide resistant metal pans to protect floors from slashes or spills that could stain the floor or react with subsequent finish floor material.
   3. Mix and apply paint in containers bearing accurate product name of material being mixed or applied.
   4. Stir products before application to produce a mixture of uniform density and as required during the application. Do not stir into the product film that forms on surface; instead, remove film and, if necessary, strain product before using.
   5. Strain products requiring such mixing procedures. After adjusting mixer speed to break up lumps and after components are thoroughly blended, strain through 35 to 50-mesh screen before application.

3.5 APPLICATION

A. General:
   1. Apply paint systems by brush, roller, or airless spray per manufacturer's recommendations and in compliance with Paint Application Specifications No. 1 in SSPC Volume 2, where applicable. Use brushes best suited for type of paint applied. Use rollers of carpet, velvet back, or high pile sheeps wool as recommended by paint manufacturer for product and texture required. Use air spray and airless spray equipment recommended by paint

manufacturer for specific painting systems specified. Submit a list of application methods proposed, listing paint systems and location.

2. Paint dry film thicknesses required are the same regardless of the application method. Do not apply succeeding coats until previous coat has completely dried.
3. Apply additional coats when undercoats, stains, or other conditions show through final coat of paint, until paint film is uniform finish, color, and appearance, particularly for intense chroma primary colors. Ensure that surfaces, including edges, corners, crevices, welds, and exposed fasteners, receive a film thickness equivalent to that of flat surfaces.
4. Surfaces of items not normally exposed-to-view require the same color as other components of system of which they are part, and require the same painting system specified for exposed surfaces of system.
5. Paint interior surfaces of ducts, where visible through registers or grilles, with a flat, non-specular black paint before final installation of registers or grilles.
6. Paint backs of access panels and removable or hinged covers to match exposed surfaces.
7. Paint aluminum parts in contact with dissimilar materials with specified paint system.
8. Paint tops, bottoms, and side edges of doors the same as exterior surfaces.
9. Omit field-applied primer on metal surfaces that have been primed in the shop. Touch-up paint shop-primed coats and pre-finished items only when approved by ENGINEER using compatible primers and manufacturer's recommended compatible field-applied finishes.
10. Welds shall be stripe-coated with intermediate or finish coat of paint after application of prime coat.
11. Paint steel water storage tanks per AWWA D102.

B. Minimum/Maximum Paint Film Thickness:
   1. Apply each product at not less than, nor more than, manufacturer's recommended spreading rate, and provide total dry film thickness as specified.
   2. Apply additional coats of paint if required to obtain specified total dry film thickness.
   3. Maximum dry film thickness shall not exceed 100 percent of minimum dry film thickness, except where more stringent limitations are recommended by paint manufacturer for a specific product.

C. Scheduling Surface Preparation and Painting:
   1. As soon as practical after preparation, apply first-coat material to surfaces that have been cleaned, pretreated, or otherwise prepared for painting. Apply first-coat material before subsequent surface deterioration due to atmospheric conditions existing at time of surface preparation and painting. Surfaces that have started to rust before first-coat application is complete shall be brought back to required standard by abrasive blasting.

2. Allow sufficient time between successive coats to permit proper drying. Do not recoat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure and application of another coat of paint does not cause lifting or loss of adhesion to undercoat.
3. Scarify primers and other painting system components by brush-blasting if paint has been exposed for lengths of time or under conditions beyond manufacturer's written recommendations for painting systems required, intended use, or method of application proposed for subsequent coats of paint.
4. Schedule cleaning and painting so that dust and other contaminants from cleaning process do not fall on wet, newly painted surfaces.

D. Prime Coats: Recoat primed and sealed walls and ceilings where there is evidence of suction spots or unsealed areas in first coat, to assure a finish coat with no burn-through or other defects caused by insufficient sealing.

E. Pigmented (Opaque) Finishes: Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance, and coverage.

F. Brush Application:
1. Brush out and work all brush coats onto surfaces in an even film. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections are unacceptable. Neatly draw all glass and color break lines.
2. Brush-apply primer or first coats, unless otherwise permitted to use mechanical applicators.

G. Mechanical Applicators:
1. Use mechanical methods for paint application when permitted by governing ordinances, manufacturer, and approved by ENGINEER.
2. Limit roller applications, if approved by ENGINEER, to interior wall finishes for second and third coats. Apply each roller coat to provide the equivalent hiding as brush-applied coats.
3. Where spray application is used, apply each coat to provide equivalent hiding of brush-applied coats. Do not double back with spray equipment for purpose of building up film thickness of multiple coats in one pass.

H. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint Work not in compliance with specified requirements as required by ENGINEER.

3.6 FIELD QUALITY CONTROL

A. ENGINEER may invoke the following material testing procedure at any time for a maximum of five times during field painting Work:
1. CONTRACTOR shall engage service of an independent testing laboratory to sample paints used, as designated by ENGINEER. Samples of products

delivered to Site shall be obtained, identified, sealed, and certified as to being products actually applied to surfaces in each area, in presence of CONTRACTOR.

2. A testing laboratory selected by OWNER and paid for by CONTRACTOR shall perform appropriate tests for any or all of the following:
   a. Abrasion resistance.
   b. Apparent reflectivity.
   c. Flexibility.
   d. Washability.
   e. Absorption.
   f. Accelerated weathering.
   g. Dry opacity.
   h. Accelerated yellowness.
   i. Recoating.
   j. Skinning.
   k. Color retention.
   l. Alkali resistance.
   m. Quantitative materials analysis.
3. If test results show that products being used do not comply with specified requirements, CONTRACTOR may be directed to stop painting Work and remove non-complying paint, and shall prepare and repaint surfaces coated with rejected paint with material complying with the Contract Documents.

B. Notify ENGINEER after completing each coat of paint. After inspection and checking of film thickness, holidays, and imperfections, and after acceptance by ENGINEER, proceed with succeeding coat. Perform testing using testing instruments specified in Article 2.4 of this Section.
   1. ENGINEER will witness all testing and shall be notified of scheduled testing at least twenty-four hours in advance.
   2. Apply additional coats, if required, to produce specified film thickness and to correct holidays and to completely fill all surface air holes.

C. For magnetic substrates, measure thickness of dry film nonmagnetic coatings following recommendations of SSPC PA-2. These procedures supplement manufacturers' approved instructions for manual operation of measurement gauges and do not replace such instructions.

D. Record time, location, number of coats, dry film thickness, holidays, and other imperfections and submit testing results to ENGINEER.

3.7 PROTECTION OF NEW FINISHES

A. Provide signs that read, "Wet Paint" as required to protect newly painted finishes. Remove temporary wrappings provided for protection of the Work after completion of painting.

3.8 ADJUSTING AND CLEANING

A. Correct damages to work of other trades through cleaning, repairing or replacing, and repainting, as acceptable to ENGINEER.

B. During progress of Work, remove from Site all discarded paint materials, rubbish, cans, and rags at end of each workday.

C. Upon completion of painting, clean paint-spattered surfaces. Remove spattered paint by proper methods of washing and scraping, while avoiding scratching or otherwise damaging finished surfaces.

D. At completion of work of other trades, touch-up and restore damaged or defaced painted surfaces as determined by ENGINEER.

3.9 SCHEDULES

A. Refer to following Table 09 91 00-C, Painting Schedule.

TABLE 09 91 00-C
PAINTING SCHEDULE

Facility or Surface *	Painting System **	Remarks
Cast in place concrete, interior, first floor	A	
Piping, including valves and appurtenances.	B	Color to match existing piping. Submit proposed color chart for match.
Structural framing	B	
Monorails	B	
PVC Piping	C	Paint at OWNER's discretion.

* Refer to Drawings for facility locations and for facilities not listed above.

** Refer to Article 2.2 of this Section.

+ + END OF SECTION + +

SECTION 10 14 00

SIGNAGE

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, tools, equipment, and incidentals as shown, specified, and required to furnish and install signage.
   2. Extent of signage is shown and specified.
   3. Types of products required include the following:
      a. Health, safety, warning, floor loading and fire extinguisher location signs.
      b. Pipe markers, tags, and equipment nameplates.
      c. Right-to-know labels, signs and tags.
      d. Stainless steel fasteners, supports, very-high-bond high-performance mounting tape, primers and other accessories.

B. Coordination:
   1. Coordinate adhesives and fasteners with mounting surfaces. Review other Sections to ensure compatibility of signage mounting accessories with various surfaces on which signage will be installed.
   2. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before signage Work.

C. Related Sections:
   1. Section 03 00 05, Concrete.
   2. Section 09 91 00, Painting.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. ASME A13.1 Scheme for the Identification of Piping Systems.
   2. ANSI/ICC A117.1, Accessible and Usable Buildings and Facilities.
   3. ANSI Z535.1, Marking Physical Hazards Safety Color Code.
   4. ANSI Z535.2, Environmental and Facility Safety Signs.
   5. ANSI Z535.3, Criteria for Safety Symbols.
   6. ASTM B26/B26M, Specification for Aluminum-Alloy Sand Castings.
   7. ASTM B584, Specification for Copper Alloy Sand Castings for General Applications.
   8. ASTM E527, Practice for Numbering Metals and Alloys in the Unified Numbering System (UNS).
   9. CDA, Properties of Cast Copper Alloys.

10. NFPA 704, System for the Identification of the Hazards of Materials for Emergency Response.

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Signage Manufacturers:
      a. Engage firms specializing in producing types of products specified, in compliance with the Contract Documents, with documented record of successful in-service performance, and that possess sufficient production capacity to avoid delaying the Work.
      b. Submit to ENGINEER name and experience record of manufacturers.

B. Component Supply and Compatibility:
   1. Obtain each separate type of signage from a single Supplier and from a single manufacturer.

C. Regulatory Requirements: Comply with applicable requirements of the following:
   1. OSHA, 29 CFR Part 1910.1200, Hazard Communication Standard.
   2. OSHA, 29 CFR Part 1910, Subpart Z, Toxic and Hazardous Substances.
   3. OSHA, 29 CFR Part 1910.144, Safety Color Code for Marking Physical Hazards.
   4. OSHA, 29 CFR Part 1910. 145, Specification for Accident Prevention Signs and Tags.
   5. United States Access Board, Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines.
   6. Americans with Disabilities Act (ADA), Public Law 101-36, 28 CFR Part 36, Appendix A, Accessibility Guidelines for Buildings and Facilities (ADAAG), relative to characters and symbols contrast only.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Schedule of all signage required for the Work, indicating signage type location, and other information to demonstrate compliance with the Contract Documents.
      b. Fabrication and erection information for each type of signage
      c. Complete selection of each specified manufacturer's standard and custom graphic layouts and pictograms, colors, and alphabetic/text styles.
      d. Full-size graphic layout drawings for plaques, individual dimensional letters and numbers, and other items where final graphic appearance is necessary prior to signage fabrication, incorporating all required graphic features specified or shown.

e. Mounting and Installation Data:
1) Drawings of and information on anchorages and accessory items.
2) Submit location template drawings for items supported or anchored to permanent construction.
3) Coordinate mounting position, method, and proposed mounting accessories and fasteners with actual Project conditions. Indicate required mounting accessories on plan drawings showing locations of required exit signs based on measurements taken at the Site. Show final location and identify type of mounting surface for each exit sign. Coordinate location of exit signs for non-interference with other Work and as required by authorities having jurisdiction.

2. Product Data:
a. Copies of manufacturer's technical data, including catalog information and specifications, for each product specified.

B. Informational Submittals: Submit the following:
1. Manufacturer's Instructions:
a. Templates for anchorages to be installed in concrete or masonry.
b. Manufacturer's instructions and recommendations for support and foundations of signs installed outdoors.

C. Closeout Submittals: Submit the following:
1. Warranty Documentation:
a. General and special warranties required under this Section.

D. Maintenance Material Submittals: Submit the following:
1. Extra Stock Materials:
a. Furnish extra stock materials from the same manufactured lot as the materials installed.
b. Submit documentation of actual quantities of signage installed for the Project and calculations indicating the required quantity of extra stock materials.
c. Furnish the following spare parts and accessories:
1) For every 20 of each type (snap-on, strap-on, adhesive type) of pipe markers installed:
a) One complete mounting assembly.
2) For every 20 equipment nameplates installed:
a) One complete nameplate mounting assembly.
3) For every 20 valve tags and pipe tags installed:
a) One stainless steel cable and splice.

1.5 WARRANTY

A. General Warranty: The special warranty specified for each type of sign in this Article shall not deprive OWNER of other rights or remedies OWNER may otherwise have under the Contract Documents and shall be in addition to, and run

concurrent with, other warranties made by CONTRACTOR under the Contract Documents. The obligations of CONTRACTOR under the Contract Documents shall not be limited in any way by the provisions of the specified special warranty.

B. Special Warranty on Products:
   1. Provide each signage manufacturer's written warranty, running to the benefit of OWNER, agreeing to correct, or at option of OWNER, remove or replace materials specified in this Section found to be defective during a period of five years after the date of Substantial Completion.
   2. Special warranty shall cover defective Work that includes, but is not limited to, the following:
      a. Deterioration of metal and polymer finishes beyond normal weathering.
      b. Deterioration of embedded graphic image colors and sign lamination.

PART 2 – PRODUCTS

2.1 SYSTEM PERFORMANCE

A. General:
   1. Details shown or indicated for signage, such as alpha-numeric and text type representation, letter spacing, designs of borders, and other graphic features, are generic and intended only to establish text, general positions, and symbols.
   2. Colors shall be brilliant, distinctive shades, matching the safety colors specified in ANSI Z535.1 and OSHA 1910.144.
   3. Accident prevention signs and tags shall comply with OSHA 1910.145.
   4. Health, safety, and warning signs shall comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, OSHA 1910.144, and 1910.145, unless otherwise shown or indicated. Colors shall be as indicated in Table 1 of ANSI Z535.1. In addition to text, safety symbol pictograms shall be incorporated into each sign.

2.2 PANEL SIGNS – HEALTH, SAFETY, WARNING, FLOOR LOADING, AND FIRE EXTINGUISHER LOCATION

A. Product Description: Provide rigid fiberglass reinforced plastic signs with fade-resistant embedded graphics.

B. Products and Manufacturers: Provide one of the following:
   1. Graphic Blast Word and Picture Series, by Best Sign Systems, Inc.
   2. Blast Etched Fiberglass Signs, by Visigraph Corporation.
   3. Or equal.

C. General:
   1. Size and Thickness: 0.125-inch thick; 10 inches by 14 inches, unless otherwise shown or indicated.
   2. Graphics and Text: Standard Helvetica Medium characters and matching arrow type-face; upper and lower case, one-inch high capitals and, in addition, Grade 2 Braille alphabet message designations and other text.
   3. Exposure: As recommended by sign manufacturer for both indoor and outdoor use and with an upper service temperature limit of 190degrees F. Average durability for outdoor use shall be 15 years.

D. Caution Signs: Standard color of sign background shall be yellow; panel shall be black with yellow letters and numbers. Provide one sign reading "CAUTION: EQUIPMENT STARTS AUTOMATICALLY"

E. Floor Loading Signs: Standard color of sign background shall be white; panel shall be blue with white letters and numbers. Letters and numbers used against white background shall be black. Provide one sign reading "FLOOR LOAD LIMIT 60 PSF".

F. Fire Extinguisher Location Signs (surface-mounted units only): Standard color of sign background shall be red with white letters and numbers. Each sign shall include international fire extinguisher pictogram and directional arrow indicating location of fire extinguisher.

G. Auxiliary Products:
   1. Mounting Brackets: Provide sign manufacturer's standard mounting brackets for installing projected or double-sided signs.

2.3 PIPE MARKERS

A. Description:
   1. Provide pipe markers for each pipeline provided under the Contract, and for other piping indicated to receive pipe markers.

B. Products and Manufacturers: Provide one of the following:
   1. Custom High Performance Pipe Markers (B-689), and SnapOn and StrapOn Pipe Markers (B-915), by Brady Worldwide, Inc., Signmark Division.
   2. Custom Ultra-Mark High Performance Pipe Markers, by Seton Identification Products, a Tricor Direct Company.
   3. Or equal.

C. Pipe Markers:
   1. Lettering of Titles/Legend and Color Field Size:
      a. Letter size and color field length shall be as indicated in Table 10 14 00-A of this Section:

TABLE 10 14 00-A, PIPE MARKERS:
SIZE OF TEXT AND COLOR FIELD

Outside Diameter of Pipeline or Covering* (inches)	Size of Text (Legend Characters)	Minimum Length of Color Field**
3/4 to 1.25	1/2-inch	8 inches
1.5 to 1-7/8	3/4-inch	8 inches
2 to 5-7/8	1.25-inch	12 inches
6 to 9-7/8	2.5-inch	24 inches
10 and Larger	3.5-inch	32 inches

*Outside diameter includes pipe diameter plus insulation and jacketing.
**Length of sign and color field shall be as required to accommodate required legend, and shall not be less than minimum length indicated unless required otherwise by space constraints.

b. Text and symbols shall be Standard Helvetica Medium, all upper case. Pipe markers shall include text with separate arrow signs indicating direction of flow of pipeline contents. Pipe markers with arrows shall be located as specified in Part 3 of this Section.

c. Pipe markers indicating pipeline contents shall identify pipeline contents by complete name, as indicated in Table 10 14 00-B of this Section. Obtain from ENGINEER interpretation of required pipe marker text for pipelines provided under the Project that are not listed in Table 10 14 00-B of this Section.

2. Pipe Marker Materials:

a. General: The following are applicable to all types of pipe markers furnished under this Section:

1) Provide pipe markers with ultraviolet light-resistant, sealed, subsurface color graphics, recommended by sign manufacturer, suitable for both indoor and outdoor use.

2) Pipe markers shall be resistant to abrasion, chemical reagents, and physical agitation such as washdowns and wind.

3) Provide manufacturer's full selection of standard and custom sizes and graphics.

4) Where manufacturer has established minimum order quantities for custom units provide minimum order quantities at no additional cost to OWNER.

b. Materials: Provide the following at CONTRACTOR's option, suitable for outside diameter of the associated pipe and pipe covering:

1) Adhesive, Wrap-Around Pipe Markers: Adhesive pipe markers shall be coiled construction, 0.006-inch total thickness, PVF over laminated polyester, with peel-off backing. Suitable for for service temperature ranging from -40 degrees F to 230 degrees F.

2) Snap-on Pipe Markers: Snap-on pipe markers shall be cylindrically coiled, printed plastic sheets. Pipe marker total thickness for pipe and pipe covering from 3/4-inch to 2-3/8-inch outside diameter

shall be not less than 0.020-inch. Pipe marker total thickness for pipe and pipe covering from 2.5-inch through six-inch ourside diameter shall be not less than 0.030-inch. Suitable for service temperature ranging from -40 degrees F to 180 degrees F.

3) Strap-on Pipe Markers: Provide strap-on pipe markers where pipe diameter is large enough to preclude overlap of pipe marker material around the circumference of the pipe. Strap-on pipe markers shall be flat, printed plastic sheets, not less than 0.020-inch total thickness, constructed to be attached to the pipe with bands. Suitable for service temperature ranging from -40 degrees F to 180 degrees F. Provide each pipe marker with two 1/4-inch wide band straps of nylon, plastic, or stainless steel, lengths as required by circumference of pipe and pipe covering. Provide manufacturer's recommended banding tools for banding.

3. Legend for Pipe Markers: Pipe markers shall have the text or abbreviations in the color combinations indicated in Table 10 14 00-B of this Section to identify the pipeline service hazard. Pipe marker colors shall comply with ASME A13.1, unless otherewise indicated.

TABLE 10 14 00-B,
SCHEDULE OF PIPE MARKERS*

Pipeline Legend	Lettering/Text Color	Background Color
WATER		
Flushing Water	White	Green
Plant Effluent Water	White	Green
FUELS AND LUBRICANTS		
Grease	Black	Yellow
High Pressure Lube Oil	Black	Yellow
Hydraulic Fluid	Black	Yellow
Lube Oil	Black	Yellow
CHEMICALS		
Neat (Bulk) Polymer	Black	Orange
Polymer Solution	Black	Orange
PROCESS		
Centrate/Drain	Black	Orange
Waste Activated Sludge	Black	Orange

2.4 EQUIPMENT NAMEPLATES

A. Description:
   1. Provide equipment nameplate for each equipment item furnished under the Contract, and for other equipment items indicated to receive nameplates. Equipment nameplates specified in this Article are in addition to equipment manufacturer's standard nameplate with manufacturer name, model number, serial number, and similar information.
   2. Install equipment nameplates as indicated in Part 3 of this Section. Mechanically fasten equipment nameplates to the associated equipment item.

B. Products and Manufacturers: Provide one of the following:
   1. Brady-Etch Stainless Steel ID Tags (B-748) custom engraved, by Brady Worldwide, Inc.
   2. Custom Screenprinted Nameplates – Stainless Steel, by Seton Identification Products, a Tricor Direct Company.
   3. Or equal.

C. Products and Manufacturers: Provide one of the following:
   1. Engraved Plastic Tags (B-1), by Brady Worldwide, Inc.
   2. Custom Engraved Plastic Nameplates, by Seton Identification Products, a Tricor Direct Company
   3. Or equal.

D. Equipment Nameplates:
   1. Material: Type 304 or Type 316 stainless steel, 26-gage, with rounded corners. Suitable for temperatures ranging from -40 to 89 degrees C.
   2. Provide each equipment nameplate with not less than two holes, each approximately 3/16-inch diameter, for mechanically fastening nameplate to the associated equipment. Provide appropriate stainless steel fasteners.
   3. Nameplate Size:
      a. Size shall be as required for required text, and shall be not less than one-inch by four inches.
   4. Text Engraved on Nameplates:
      a. Text Size: Equipment nameplate titles shall have text as large as possible to fit on nameplate; text shall be not less than ½-inch high. All text on a given nameplate shall be one size.
      b. Text and symbols shall be Standard Helvetica Medium, all upper-case.
      c. Left-justify multiple lines of text.
      d. Where more than one item of the same type of equipment is furnished, consecutively number each associated equipment nameplates as shown or indicated; for example "Pump No. 1", "Pump No. 2", "Pump No. 3", and so on.

5. Legend for Nameplates:
    a. Nameplates for equipment, including operating stands for valves and gates, shall be in accordance with the required text and colors indicated in Table 10 14 00-C.
    b. Obtain interpretation from ENGINEER for equipment not included in Table 10 14 00-C.

TABLE 10 14 00-C,
SCHEDULE OF EQUIPMENT NAMEPLATES*

Legend		Color	
First Line	**Second Line**	**Lettering/Text**	**Background**
CENTRIFUGE	NO. 1	Black	White
CENTRIFUGE	NO. 2	Black	White
CENTRIFUGE	NO. 3	Black	White
AIR COMPRESSOR	NO. 1	Black	White
AIR COMPRESSOR	NO. 2	Black	White
AIR COMPRESSOR	NO. 3	Black	White
POLYMER FEED	NO. 1	Black	White
POLYMER FEED	NO. 2	Black	White
POLYMER FEED	NO. 3	Black	White
BOOSTER PUMP SYTEM		Black	White

* All equipment requiring nameplates may not be included int his Table. Refer to the Drawings and Specifications for additional equipment that may also require nameplates.

2.5 VALVE AND PIPELINE TAGS

A. Products and Manufacturers: Provide one of the following:
    1. Custom Engraved Stainless Steel Valve Tags, by Brady Worldwide, Inc.
    2. Custom Stainless Steel Valve Tags, by Seton Identification Products, a Tricor Direct Company.
    3. Or equal.

B. Metal Tags:
    1. For each valve and for pipelines smaller than 3/4-inch outside diameter, provide permanently-legible, round metal tags, each two-inch diameter, Type 304 or Type 316 stainless steel, with engraved lettering filled with black enamel. Provide tags with 3/16-inch diameter hole located that does not interfere with legend.
    2. Legend for Valve Tags:
        a. Based on information provided on the Drawings, submit to ENGINEER not less than 60 days before system startup, a valve schedule indicating all required valves.

b. For each valve, the valve schedule shall indicate: location, valve type, valve number, words to identify valve's function, type of operator, and normal operating position.
c. Information presented in the valve schedules shall be coded on tags in a system provided by or acceptable to OWNER. Each valve shall be coded and identified by ENGINEER utilizing a combination of up to twelve letters and numbers.

3. Legend for Small Pipeline Tags: Comply with requirements for pipe markers relative to legend. Where legend is not indicated, obtain interpretation from ENGINEER.
4. Miscellaneous Valve and Small Pipeline Tag Accessories:
   a. Stainless Steel Wire: Nylon-coated; 0.048-inch outside diameter.
   b. Clamps: Brass.
   c. Lead Seals: Monel; four ply, 0.014-inch by 10 inches long; for attaching tags.
   d. Hand Sealing Press: As recommended by tag manufacturer for crimping lead seals.

2.6 AUXILIARY MATERIALS

A. Very-High-Bond High-Performance Bonding Tape:
   1. Provide all surface-mounted signage with very-high-bond foam tape backing except where specified as requiring mechanical fasteners.
   2. Products and Manufacturers: Provide one of the following:
      a. Scotch Brand (Very-High-Bond) 4942 VHB Double Coated Acrylic Foam Tape and No. 94 Acrylic Primer, by 3M Industrial Tape and Specialties Division.
      b. Or equal.
   3. Provide a very-high-bonding pressure sensitive joining system consisting of double-coated conformable acrylic foam tape and release liners.
   4. Thickness: 0.045-inch.
   5. Tape Width: 1.5 inches.
   6. Color: Dark gray.
   7. Bonding Adhesive: Acrylic; very-high-bond, solvent and shear resistance.
   8. Primer: High-performance tape manufacturers recommended acrylic primer.

B. Fasteners: Provide fasteners of non-magnetic stainless steel of size and type required and recommended by the associated individual signage manufacturer.

C. Anchors and Inserts: Provide nonferrous metal or hot-dipped galvanized anchors and inserts. Provide toothed stainless steel or lead expansion bolts for drilled-in-place anchors.

D. Mounting Brackets:
   1. Provide manufacturer’s standard mounting brackets for each of the following sign types: hanging, projected, double-sided.

2. Provide inserts, and mechanical and adhesive anchoring devices as specified in this Article for installation of signage.

2.7 FABRICATION

A. Shop Assembly:
   1. Fabricate and preassemble items in the shop to the greatest extent possible.
   2. Disassemble units only to extent necessary for shipping and handling limitations.
   3. Clearly mark units for reassembly and coordinated installation.

2.8 SOURCE QUALITY CONTROL

A. Fabrication Tolerances:
   1. Produce smooth, even, level sign panel surfaces, constructed to remain flat under installed conditions within tolerance of plus or minus 1/16-inch measured diagonally across each sign.

PART 3 – EXECUTION

3.1 INSPECTION

A. Examine substrates and conditions under which signage will be installed and notify ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. General:
   1. Location:
      a. Install signage and appurtenances at the locations shown or indicated. When locations are not shown or indicated, install signage at locations directed by ENGINEER.
      b. Provide exit signs at locations shown or indicated. Surface-mount signs above each point of egress, unless otherwise shown or indicated.
      c. Lightly mark and locate position of each sign. Obtain ENGINEER's acceptance of marked locations before mounting.
   2. Installation – General:
      a. Install signs level, plumb, and at proper height.
      b. Signage shall be securely mounted with concealed, very-high-bond acrylic foam tape, specified adhesives, or mechanical fasteners where specified. Attach signs to surfaces in accordance with sign manufacturer's instructions, unless otherwise shown or indicated.

c. Provide very-high-bond acrylic foam tape on back of signage using a full perimeter of specified tape. Leave no gaps in tape perimeter at back of signage; peel off second release liner and press onto surfaces.

3. Repair or replace damaged units.

B. Panel Signs – Room Identification, Directional, and Information Signs:

1. Where permanent identification is provided for rooms and spaces, install signs on the wall adjacent to the latch side of the door.
2. Where there is no wall space on the latch side of the door, including at double leaf doors, install signs on the nearest adjacent wall.
3. Mounting height shall be in accordance with ADA-ABA Accessibility Guidelines in areas accessible to disabled people. For other areas install signs with five feethes from the finished floor to centerline of sign. Mount such signage so that a person may approach within three inches of the sign without encountering protruding objects or, when reading sign, be forced to stand within the swing of a door.

C. Pipe Markers, Equipment Nameplates, and Pipe and Valve Tags:

1. Location of Pipe Markers and Pipe Tags:
   a. Provide pipe markers with text (pipeline contents or service) and adjacent arrow indicating the direction of flow of pipeline contents on each piping system provided under the Project and other piping systems shown or indicated as to receive pipe markers.
   b. Locations: Provide pipe markers at each of the following locations:
      1) At intervals of not more than 30 linear feet apart
      2) Directly adjacent to each side of each penetration by the pipeline of the following: wall, floor, ceiling, roof.
      3) Adjacent to each change in flow direction.
      4) On each branch where pipes connect together including but not limited to tees, wyes, and crosses.
      5) Adjacent to each side of each valve (including but not limited to check valves, isolation valves, control valves, and other valves), strainer cleanouts, and each equipment item along the pipeline.
      6) Comply with ASME A13.1.
   c. Provide flow-direction arrows at intervals not greater than 15 linear feet. Where flow may be bi-directional, provide arrows adjacent to each other to indicate both directions.
   d. Pipe marker locations will be determined by ENGINEER, but in general place pipe markers where personnel view of label is unobstructed. When pipeline is overhead, install label on the two lower quarters of the pipe or pipe covering. Pipe markers shall be clearly visible from personnel operating positions, especially operating positions adjacent to valves and equipment.
   e. Provide pipe tags, where specified, at locations as specified for pipe markers.

2. Location of Valve Tags and Valve Nameplates:
    a. Valve nampeplates and valve signs for large valves shall be located on or adjacent to the valve.
    b. For smaller valves, attach tags to valve bonnet or valve flange bolts.
    c. For valves to receive equipment nameplates, as specified in this Section, install nameplate as requied for other equipment nameplates.
    d. Do not attach tags, nameplates, or signs to valve handwheels or other valve actuators.
3. Equipment Nameplates:
    a. Locate nameplates on equipment bases and on structures at readily-visible elevation in such positions relative to the equipment and structures as to prevent damage to nameplate.
    b. Position nameplace for ease of reading by operations and maintenance personnel.

3.3 PROTECTION AND CLEANING

A. After installation, clean soiled signage surfaces in accordance with manufacturer's written instructions.

B. Protect signage from damage until completion of the Work.

+ + END OF SECTION + +

SECTION 22 07 19

PIPING INSULATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install plumbing piping insulation complete with accessories on the Plant Effluent water piping above Elevation 71.75 feet.
   2. This Work also includes:
      a. Repairing all existing plumbing piping insulation in all areas that is damaged or displaced due to new construction by Contractor with materials and procedures identical to the existing plumbing piping insulation.

B. Coordination:
   1. Plumbing piping insulation shall not be installed until piping has been field tested and approved by Engineer.
   2. Review installation procedures under this and other Sections and coordinate installation of items that must be installed with or before plumbing piping insulation Work.
   3. Notify other Contractors in advance of the installation of plumbing piping insulation to provide other contractors with sufficient time for the installation of items included in their contracts that must be installed with, or before, the plumbing piping insulation Work.

C. Related Sections:
   1. Section 09 91 00, Painting.
   2. Section 10 14 00, Signage.

1.2 REFERENCES

A. American National Standards Institute (ANSI):
   1. ANSI A117.1, Guidelines for Accessible and Usable Buildings and Facilities.

B. American Society for Testing and Materials (ASTM):
   1. ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
   2. ASTM C411, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
   3. ASTM C449, Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
   4. ASTM D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.

C. National Fire Protection Association (NFPA):
   1. NFPA 255 – Standard Method of Test of Surface Burning Characteristics of Building Materials.

D. Underwriters Laboratories Inc. (UL):
   1. UL 723 – Test for Surface Burning Characteristics of Building Materials.

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer:
      a. Minimum of five years of experience producing substantially similar material and able to show evidence of at least five installations in satisfactory operation for at least five years in the continental United States.
      b. Material shall be manufactured in the United States.
   2. Installer:
      a. Engage an experienced installer to perform the work of this Section who has specialized in installing plumbing piping insulation similar to that required for this Project and who is acceptable to manufacturer.
      b. Submit name and qualifications to Engineer along with the following information on a minimum of three successful projects:
         1) Names and telephone numbers of owners, architects or engineers responsible for projects.
         2) Approximate contract cost of the plumbing piping insulation.
         3) Amount of area installed.

B. Regulatory Requirements:
   1. Americans with Disabilities Act (ADA).
   2. National Fire Protection Association (NFPA).
   3. Underwriters Laboratories Inc. (UL).
   4. Local and State Building Codes and Ordinances.
   5. Permits: Contractor shall obtain and pay for all required permits, fees and inspections.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Drawings showing fabrication methods, assembly, accessories, and installation details.
   2. Product Data:
      a. Manufacturer's literature, illustrations, specifications, weight, dimensions, required clearances, materials of construction, and performance data for all material.
      b. Deviations from Contract Documents. Any exceptions to the Contract Documents must be clearly defined. Contractor shall be responsible for any additional expenses that may occur due to any exception made.

c. Other technical data related to specified material and equipment as requested by Engineer.

B. Informational Submittals: Submit the following:
   1. Certificates:
      a. Independent certification reports:
         1) UL Label.
   2. Manufacturer Instructions:
      a. Instructions and recommendations for handling, storing, protecting the material.
      b. Installation Data.
   3. Source Quality Control Submittals:
      a. Factory test reports.
   4. Qualifications Statements:
      a. Manufacturer, when requested by Engineer.
      b. Installer, when requested by Engineer.

1.5 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling and Unloading:
   1. Deliver materials to the Site to ensure uninterrupted progress of the Work.

B. Storage and Protection:
   1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
   2. Store all material in covered storage off the ground and prevent condensation and in accordance with the manufacturer's recommendations for long-term storage.

C. Acceptance at Site:
   1. All boxes, crates and packages shall be inspected by Contractor upon delivery to the Site. Contractor shall notify Engineer, in writing, if any loss or damage exists to material or components. Replace lost material or components and repair damage to new condition, in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

A. Design Criteria:
   1. All insulation systems including covering, mastics, adhesives, sealers and facings shall have the following Fire Hazard Classifications in accordance with ASTM E84 or UL 723:
      a. Flame Spread Index: 25 maximum.
      b. Smoke Developed Index: 50 maximum.

2. All insulation systems shall not flame, glow, smolder or smoke when tested in accordance ASTM C411 at service temperature of 220 degrees F.
3. All insulation systems shall meet fire safety standard NFPA 255 where applicable.

2.2 DETAILS OF MATERIALS

A. Fiberglass Thermal Insulation:
   1. Product and Manufacturer: Provide one of the following:
      a. Model FIBERGLAS SSL II – ASJ, as manufactured by Owens Corning.
      b. Model Micro-Lok HP, as manufactured by Johns Manville.
      c. Or equal.
   2. Type: Heavy density sectional pipe insulation with a smooth, reinforced, wrinkle resistant all-service vapor retarder jacket and self-sealing adhesive lap.
   3. Density: Minimum three pound per cubic foot.
   4. Thermal Conductivity: Maximum 0.23 Btu-in/hr-ft^2-degree F at 75 degrees F mean temperature.
   5. Water Vapor Transmission: Maximum 0.02 perm.
   6. Fittings: Molded fiberglass, or pre-cut fiberglass inserts.
   7. Fittings Covers: One piece high impact polyvinyl chloride fitting covers.
   8. Jointing Materials: Manufacturer's recommended adhesives and tape.
   9. Valve Insulation: Miter cut nesting size covering segments of same thickness as pipeline, for insulation of valves.

B. Calcium Silicate Insulation at Insulation Protection Shields:
   1. Product and Manufacturer: Provide one of the following:
      a. Model Thermo-12 Gold, as manufactured by Johns Manville.
      b. Or equal.
   2. Type: Calcium silicate pipe insulation.
   3. Density: Minimum 14 pound per cubic foot.
   4. Thermal Conductivity: Maximum 0.41 Btu-in/hr-ft^2-degree F at 200 degrees F mean temperature.
   5. Compressive Strength: 100 psi.
   6. Cut insulation 1/2-inch longer than insulation shield upon which it rests.
   7. Provide manufacturer’s approved asbestos free, hydraulic setting, refractory type insulating cement for sealing seams and butt joints. Cement shall be noncorrosive to ferrous metals.
   8. Provide manufacturer’s approved asbestos free, fire retardant coating meeting ASTM C449.

2.3 ACCESSORIES

A. PVC Jacketing (for insulated piping and appurtenances located indoors, unless otherwise shown or indicated):
   1. Manufacturer: Provide product of one of the following:
      a. Childers Product Company.
      b. Certain-Teed Products Corporation.
      c. Zeston PVC Products/Schuller International, Inc.

d. Or equal.

2. Material: 25/50 PVC conforming to ASTM D1784, Class 16354-C and C-585.
3. Thickness: 20 mils.
4. Color: White.
5. Finish: Glossy.
6. Temperature: Suitable for 150 degrees F, minimum.

2.4 FINISHING

A. Field Primer and Finish Coats:
   1. All thermal insulation exterior surfaces and appurtenances shall receive field primer and finish coating in accordance with Section 09 91 00, Painting.

2.5 IDENTIFICATION

A. All plumbing piping insulation identification shall be provided in accordance with Section 10 14 00, Signage.

2.6 SOURCE QUALITY CONTROL

A. Shop Tests:
   1. Material shall be completely manufactured and pre-assembled in accordance with Reference Standards. Perform the following tests and inspections at factory before shipment:
      a. Tested and inspected for approval as a unit by Underwriters Laboratories Inc., UL Label.
      b. Factory test material to ensure that the entire package has been properly fabricated and assembled, and that the package meets the specified performance requirements including manufacturer's data report.
      c. Flame Spread.
      d. Smoke Developed.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine conditions under which materials and equipment will be installed and notify Engineer in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

B. All plumbing piping leaks shall be repaired prior to installation of plumbing piping insulation.

C. Take field measurements where required prior to installation to ensure proper fitting of Work.

3.2 INSTALLATION

A. General:
   1. Install the material in accordance with the Contract Documents and by manufacturer's instructions and recommendations. Obtain written interpretation from Engineer in the event of conflict between manufacturer's instructions and recommendations and the Contract Documents.
   2. Install in accordance with Laws and Regulations.
   3. Do not modify structures to facilitate installation of material, unless approved in writing by Engineer.
   4. Installation to conform to requirements of all local and state codes.

B. Plumbing piping insulation shall be continuous through walls and floor openings except where walls or floors are required to be firestopped or required to have a fire resisting rating.

C. Where hangers are in direct contact with low temperature piping the hanger and supporting rod shall be wrapped with foil-faced blanket insulation and vapor sealed. Hanger rod insulation and vapor barrier shall extend up to the rod a minimum distance equal to the diameter of the pipe.

D. Install insulation so as to make surfaces smooth, even, substantially flush with adjacent insulation and installed in a manner to maintain the integrity of the vapor barrier.

E. Provide insulation protection shields for insulated piping supported by pipe hangers.

3.3 CLEANING

A. Thoroughly clean and dry all exterior surfaces of plumbing piping and accessories prior to installation.

B. Remove all dirt, rust, dust, etc. from plumbing piping insulation after installation.

C. Remove and dispose of all debris and waste from the Site resulting from installation.

3.4 PROTECTION OF EXECUTED WORK

A. All insulation applied in one day shall have the vapor barrier applied the same day and any exposed ends shall be temporarily protected with a moisture barrier and sealed to the piping.

3.5 SCHEDULES

A. See Schedule below for minimum insulation thickness and locations where required.

Pipe Service (Including Valves, Fittings, and Accessories)	Pipe Size	Minimum Insulation Thickness	Location
Hot	≤1-1/2 inches	1 inch	All Piping
	>1-1/2 inches	2 inches	
Cold, Tepid (Plant Effluent)	≤2-1/2 inches	1 inch	All Piping
	>2-1/2 inches	1-1/2 inches	

B. All insulated piping exposed within six feet vertically of floor or other working surface shall be covered with PVC jacketing.

+ + END OF SECTION + +

SECTION 22 11 23

WATER BOOSTER SYSTEM

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals required to furnish and install water booster system complete and operational with pumps, motors, hydro-pneumatic tanks, control equipment and appurtenances as shown and indicated in the Contract Documents.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate installation of items that must be installed with or before water booster system Work.

C. Related Sections:
   1. Section 09 91 00, Painting.
   2. Section 40 05 53, Process Valves Four-inch Diameter and Larger.
   3. Section 40 05 93, Common Motor Requirements for Process Equipment.
   4. Section 40 61 13, Process Control System General Provisions.
   5. Section 40 67 17, Process Control Panels and Enclosures.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. American National Standards Institute (ANSI).
   2. American Society for Testing and Materials (ASTM).
   3. Institute of Electrical and Electronics Engineers (IEEE).
   4. National Electrical Code (NEC).
   5. National Sanitation Foundation (NSF).

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer: Shall have minimum of 10 years' experience producing substantially similar equipment to that required and shall be able to document of at least five installations in satisfactory operation within the last five years.

B. Component Supply and Compatibility:
   1. Single-Source Responsibility: In order to maintain a standard of compatibility, all pumps to be provided by the same manufacturer.

2. Materials and equipment shall be fully compatible with specified service conditions and shall be integrated into overall assembly by pumps, motors, control panel and accessories Supplier.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Complete layout and installation drawings for each type and size of pump showing mounting details, dimensions, fitting locations, and materials of construction.
      b. Wiring diagrams.
   2. Product Data:
      a. Complete product data for each size and type of pump, motor, and accessories, including manufacturer's brochure, specifications, weight, performance data, turndown, and capacity.
      b. Bill of Materials for equipment showing materials of construction and part numbers.
      c. Certified performance data curves showing head, capacity, horsepower demand, and pump efficiency over the entire operating range of the pump, from shutoff to maximum capacity.
      d. Motor nameplate data, as defined by NEMA, motor manufacturer, and including any motor modifications.
   3. Testing Plans:
      a. Source quality control testing plan.
      b. Field quality control testing plan.

B. Informational Submittals: Submit the following:
   1. Certificates:
      a. Paint certification.
   2. Manufacturer's Instructions:
      a. Setting drawings, templates, and directions for installing anchor bolts and other anchorage devices.
      b. Instructions for handling, storing, and installing equipment.
   3. Source Quality Control Submittals:
      a. Results of source quality control tests and inspections.
   4. Site Quality Control Submittals:
      a. Results of field quality control tests.
      b. Manufacturer's Reports: Submit a written report of results of each visit to Site by Supplier's service technician, including purpose and time of visit, tasks performed, and results obtained.
   5. Qualifications Statements:
      a. When requested by ENGINEER, submit qualifications data for manufacturer.

C. Closeout Submittals:
   1. Operation and Maintenance Data: Furnish Operation and Maintenance Manuals in conformance with the requirements of Section 01 78 23, Operations and Maintenance Data.
   2. Spare Parts, Extra Stock Materials, and Tools:
      a. Furnish the following for each type and size of pump furnished:
         1) One impeller.
         2) One set of wear rings.
         3) One set of bearings.

1.5 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling, and Unloading:
   1. Deliver materials and equipment to Site to ensure uninterrupted progress of the Work. Deliver anchorage materials to be embedded in concrete in ample time to prevent delaying the Work.
   2. Inspect all boxes, crates, and packages upon delivery to the Site and notify ENGINEER in writing of loss or damage to products. Promptly remedy loss and damage to new condition in accordance with manufacturer's instructions.
   3. Conform to Section 01 65 00, Product Delivery Requirements.

B. Storage and Protection:
   1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
   2. Store all equipment in covered storage off the ground and prevent condensation and in accordance with the manufacturer's recommendations for long-term storage.
   3. Equipment shall be tightly covered and protected against dirt, water, and chemical or mechanical damage.

C. Acceptance at Site:
   1. All boxes, crates and packages shall be inspected by CONTRACTOR upon delivery to the Site. CONTRACTOR shall notify ENGINEER, in writing, if any loss or damage exists to equipment or components. Replace lost equipment or components and repair damage to new condition, in accordance with manufacturer's instructions.

PART 2 – PRODUCTS

2.1 WATER BOOSTER SYSTEM

A. Manufacturers: Provide products of one of the following:
   1. Bell and Gossett/ITT Fluid Products Model 1531.
   2. PACO Pumps Model Type VL.

3. USEMCO.
4. Grundfos Triplex BoosterPaq
5. Or equal.

B. General: The water booster system shall be specifically designed, constructed and installed for the intended service conditions (wastewater treatment plant effluent from membrane bioreactor process) and as specified herein.
   1. Pumps shall be Vertical centrifugal, single-stage, close-coupled, end suction as indicated.
   2. All pumps shall be furnished by the same manufacturer. The pumps, motors and specified accessories shall all be provided by the pump supplier and the supplier shall take responsibility for ensuring that all the proper components are appropriate, compatible, and are incorporated in the package.
   3. Furnish a coordinated and operating skid mounted booster pump system complete with piping, strainer, pressure reducing valves, pressure gauges, isolation valves, fittings, pressure sensors, control panel with duplex pump logic controller, pump steel base, hydro-pneumatic tanks, bypass line with check valve and appurtenances required for a fully functional system.
   4. The pump system shall be factory-assembled to the maximum extent possible. All component parts not pre-assembled due to packaging and shipping concerns shall be identified and clearly labeled.
   5. Changes to the project design, including but not limited to redesign of piping, pump configuration, electrical features, control features, or structural elements due to CONTRACTOR selected equipment shall be completed by the CONTRACTOR no additional cost to OWNER.

C. Operating Conditions
   1. Water Pumps:
      a. Quantity: 3.
      b. Available Suction Pressure: 92 to 150 ft.
      c. Capacity Each:
         1) Pump No. 1 (Lead): 50 gpm at 81 ft., T.D.H.
         2) Pump No. 2 (Lag): 50 gpm at 81 ft., T.D.H.
         3) Pump No. 3 (Standby): 50 gpm at 81 ft., T.D.H.
      d. Shut-off Head: 120 ft., T.D.H.
      e. Motor RPM: 1800 or 3600 rpm.
      f. Motor Horsepower: 15 hp (max.) each.
      g. Electrical Volts/Phase/Hertz: 460/3/60.
   2. Operating Sequence: Booster pump system shall operate automatically, using hydro-pneumatic tanks, pressure transmitters and pump alternation logic, to maintain a minimum downstream pressure of 173 feet head (75 psi) with continuous flow rate of 50 gpm and also at an intermittent flow rate (30 minutes, once per day) of 100 gpm. Maximum downstream pressure shall not exceed 90 psi.

D. Pumps:
   1. Type: Vertical centrifugal, single-stage, close-coupled, end suction as indicated.
   2. Casing:
      a. Close-grained cast iron; ASTM A48 Class 30; 175 psi maximum casing working pressure; one- piece construction with bottom suction and side tangential discharge.
      b. Provide volute with smooth unobstructed fluid passages large enough at all points to pass any size solid which can pass through the impeller. Manufacture casing, adapter and frame with concentric shoulder fits to ensure accurate centering; back pull out and rotation in 45-degree increments to accommodate piping orientation independent of base location. Design casing for impeller removal without disturbing either suction or discharge piping.
      c. Provide suction and discharge threaded connections. Provide cleanout and 1/2-inch NPT drain, vent and gage connections.
   3. Impeller: One-piece, close-grained bronze 1836 C89833. Design impellers with smooth water passages. Dynamically balance impellers prior to assembly and secure to a straight fit on the shafts by means of a key and lock nut, tapered split cone and locking nut or by a splined shaft arrangement. Provide external jackscrews or shims for adjustment of the impeller axial clearance without disturbing pump, driver or piping.
   4. Wear Rings: Provide replaceable wear rings of unlike hardened stainless steel on the impeller and casing. Arrange with the wearing surfaces normal to the axis of rotation and fasten securely with recessed screws to prevent any relative rotation. Wear rings designed to compensate for a minimum of 1/8 inch wear.
   5. Pump Shafts and Sleeves: Construct pump shafts of AISI C1045 carbon steel, accurately machined and ground and polished over entire length and of sufficient size to transmit full driver output. Protect each shaft from wear in the stuffing box by a renewable bronze shaft sleeve seated to prevent leakage between the sleeve and shaft.
   6. Stuffing Box: Integrally cast with the stuffing box head, design for use with packing or mechanical seals without re-machining and fit with a removable bronze gland to facilitate packing replacement. Furnish a minimum of five rings of approved packing and Teflon seal ring.
   7. Bearings: Ball bearing, cylindrical or tapered roller type, mount in a cast iron bearing frame, arrange to eliminate all radial play and thrust and design for a minimum B-10 life of 100,000 hours in accordance with AFBMA. Provide a rigid cast iron bearing frame that completely encloses the shaft between bearings. Furnish dust-proof design bearing housings incorporating lip seals in contact with the shaft, provisions for external impeller adjustment, grease taps for bearing lubrication at top and bottom of bearing housings and provisions for the relief of grease.
   8. Structural Base:
      a. Design pump base to support the assembled weight of the pump and motor, piping and valves to safely withstand all stresses imposed thereon

by vibration, shock and all possible direct and eccentric loads. Provide adequate horizontal dimensions, foundation contact area, and anchorage facilities.

b. Provide fabricated steel base and design for easy maintenance access to stuffing box, bearing frame and coupling.

9. Guards: Provide around all exposed moving parts; comply with Laws and Regulations.

E. Motors:

1. Follow Section 40 05 93 and the following:
   a. Booster Pumps: 1.15 service factor; ODP enclosure.

F. Pump Controls:

1. Control Panel:
   a. Construction: NEMA 4X stainless steel. Dead front with hinged inside panel for support of inner-door mounted components. Provide door with quick disconnect latches, lock hasp, lock, and six keys. Follow Section 40 67 17.
   b. Electrical Service to Panel: 480 volts, three-phase, four-wire, 60 Hz.
   c. Main panel disconnect with external operating handle linked to thermal-magnetic main circuit breaker.
   d. The entire control panel shall be UL 508A listed for INDUSTRIAL CONTROL PANELS, and have all UL listed devices of "Touch-Safe" design, which shall eliminate any bare-handed shock hazard while the controller is fully powered.
   e. Adjustable magnetic trip type circuit breakers for protection of each motor.
   f. NEMA size magnetic starters with three ambient compensating overload relays for each pump motor. Provide one spare N.O. auxiliary contact for "Pump Running" and from the overload relay for remote alarm monitoring.
   g. Fused 120 V control circuit transformer (fused on all ungrounded legs) for the master control circuit. Master control circuit shall provide automatic control and alternation of pumps. Control transformer shall be sized for a minimum of 300 VA, and rated for at least 200 percent of the calculated maximum control circuit loading.
   h. HOA switch for each pump.
   i. Inside panel-mounted, elapsed time meter for measuring hours and tenths of hours running time for each pump.
   j. Provide molded case circuit breakers for each of the following circuits:
      1) Lighting fixture and duplex outlet; 15 amperes.
      2) Two spare 15 ampere, single-pole circuit breakers.
   k. Alternating relay to automatically alternate the pumps on each successive cycle of operation. Provide a three-position selector switch for selecting Pump No. 1 as lead, Pump No. 2 as lead, or selecting automatic alternation of the lead pump on each pump-down cycle.

l. Provide anti-cycling time delay circuits in the control circuitry to prevent a pump from restarting within the first 3 minutes after it has shut down.
m. Provide control circuitry to prevent simultaneous starting/operation of pumps in both HAND and AUTO modes.
n. Push buttons and selector switches: Follow Section 40 78 00.
o. Pilot Lights: Follow Section 40 78 00.
p. Equipment Identification: Follow Section 40 78 00.
q. Fluorescent fixture: Follow Section 40 78 00.
r. Receptacle: Follow Section 40 78 00.
s. 120 VAC transient surge protection: Follow Section 40 64 00.
t. Ground lug properly sized for termination of the ground wire.
u. Connect incoming and outgoing wire and cable to a master numbered terminal strip.
v. A placard shall be affixed to the inside surface of the access door of the panel displaying the connection legend and the circuit schematic. The schematic shall identify each wire, junction and termination with respect to corresponding terminals and connections in the panel. Devices and connections associated with, but exterior to, the panel shall be shown in phantom and appropriately identified. The schematic may be a miniature, plasticized copy of the connection schematic furnished, if suitable for display.

2. Pump Logic Controller:
a. Pump logic controller assembly shall be listed and bear the label of a nationally recognized test lab.
b. Pump logic controller shall be microcomputer based and hold its software in non-volatile memory. On-line field modified data entries, such as stage point, or method of staging, shall be stored in flash memory with capability to prevent accidental loss of data due to voltage surge or spike. In the event of a complete power outage, all factory preset data values remain stored and available for recall by the Operator.
c. Pump logic controller shall be powered by 115V AC power from the control power transformer within the control panel enclosure. Pump logic controller shall be equipped with a regulated 24VDC power supply to power analog input signals. Pump logic controller shall be capable of receiving four 4-20 mA analog input signals and RTD signals.
d. The staging of pumps shall be user-selectable based on kilowatts (kW), current (Amps), flow (GPM) or pressure (PSI).
e. kW shall be true power derived from a transducer. Amps shall be RMS from the kW transducer. Both kW and Amps shall be microcontroller calibrated with calibration held in non-volatile memory. PSI shall be derived from a pressure transducer with a 4-20 mA analog input. Optional flow shall be derived from a supplied and calibrated transducer with a 4-20 mA analog input.
f. Pump logic controller enclosure shall conform to NEMA 1 requirements and shall include motor starters, overloads, control power transformer and microprocessor with NEMA 4 rated operator interface.

g. Controller shall have off line and on line diagnostic software. Off line diagnostics shall consist of CPU, non-volatile memory and RAM memory test. Controller shall have digital input diagnostics, display test, program test and all analog and digital I/O user-tests. Fault information may be accessed by interrogating the pump logic controller through its HELP and log keys.

h. A data logging feature shall be provided to record historical information of key events with date and time stamps. Log information includes alarms, pump run timers, system on-off times and pump cycle counters. Data log shall display the minimum, maximum and average values of temperature, pressure and flow, as well as displaying kilowatt-hours.

i. Pump logic controller shall be powered by 115V/1ph/60Hz Hz power. The incoming power and I/O circuitry shall reject electromagnetic (EMI) and radio frequency interference (RFI). All digital outputs shall be externally isolated.

j. Pump logic controller shall be capable of operation in ambient conditions of 0 C to 60 C and a humidity range of 5% to 95%, non-condensing.

k. All external sensors/transmitters and switches shall be powered by the pump logic controller through its integral 24VDC power supply. Over voltage and short circuit protection shall be on-board. All analog circuits shall be protected from up to 575V with a fast-acting fuse and sacrificial input resistors.

l. Pump logic controller shall operate the pump(s) in a pre-determined manner as indicated in the sequence of operation.

m. Controller's user interface shall contain a 4-line x 20 character liquid crystal display with 1/4" characters.

n. Pump logic controller shall be capable of operating in automatic, manual or off-line diagnostic modes. One level of password and software security shall be provided for protection of field modifiable data.

o. Pump logic controller shall provide the following standard user selectable features:
    1) Low suction pressure alarm and cut out.
    2) High suction pressure alarm and cut out.
    3) Low system pressure alarm.
    4) High system pressure alarm and cut out.
    5) Visual alarm messages.
    6) No-flow shut down.
    7) Pump failure alarm.
    8) High temperature alarm and cut out.
    9) Low level alarm and cut out.
    10) Overload failure alarm.
    11) Automatic or manual alternation.

3. Sequence of Operation:
    a. In the “AUTO” mode, the lead pump shall start upon initiation of the system either by activation of the “START” button or by low system pressure detection of 70 psi. At 80 psi, lead pump shall be deactivated. If

system does not reach 80 psi, after a timed period, lead pump shall be de-energized, pump trouble light shall be activated, and lag pump shall be activated. Dysfunctional pump shall remain de-energized until reset after corrective maintenance. Hydro-pneumatic tanks shall provide pressurized storage to provide water to the system during periods of a no flow shutdown of the booster pump or it can provide water to replace leak loads.

b. The lead pump shall continue to run except for the following instances:
   1) Low suction pressure (automatic reset).
   2) High suction pressure (automatic reset).
   3) High system pressure (manual reset).
   4) High temperature (automatic reset).
   5) No flow (automatic reset).
   6) Motor overload (manual reset).

c. In the event of a failure due to motor overload, the next pump in sequence shall be started.

4. Alarms:
   a. Low suction pressure alarm and cutout set at 30 psi.
   b. High suction pressure alarm and cutout set at 75 psi.
   c. High system pressure alarm and cutout set at 95 psi.
   d. High temperature alarm and cutout set at 100 o F.
   e. Pump overload failure alarm.
   f. Low system pressure alarm set at 65 psi.
   g. Lead pump failure alarm.
   h. No-flow shut down.
   i. A visual indicating display mounted on the front of the panel shall display suction and discharge pressures.
   j. An alarm light shall be provided for each alarm. Only the cutout or shut down alarm occurring first shall be the only alarm light active on the panel.
   k. Each alarm shall have a common audible alarm horn with silence button. A reset button to clear the alarm once normal operation has been restored shall be provided.

2.2 ACCESSORIES

A. Provide 4-inch diameter, Type 316 stainless steel suction and discharge piping and fittings with flanged connections. Piping and all pressurized components shall be cold water rated for a minimum working pressure of 125 psi.

B. Each pump suction and discharge line shall have wafer style butterfly insolation valves; follow Section 40 05 53, Process Valves Four-inch Diameter and Larger.

C. Each pump discharge line shall have an angle type, combination pressure reducing (PRV) and check valve. Valve shall have an epoxy-coated body with bronze disc.

Valve shall be manufactured by Cla-Val Company, or equal. Each PRV shall be sized for a maximum pressure drop of 6.9 psi at the scheduled flow rate.

D. Pressure transmitters shall be installed on the suction and discharge pipe headers; provide pressure transmitter unit in accordance with the following:
   1. Manufacturers:
      a. ABB.
      b. Emerson/Rosemount.
      c. Endress & Hauser.
      d. Or equal.
   2. Quantity: Three (one as spare).
   3. Functional Features:
      a. Description: Microprocessor-based smart transmitter, capable of configuration and calibration via digital signal superimposed upon 4-20 mAdc current output signal.
      b. Service: Gage pressure.
      c. Instrument Range: 0 – 160 psi. Ratio of total instrument range as compared to measured range shall not exceed a 5:1 ratio.
      d. Span Turndown Ratio: 10 to 1, minimum.
      e. Electronic Dampening: Time constant, adjustable from 0 to 20 seconds.
      f. Output: Two-wire, 4-20 mAdc current signal proportional to measured variable.
      g. Local Indicator: Provide local indicator, calibrated to display process value in engineering units of instrument range.
   4. Physical Features:
      a. Housing: NEMA 4, low copper aluminum or stainless steel.
      b. Process Connection: 1/4 or 1/2-inch NPT on flange. Use valve manifold between instrument and sensing lines.
      c. Electrical Connection: 1/2-inch NPT conduit connection with internal screw terminals for output and test connections.
      d. Wetted Materials: Type 316 stainless steel or Hastalloy C.
      e. Body and Bolt Materials: Type 316 stainless.
      f. Fill Fluid: Silicone fill fluid.
   5. Performance:
      a. Accuracy: +0.25 percent of calibrated span, including effects of linearity, hysteresis, and repeatability.
      b. Stability (12 Months): +0.20 percent of upper range limit, including ambient temperature effects for a 50 degree F temperature change.
   6. Mounting Bracket: Pipe or angle mount.
   7. Accessories:
      a. Provide all taps, connections fittings and piping from the process lines to the instrument and accessories as part of the water booster system package.

b. Provide a two-valve, stainless steel block and bleed valve manifold for each pressure transmitter. Block and bleed valve shall allow for:
   1) Isolation and calibration of the transmitter without removing the transmitter from the process sensing line connection.
   2) Bleeding of air from the process sensing line.

E. A temperature transmitter shall be installed on the discharge pipe header; provide resistance temperature detector (RTD) unit in accordance with the following:
   1. Manufacturers:
      a. Minco Products, Inc.
      b. Ronan Engineering.
      c. Rosemount.
      d. Or equal.
   2. Operating Principle: Voltage measurement utilizing NULL-balance bridge to determine the change in resistance corresponding to the change in temperature.
   3. Service: Continuous.
   4. Sensor:
      a. Standard Resistance: 100 ohms at 32 degrees F.
      b. Process-Wetted Parts: Platinum.
      c. Accuracy: ±0.2 percent of calibrated span.
   5. Transmitter:
      a. Output: 4-20 mAdc.
      b. Enclosure: NEMA 4X.
      c. Power Supply: 24 VDC.
      d. Operating Temperature: -13 to 185 degrees F.
      e. Housing Paint: Epoxy polyester.
      f. Housing Seal: Buna-N O-rings.
      g. Indicator: None.
      h. Load: Up to 600 ohms at 24 VDC.
      i. Humidity Limits: 0-100 percent.
      j. Zero Adjustments: Face of meter.
      k. Calibration: Zero and span adjustments.
      l. Accessories: Mounting bracket for 2-inch pipe.

F. A flow switch shall be installed on the discharge pipe header; provide in accordance with the following:
   1. Manufacturer: Dwyer Instruments, or equal.
   2. Quantity: two (one as spare).
   3. Functional Features:
      a. Adjustable flow range: 0.04 to 10 fps.
      b. LED flow indicator.
      c. Measurement Method: Thermal dispersion.
   4. Physical Features:
      a. Sensor:
         1) Housing: PVDF body suitable for chemicals listed in schedule.
         2) Mounting Configuration: Tee-mount.
         3) Operations Voltage: 24 VDC.

b. Mounting Tee:
1) Construction: PVDF.
2) Size: Compatible with flow sensor.

5. Performance:
a. System Accuracy: +2 percent of full scale.
b. Repeatability: +5 percent of full scale.

G. Pumps shall be protected from thermal accumulation via a common thermal relief mechanism. Thermal purge piping shall be separate from the main manifold and shall be Type 316 stainless steel.

H. Each pump shall have Type 316 stainless steel interconnecting piping and fittings as necessary to connect to the suction and discharge pipe headers.

I. Booster system manufacturer shall provide two 90-gallon, 24-inch diameter by 61-inch-high, pre-charged hydro-pneumatic tanks with replaceable heavy-duty butyl rubber bladder and FDA approved for potable water applications. Tanks shall have a bottom NPT epoxy lined system connection and a charging valve connection standard tire valve to facilitate the on-site charging of the tank to meet system requirements. Tanks shall be fitted with lifting rings and a floor mounting skirt for vertical installation. A 3-inch diameter flanged system connection shall be provided. The tanks shall be constructed in accordance with Section VII of the ASME Boiler and Pressure Vessel Code and stamped 125-psi working pressure.

2.3 DATA PLATE

A. Material: Corrosion-resistant metal.

B. Information Engraved on Plate:
1. Manufacturer's name.
2. Pump type.
3. Pump size.
4. Serial number.
5. Speed.
6. Impeller diameter.
7. Capacity and head.
8. Frame and bearing numbers.

C. Mechanically attach plate to pump.

2.4 FINISHING

A. Shop Painting:
1. Surface preparation and painting shall conform to Section 09 91 00, Painting.
2. Apply in the shop primer coating to metallic parts (excluding surfaces exempted) of pumps, motors, drives, frames, supports, and appurtenances.

3. Do not paint corrosion-resistant parts such as plastic, fiberglass, and stainless steel.
4. Gears, bearing surfaces, machined surfaces, and other surfaces that are to remain unpainted shall receive heavy application of grease or other rust-resistant coating. Maintain coating during storage and until equipment is placed into operation.

B. Field Painting:
1. Conform to Section 09 91 00, Painting.
2. CONTRACTOR shall certify in writing that shop primer and finish coating systems are compatible with each other and conform to Section 09 91 00, Painting.

2.5 SOURCE QUALITY CONTROL

A. Booster Pumps: Test each pump in the shop as follows:
1. Test each pump at the factory in accordance with the Hydraulic Institute.
2. Standards for centrifugal pumps; submit certified performance curves.
3. Standard test motors may be used in factory test.
4. Test each pump at no less than three head conditions including shut-off head and design head.
5. All pump curves to indicate varying efficiencies, horsepower, and head versus flow, with head versus flow curve to also indicate the acceptable operating range of the pump.
6. Provide a standard NPSH curve based on testing of standard pumps.
7. Submit test data to ENGINEER for approval prior to shipment of pumps.

B. Controls: Test controls in the shop as follows:
1. Verify operation in all operating modes.
2. Inspect control components and panels for defects.
3. Perform manufacturer’s standard quality tests.

C. Valves: Test valves and appurtenances in the shop as follows:
1. Inspect components for defects.
2. Perform manufacturer’s standard quality tests.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
1. Install all items as shown, specified, and as recommended by the manufacturer.
2. Request instructions from ENGINEER, in writing, when there is a conflict between the manufacturer's recommendations and the Contract Documents.

3. Present conflicts to ENGINEER, in writing, who will determine corrective measures to be taken.
4. Do not modify structures to facilitate installation of equipment, unless specifically approved by ENGINEER.
5. Installation to conform to the requirements of all local and state codes.

3.2 FIELD QUALITY CONTROL

A. Field Tests:
1. Fill all systems and fully test all equipment, valves, etc. in operation.
2. Check for excessive vibration while all systems are operating.
3. Installed systems and components will not be released to OWNER unless all systems have been tested and approved by the ENGINEER.

B. Inspection:
1. Examine areas to receive equipment and accessories for:
   a. Defects that adversely affect execution and quality of the Work.
   b. Deviations beyond allowable tolerances for equipment and accessories.
   c. Start the Work only when conditions are satisfactory.
2. The ENGINEER reserves the right to reject and/or authorize replacement of equipment and accessories found to defective.

3.3 ADJUSTING AND CLEANING

A. Adjusting:
1. Adjust all controls for proper settings.
2. While system is operable, balance all equipment, valves, etc. to achieve design conditions.

B. Cleaning:
1. Thoroughly clean all equipment and accessories prior to installation.
2. Remove all dirt, rust, dust, etc. from equipment in preparation for painting.
3. Remove and dispose of all debris and waste from the Site resulting from installation.

3.4 MANUFACTURER'S SERVICES

A. A factory trained representative shall be provided for installation supervision, start-up and test services and operation and maintenance personnel training services. The representative shall make a minimum of 2 visits, minimum 4-hours on-Site for each visit, to the Site. The first visit shall be for assistance in the installation of equipment. Subsequent visits shall be for checking the completed installation, start-up and training of the system. Manufacturer's representative shall test operate the system in the presence of the ENGINEER and verify that the equipment conforms to the requirements. Representative shall revisit the Site as often as necessary until all trouble is corrected and the installation is entirely satisfactory.

B. All costs, including travel, lodging, meals and incidentals, for additional visits shall be at no additional cost to the OWNER.

+ + END OF SECTION + +

SECTION 23 05 29

HANGERS AND SUPPORTS FOR HVAC DUCTWORK, PIPING, AND EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, tools, equipment and incidentals as shown, specified and required to furnish and install hangers and supports complete with required appurtenances for HVAC ductwork, piping, and equipment.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before, the hangers and supports for HVAC ductwork, piping, and equipment Work.

C. Related Sections:
   1. Section 05 05 33, Anchor Systems.
   2. Section 05 12 00, Structural Steel Framing.
   3. Section 05 50 13, Miscellaneous Metal Fabrications.

1.2 REFERENCES

A. American National Standards Institute (ANSI):
   1. ANSI B1.1 – Unified Inch Screw Threads (ASME B1.1).

B. American Society of Civil Engineers (ASCE):
   1. ASCE 7 – Minimum Design Loads for Buildings and Other Structures.

C. American Society for Testing and Materials (ASTM):
   1. ASTM A36/A36M – Standard Specification for Carbon Structural Steel.
   2. ASTM A47/A47M – Standard Specification for Ferritic Malleable Iron Castings.
   3. ASTM A307 – Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
   4. ASTM A575 – Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades.
   5. ASTM A668/A688M – Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use.

D. American Welding Society (AWS):
   1. AWS B2.1 – Specification for Welding Procedure and Performance Qualification.

E. Federal Specifications (FS):
   1. FS WW-H-171 – Hangers and Supports, Pipe.

F. Manufacturers Standardization Society (MSS):
   1. MSS SP 58 – Pipe Hangers and Supports-Materials, Design and Manufacture.
   2. MSS SP 69 – Pipe Hangers and Supports - Selection and Application.

G. National Fire Protection Association (NFPA):
   1. NFPA 90A – Standard for the Installation of Air-Conditioning and Ventilating Systems.

H. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):
   1. HVAC Duct Construction Standards – Metal and Flexible.
   2. Seismic Restraint Manual: Guidelines for Mechanical Systems.
   3. Thermoset FRP Duct Construction Manual.

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer:
      a. Minimum of five years of experience producing substantially similar equipment and able to show evidence of at least five installations in satisfactory operation for at least five years in the continental United States.
   2. Professional Engineer:
      a. Engage a registered professional engineer legally qualified to practice in the State of Ohio and experienced in providing engineering services of the kind indicated.
      b. Submit qualifications data.
      c. Responsibilities include but are not necessarily limited to:
         1) Carefully reviewing system performance and design criteria stated in the Contract Documents.
         2) Preparing written requests for clarifications or interpretations of performance or design criteria for submittal to ENGINEER by CONTRACTOR.
         3) Preparing or supervising the preparation of design calculations and related drawings, Shop Drawings, testing plan development, test-result interpretation and a comprehensive engineering analysis verifying compliance of the system with the requirements of the Contract Documents.
         4) Signing and sealing all calculations and design drawings, and Shop Drawings.
         5) Certifying that:
            a) it has performed the design of the system in accordance with the performance and design criteria stated in the Contract Documents, and
            b) the said design conforms to all applicable local, state and federal codes, rules and regulations, and to the prevailing standards of practice.

3. Installer:
    a. Engage an experienced installer to perform the work of this Section who has specialized in installing hangers and supports for HVAC ductwork, piping, and equipment similar to that required for this Project and who is acceptable to manufacturer.
    b. Submit name and qualifications to ENGINEER along with the following information on a minimum of three successful projects:
        1) Names and telephone numbers of owners, architects or engineers responsible for projects.
        2) Approximate contract cost of the hangers and supports for HVAC ductwork, piping, and equipment.
        3) Amount of area installed.
4. Welding:
    a. Qualify processes and operators in accordance with AWS B2.1 as appropriate for material to be welded.
    b. Provide certification that operators employed on or to be employed for the Work have satisfactorily passed AWS qualification tests within previous 12 months. Ensure that all certifications are current.

B. Component Supply and Compatibility:
1. Obtain all equipment included in this Section regardless of the component manufacturer from a single hangers and supports for HVAC ductwork, piping, and equipment manufacturer.
2. Require the hangers and supports for HVAC ductwork, piping, and equipment manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.
3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall equipment assembly by the hangers and supports for HVAC ductwork, piping, and equipment manufacturer.

C. Regulatory Requirements:
1. International Building Code (IBC).
2. National Fire Protection Association (NFPA).
3. Local and State Building Codes and Ordinances.
4. Permits: CONTRACTOR shall obtain and pay for all required permits, fees and inspections.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
1. Shop Drawings:
    a. Drawings showing fabrication methods, assembly, accessories, and installation details.
    b. Setting drawings, templates, and directions for the installation of anchor bolts and other anchorages.
    c. Drawings showing floor supported components and installation arrangement.

2. Product Data:
    a. Manufacturer's literature, illustrations, specifications, weight, dimensions, required clearances, materials of construction, and performance data for all equipment.
    b. Complete component list.
    c. Detailed description of each component.
    d. Catalog cut sheets for each component.
    e. Deviations from Contract Documents. Any exceptions to the Contract Documents must be clearly defined. Contractor shall be responsible for any additional expenses that may occur due to any exception made.
    f. Other technical data related to specified material and equipment as requested by Engineer.
3. Delegated Design Submittals:
    a. 1/4-inch scale HVAC ductwork, piping, and equipment layouts, dimensioned to show length of runs, with all expansion joints, alignment guides, anchors and appurtenances required for proper control of HVAC ductwork, piping, and equipment forces. The drawings shall include all forces acting on the HVAC ductwork, piping, and equipment and the corresponding reactions of the compensation and anchor devices provided.
    b. All drawings, design calculations, and a letter indicating that the hanger and support systems have been properly designed shall be signed and sealed by a registered professional engineer legally qualified to practice in Ohio.

B. Informational Submittals: Submit the following:
1. Certificates:
    a. Independent certification reports.
2. Manufacturer Instructions:
    a. Instructions and recommendations for handling, storing, protecting the equipment.
    b. Installation Data.
3. Source Quality Control Submittals:
    a. Factory test reports.
4. Qualifications Statements:
    a. Manufacturer, when requested by ENGINEER.
    b. Professional Engineer, when requested by ENGINEER.
    c. Installer, when requested by ENGINEER.
    d. Welding, when requested by ENGINEER.

1.5 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling and Unloading:
1. Deliver materials to the Site to ensure uninterrupted progress of the Work.
2. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete, in ample time to prevent delay of that Work.
3. Comply with manufacturer's recommendations for rigging of equipment.

B. Storage and Protection:
   1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
   2. Store all equipment in covered storage off the ground and prevent condensation and in accordance with the manufacturer's recommendations for long-term storage.

C. Acceptance at Site:
   1. All boxes, crates and packages shall be inspected by Contractor upon delivery to the Site. Contractor shall notify Engineer, in writing, if any loss or damage exists to equipment or components. Replace lost equipment or components and repair damage to new condition, in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

A. Design Criteria:
   1. Seismic Requirements:
      a. Where required by local codes, all HVAC ductwork, piping, and equipment shall be provided with seismic restraints in accordance with the SMACNA Seismic Restraint Manual: Guidelines for Mechanical Systems, latest edition.
      b. Seismic restraints shall be designed in accordance with the seismic provisions of the International Building Code (IBC) and ASCE 7 in conjunction with the current Ohio Building Code to the extent that the most stringent provisions are utilized in developing the design seismic forces.
   2. Designs generally accepted as exemplifying good engineering practice and using stock or production parts shall be utilized wherever possible.
   3. Accurate weight balance calculations shall be made to determine the required force at each hanger and support location and the weight load at each force concentration point.
   4. Hangers and supports shall be capable of supporting and restraining HVAC ductwork, piping, and equipment in all conditions of operation. They shall allow free expansion and contraction, and prevent excessive stress resulting from transferred weight being induced into the HVAC ductwork, piping, and equipment.
   5. Hangers and supports shall be designed so that they cannot become disengaged by movements of the supported HVAC ductwork, piping, and equipment.
   6. Rod length shall be limited to a maximum length of eight linear feet.
   7. HVAC ductwork, piping, and equipment that cannot be hung by rod and hanger arrangement shall be floor or wall supported.
   8. All structural components shall be designed based on static and dynamic loads imposed by the supported HVAC ductwork, piping, and equipment and shall include a safety factor of 2 for the yield strength. Minimum angle sizes shall be 2-inch x 2-inch x1/4-inch.

9. Support from hollow core slabs or double tee slabs shall be per Section 05 05 33 Anchor Systems. The Centrifuge Room roof consists of a hollow core slab.
10. Load ratings, materials and installation shall be consistent with the recommendations from the latest edition of MSS SP 58, MSS SP 69, and FS WW-H-171.
11. Hanger and support design calculations for all HVAC ductwork, piping, and equipment shall be signed and sealed by a registered professional engineer legally qualified to practice in the State of Ohio.

2.2 MANUFACTURERS

A. Manufacturer: Provide product of one of the following:
   1. Erico International Corporation.
   2. Anvil International.
   3. Or equal.

2.3 DETAILS OF CONSTRUCTION

A. Materials:
   1. Hangers, supports, restraints, and appurtenances located in wet and corrosive areas shall be Type 316 stainless steel. Fiberglass reinforced plastic (FRP) hangers and supports shall be allowed for nonmetal ductwork only.
   2. Hangers, supports, restraints, and appurtenances located in non-corrosive or dusty areas shall be hot dipped galvanized steel.
   3. Hangers, supports, restraints, and appurtenances located outdoors shall be Type 316 stainless steel.
   4. Steel used for the support of uninsulated copper piping or plastic piping shall be PVC coated.
   5. The Centrifuge Room of the Sludge Handling Building is considered to be a wet and corrosive area.

B. Components of hangers and supports shall conform to the following:
   1. Bolts: ASTM A307, Grade A, unless otherwise specified below.
   2. Forgings: ASTM A668/A688M.
   3. Malleable Iron: ASTM A47/A47M.
   4. Rods and Bars: ASTM A575.
   5. Threads: Unified Screw Threads, Class 2A and 2B, ANSI B1.1.
   6. Structural Steel: ASTM A36/A36M.

C. Hanger Attachments: The following types of attachments shall be considered acceptable:
   1. Adjustable Steel Clevis: FS WW-H-171E, Type 1.
   2. Steel Double Bolt Pipe Clamp: FS WW-H-171E, Type 3.
   3. Steel Pipe Clamp: FS WW-H-171E, Type 4.
   4. Adjustable Swivel Pipe Ring: FS WW-H-171E, Type 6.
   5. Adjustable Steel Band Hanger: FS WW-H-171E, Type 7.
   6. Riser Clamp: FS WW-H-171E, Type 8.
   7. Light-Duty Clevis Hanger: FS WW-H-171E, Type 12.
   8. Long Clips: FS WW-H-171E, Type 26.

9. Offset J-Hooks: FS WW-H-171E, Type 27.
10. Steel Pipe Covering Protection Saddle: FS WW-H-171E, Type 40A.
11. Insulation Protection Shield: FS WW-H-171E, Type 41.
12. Pipe Saddle Support: FS WW-H-171E, Type 37.
13. Pipe Stanchion Saddle: FS WW-H-171E, Type 38.
14. Pipe Saddle Support with Base: FS WW-H-171E, Type 36.
15. Adjustable Roller Hanger: FS WW-H-171E, Type 42.

D. Structural Attachments: The following types of attachments shall be considered acceptable:
1. Side Beam Clamp: FS WW-H-171E, Type 20.
2. Center I-Beam Clamp: FS WW-H-171E, Type 21.
3. Welded Steel Bracket: FS WW-H-171E, Types 32 and 33.
4. Side Beam Bracket: FS WW-H-171E, Type 35.

E. Hanger Rod Attachments: Use as required to complete assembly:
1. Forged Steel Clevis: FS WW-H-171E, Type 14.
2. Adjustable Turnbuckle: FS WW-H-171E, Type 15.
3. Forged Steel Welders Eye Nut: FS WW-H-171E, Type 17.

F. Concrete anchorage shall be provided in accordance with Section 05 05 33, Anchor Systems.

G. Structural steel shall be provided in accordance with Section 05 12 00, Structural Steel Framing.

H. Miscellaneous metal fabrications shall be provided in accordance with Section 05 50 13, Miscellaneous Metal Fabrications.

2.4 SOURCE QUALITY CONTROL

A. Shop Tests:
1. Equipment shall be completely manufactured and pre-assembled in accordance with Reference Standards. Perform the following tests and inspections at factory before shipment:
a. Tested and inspected for approval as a unit by Underwriters Laboratories Inc., UL Label or equal.
b. Factory test equipment to ensure that the entire package has been properly fabricated and assembled, that the package meets the specified performance requirements including manufacturer's data report.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine conditions under which materials and equipment will be installed and notify Engineer in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

B. Take field measurements where required prior to installation to ensure proper fitting of Work.

3.2 PREPARATION

A. Support from Hollow Core or Double Tee Slabs:
   1. Attachment to hollow core slabs or double tee slabs shall be provided in accordance with requirements of Section 05 05 33 Anchor systems to prevent damage to pre-stressing strands.

3.3 INSTALLATION

A. General:
   1. Install the equipment in accordance with the Contract Documents and by manufacturer's instructions and recommendations. Obtain written interpretation from Engineer in the event of conflict between manufacturer's instructions and recommendations and the Contract Documents.
   2. Install in accordance with Laws and Regulations.
   3. Do not modify structures to facilitate installation of equipment, unless approved in writing by Engineer.
   4. Installation to conform to requirements of all local and state codes.

B. Ductwork:
   1. The construction and installation of hangers and supports for ductwork shall conform to the recommendations given in the SMACNA HVAC Duct Construction Standards, the SMACNA Seismic Restraint Manual, and the SMACNA Thermoset FRP Duct Construction Manual, except as specified.
   2. Hanger rods shall have threaded ends.
   3. All ductwork shall be supported from trapeze type hangers. No sheet metal duct hangers or straps will be allowed.
   4. A pair of rods shall be provided at each duct support point.
   5. For nonmetal ductwork, there shall be not less than a 1/4-inch buildup of FRP over the duct at each support. Each support shall be furnished with a 1/8-inch thick Teflon sheet to shield the duct from the support.

C. Piping:
   1. Insulated pipes with vapor barriers shall have an insulation protection shield conforming to FS WW-H-171E, Type 41 tack-welded to hanger.
   2. Insulated pipes without vapor barriers shall have a steel protection saddle conforming to FS WW-H-171E, Type 40A.
   3. All uninsulated copper piping shall be supported by plastic coated steel pipe attachments.
   4. All piping shall be braced as required, to prevent sway in any direction.
   5. All insulated piping 3-inch diameter and larger shall be supported by roller hangers conforming to FS WW-H-171E, Type 42.
   6. Additional supports shall be placed immediately adjacent to any change in direction.

7. Supports for Vertical Piping:
    a. Provide riser clamp placed under hub, fitting or coupling with approved solid bearing on steel sleeve at each floor level.
    b. Where riser clamps are used with plastic piping they shall be modified so as not to exert any compressive forces on the pipe.
    c. Support spacing shall not exceed code requirements.
8. Allow clearances for expansion and contraction of piping.

D. Anchorages and Base Plates:
    1. Provide anchorages in new or existing concrete, as applicable, in accordance with equipment manufacturer's recommendations and the Contract Documents. Install anchors in accordance with Section 05 05 33, Anchor Systems.

3.4 ADJUSTING

A. Adjust all equipment for proper settings.

3.5 CLEANING

A. Thoroughly clean all equipment and accessories prior to installation.

B. Remove all dirt, rust, dust, etc. from equipment and accessories after installation.

C. Remove and dispose of all debris and waste from the Site resulting from installation.

3.6 SCHEDULES

A. Hangers and Supports for Ductwork:
    1. Spacing:
        a. Ductwork shall be supported at distances not exceeding the spacing specified below:
            1) Metal Ductwork:
                a) Maximum Spacing: 10 feet.
            2) Flexible and Other Factory-Made Ductwork (such as FRP):
                a) Maximum Spacing: In accordance with the manufacturer's installation instructions.
                b) Maximum hanger spacing shall be 8 feet for ducts with half perimeter up to 72 inches and 6 feet for ducts with half perimeter larger than 72 inches.
                c) Support shall be furnished at each fitting.
    2. Hanger Rod Sizes:
        a. Hanger rods shall be sized based on static and dynamic loads imposed by the supported ductwork and shall include a safety factor of 2 for the yield strength.
        b. Rod load shall not exceed rod manufacturer's recommended capacity.

B. Hangers and Supports for Piping:
   1. Spacing:
      a. Piping shall be supported at distances not exceeding the spacing specified below or in accordance with MSS SP 69:
         1) Copper Tube:
            a) Maximum Horizontal Spacing: 6 feet.
            b) Maximum Vertical Spacing: 10 feet.
         2) Copper Pipe:
            a) Maximum Horizontal Spacing: 12 feet.
            b) Maximum Vertical Spacing: 10 feet.
         3) Steel Pipe:
            a) Maximum Horizontal Spacing: 12 feet.
            b) Maximum Vertical Spacing: 15 feet.
   2. Hanger Rod Sizes:
      a. Hanger rods shall be sized based on static and dynamic loads imposed by the supported piping and shall include a safety factor of 2 for the yield strength.
      b. Rod load shall not exceed rod manufacturer's recommended capacity.

C. Hangers and Supports for HVAC Equipment:
   1. Provide spacing and hanger rod sizes in accordance with equipment manufacturer's installation instructions.

+ + END OF SECTION + +

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, tools, equipment and incidentals as shown, specified, and required to perform the testing, adjusting, and balancing for HVAC as specified herein.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before, the testing, adjusting, and balancing for HVAC Work.

C. Related Sections:
   1. Section 10 14 00, Signage.

1.2 REFERENCES

A. Associated Air Balance Council (AABC):
   1. AABC National Standards for Total System Balance.

B. American National Standards Institute/American Industrial Hygiene Association (ANSI/AIHA):
   1. ANSI/AIHA Z9.5 – Laboratory Ventilation.

C. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
   1. ASHRAE Handbook – Fundamentals.

D. National Environmental Balancing Bureau (NEBB):
   1. NEBB Procedural Standards for Testing Adjusting Balancing of Environmental Systems.

E. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):
   1. SMACNA HVAC Systems – Testing, Adjusting & Balancing Handbook.

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Balancer:
      a. Engage an experienced balancer to perform the work of this Section who has specialized in testing, adjusting, and balancing for HVAC systems similar to that required for this Project.
      b. Minimum of five years of experience in testing, adjusting, and balancing substantially similar equipment and able to show evidence of at least five installations in satisfactory operation for at least five years in the continental United States.
      c. Submit name and qualifications to Engineer along with the following information on a minimum of five successful projects:
         1) Names and telephone numbers of owners, architects or engineers responsible for projects.
         2) Approximate contract cost of the testing, adjusting, and balancing for HVAC Work.
         3) Amount of area tested, adjusted, and balanced.
         4) Biographical information on employee proposed to directly supervise the testing, adjusting, and balancing Work.

B. Regulatory Requirements:
   1. Associated Air Balance Council (AABC).
   2. National Electrical Code (NEC).
   3. National Environmental Balancing Bureau (NEBB).
   4. National Fire Protection Association (NFPA).
   5. Underwriters Laboratories Inc. (UL).
   6. Local and State Building Codes and Ordinances.
   7. Permits: CONTRACTOR shall obtain and pay for all required permits, fees and inspections.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Valve Charts:
         1) Frame and Glazing: 1/8-inch sheet acrylic in 8-1/2 by 11-inch extruded aluminum frame.
         2) Charts shall be typed with the following information for each valve:
            a) Valve identification number.
            b) Valve location.
            c) Valve use.
            d) Valve size.
            e) Manufacturer’s name and model.

2. Product Data:
    a. Data sheets with name of devices, manufacturer's name, model number, latest date of calibration, and correction factors for each testing, adjusting, and balancing instruments.
    b. Other technical data related to specified material and equipment as requested by Engineer.
3. Samples:
    a. Valve tags with sample identification lettering.

B. Informational Submittals: Submit the following:
1. Certificates:
    a. Certification by National Environmental Balancing Bureau (NEBB), Association Air Balance Council (AABC), or equal.
2. Source Quality Control Submittals:
    a. Specimen copies of report forms for Engineer's review and approval.
        1) Forms shall be 8-1/2 by 11-inch paper for loose-leaf binding, with blanks for certification of report and listing all required testing, adjusting, and balancing requirements and ratings.
3. Field Quality Control Submittals:
    a. Written startup and field test reports presenting results of required field testing, adjusting, and balancing.
        1) Certified reports shall be in typed format on approved forms imprinted with the company's name.
        2) Reports shall include procedure outline used to test, adjust, and balance the systems and the types of instruments used.
        3) Minimum three certified copies of testing, adjusting, and balancing reports to the ENGINEER for review.
        4) Reports must be submitted to ENGINEER and OWNER for approval prior to OWNER's acceptance for responsibility.
4. Qualifications Statements:
    a. Balancer, when requested by ENGINEER.

C. Closeout Submittals: Submit the following:
    a. Check List:
        1) Provide a checklist and post a copy of it, where directed by the OWNER.
        2) Include each piece of equipment specified or shown.
        3) Provide four columns for required quarterly inspections.
        4) Provide columns for the following:
            a) Equipment condition.
            b) Equipment operation.
            c) Equipment lubrication.
            d) Preventive maintenance.

5) Preventive maintenance shall be performed in accordance with the manufacturer's recommendations and accepted practice.

2. Operations and Maintenance Data:
   a. Submit complete Installation, Operation and Maintenance Manuals, including, test reports, maintenance data and schedules, description of operation, and spare parts information.
   b. Furnish Operation and Maintenance Manuals in conformance with the requirements of Section 01 78 23, Operations and Maintenance Data.

1.5 SITE CONDITIONS

A. Environmental Requirements:
   1. Testing, adjusting, and balancing for HVAC shall be performed when outside ambient conditions are approximate to the local ASHRAE Handbook – Fundamentals design conditions (between 1.8 degrees F and 88.7 degrees F) for all ventilating functions.

PART 2 - PRODUCTS

2.1 EQUIPMENT PERFORMANCE

A. Equipment Description:
   1. Air Balance Instruments:
      a. Provide all velometers, anemometers, pitot tubes, differential air pressure gages, manometers, hook gages, static pressure probe units, and all other instruments and accessories as required to perform all air balance tests of HVAC equipment, ducts, registers, grilles, etc.
      b. Flow-measuring hoods (manufactured, not fabricated) shall be acceptable for measurement of ceiling diffuser performance only.
   2. System Performance Measuring Instruments:
      a. Provide insertion thermometers, sling psychrometers, tachometers, revolution counters, clamp-on volt-ammeter recorders, and other instruments as required to measure all facets of the complete HVAC system performance.

B. Performance Criteria:
   1. Instrumentation shall be in accordance with NEBB, AABC, or SMACNA requirements and shall be calibrated to the accuracy standards demanded by these organizations.

2.2 ACCESSORIES

A. Balancing Sheaves and Belts:
   1. Balancing sheaves and belts shall be provided for all belt driven equipment.

2. Sheaves and belts shall be provided to match construction and duty provided by the equipment manufacturer.
3. Equipment sheaves and belts replaced or not required to achieve balancing shall be submitted to the OWNER as spare parts.

2.3 IDENTIFICATION

A. All equipment and component identification, including valve tags, shall be provided in accordance with Section 10 14 00, Signage.

PART 3 - EXECUTION

3.1 INSPECTION

A. Heating, ventilating and air conditioning equipment and components shall be completely installed and in continuous operation, as required, to accomplish the testing, adjusting and balancing Work specified.

B. Inspect all HVAC equipment and components for proper operation prior to testing, adjusting and balancing.
   1. Fan Belt Deflection: Not less than 1/4-inch or more than 1/2-inch.

C. Pre-Startup Inspection:
   1. Verify proper equipment mounting and setting.
   2. Verify that control, interlock and power wiring is complete.
   3. Verify alignment of motors and drives.
   4. Verify proper piping connections and accessories.
   5. Verify that lubrication is completed.

D. First Run Observations:
   1. Verify direction of rotation.
   2. Verify setting of safety controls.
   3. Monitor heat build-up in bearings.
   4. Check motor loads against nameplate data.

E. Equipment Check:
   1. Verify proper overload heater sizes.
   2. Verify function of safety and operating controls.
   3. Verify proper operation of equipment.
   4. Report on inspection, observation and checking procedures.

F. Promptly report defects which may affect the Work to ENGINEER.

G. Should corrective measures caused by faulty installation require re-testing, adjusting and balancing, such Work shall be at no additional cost to the OWNER.

3.2 APPLICATION

A. General:
   1. Test, adjust, and balance all systems, ductwork, piping, etc. and their control systems in accordance with the AABC National Standards for Total System Balance, NEBB Procedural Standards for Testing Adjusting Balancing of Environmental Systems, SMACNA HVAC Systems - Testing, Adjusting & Balancing Handbook, or in compliance with the standard procedure manual published by the testing, adjusting, and balancing organization affiliated with CONTRACTOR. CONTRACTOR shall submit one copy of the standard procedure manual to the ENGINEER for their records.
   2. CONTRACTOR shall provide all necessary instruments, tools, ladders, etc. to complete all testing, adjusting, and balancing Work.
   3. CONTRACTOR shall assume full responsibility for safe keeping of all instruments, tools, ladders, etc. during the course of the Work.
   4. CONTRACTOR shall be solely responsible for the protection and safeguarding of the Work and shall provide every protection against accidents, injury, and damage to persons and property.
   5. CONTRACTOR shall keep dust, dirt, and debris to an absolute minimum and reinstall all removed ceiling components to their original positions at the end of each day's Work.
   6. CONTRACTOR shall be fully responsible for removal and reinstallation of ceiling system and replacement of any component damaged.
   7. CONTRACTOR shall install additional access panels at no extra cost to the OWNER, as is required to gain access to equipment concealed above ceilings, behind walls, or any other concealed space.
   8. Systems shall be tested, adjusted, and balanced with clean filters and strainers.
   9. Where equipment is provided with a variable speed controller (VSC) or variable frequency drive (VFD), balance the equipment first with the VSC or VFD and then with balancing dampers (air systems) or valves (hydronic systems). All systems shall be optimized through the VSC or VFD by balancing with the minimum static pressure needed to meet design flow conditions.

B. Air Systems:
   1. Preliminary:
      a. Identify and list size, type and manufacturer of all equipment to be tested, including air terminals.
   2. Central Systems:
      a. Test rpm for all equipment, including adjusting of each fan, air handling unit, and air conditioning unit to design requirements within the limits of mechanical equipment provided.
      b. Test and record motor voltages and running amperes including motor nameplate data, and starter heater ratings for each unit as listed above.

c. Make pitot tube traverse of main supply, exhaust and return ducts, determine airflow at all fans and units and adjust fans and units to within five percent of design requirements.
d. Test and record system static pressure, suction and discharge.
e. Test and adjust system for design outside air, (cfm).
f. Test and adjust system for design recirculated air, (cfm).
g. Test and record heating apparatus entering air temperatures, (dry bulb).
h. Test and record cooling apparatus entering air temperatures, (dry bulb and wet bulb).
i. Test and record heating apparatus leaving air temperatures, (dry bulb).
j. Test and record cooling apparatus leaving air temperatures, (dry bulb and wet bulb).
k. Record all fan and air handling unit speeds.
l. Record air quantity delivered by each fan and air-handling unit.

3. Distribution:
   a. Sheave and belt replacement shall be provided as the first means of accomplishing the balancing Work before volume dampers are adjusted from their initial open positions.
   b. Adjust volume dampers, control dampers, splitter dampers, etc., to proper design airflow in main ducts, branch ducts, and zones.
4. Air Terminals:
   a. Identify each air terminal as to location and determine required flow reading.
   b. Test and adjust each air terminal to within tolerance of design requirements as listed below.
      1) Positive Zones:
         a) Diffusers and Supply Air Terminals: 0 percent to +10 percent.
         b) Exhaust and Return Air Terminals: 0 percent to -10 percent.
      2) Negative Zones:
         a) Diffusers and Supply Air Terminals: 0 percent to -10 percent.
         b) Exhaust and Return Air Terminals: 0 percent to +10 percent.
      3) Neutral Zones:
         a) All Air Terminals: -10 percent to +10 percent.
   c. Test procedure on air terminals shall include recording comparison of required airflow and observed airflow, adjustment of terminal, and recording of final airflow.
   d. Adjust flow patterns from air terminal units to minimize drafts to the extent that the design and equipment permits.
5. Verification:
   a. Prepare summation of readings of observed airflow for each system, compare with required airflow, and verify that duct losses are within specified allowable range.
   b. Verify design airflow at fans as described above.

c. If determined that the air system has not been properly balanced, CONTRACTOR shall rebalance and recheck all equipment and components in the presence of the ENGINEER and as accepted by the ENGINEER.

3.3 FIELD QUALITY CONTROL

A. Balancer's Services:
   1. Provide a qualified, factory-trained service person to perform the following:
      a. After HVAC equipment installation, inspect and adjust equipment, verify proper operation, and assist with field testing.
      b. Instruct operations and maintenance personnel in operation and maintenance of the equipment.
   2. Balancer's service person shall make visits to the Site as follows:
      a. First visit shall be for checking completed installation, start-up of system; and performing field testing. Minimum number of hours on-Site: 8 hours.
      b. Second visit shall be to instruct operations and maintenance personnel.
         1) Furnish services of balancer's qualified, factory-trained specialists to instruct operations and maintenance personnel in recommended operation and maintenance of equipment.
         2) Training requirements, duration of instruction, and qualifications shall be in accordance with Section 01 79 23, Instruction of Operations and Maintenance Personnel.
         3) Number of hours on-Site shall be in accordance with Section 01 79 23, Instruction of Operations and Maintenance Personnel.
      c. Technician shall revisit the Site as often as necessary until installation is acceptable.
   3. All costs, including expenses for travel, lodging, meals and incidentals, and cost of travel time, for visits to the Site shall be included in the Contract Price.

3.4 SCHEDULES

A. Test, adjust, and balance the fan, air terminal devices and ductwork, associated with the following HVAC equipment:
   1. Existing Biofilter Fan.

+ + END OF SECTION + +

SECTION 23 31 16

NON-METAL DUCTWORK AND ACCESSORIES

PART 1 - GENERAL

1.1 DESCRIPTION

A. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install all fiberglass reinforced plastic (FRP) non-metal ductwork complete with auxiliary equipment and accessories as shown, specified and/or required for proper operation.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before FRP ductwork and accessories Work.

C. Related Sections:
   1. Section 05 05 33, Anchor Systems.
   2. Section 09 91 00, Painting.
   3. Section 10 14 00, Signage.
   4. Section 23 05 29, Hangers and Supports for HVAC Ductwork, Piping, and Equipment.
   5. Section 23 05 93, Testing, Adjusting, and Balancing for HVAC.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM):
   1. ASTM C581-655, Tentative Method of Test for Chemical Resistance of Thermosetting Resins Used in Glass Fiber Reinforced Structures.
   2. ASTM D2310, Classification for Machine-Made Reinforced Thermosetting Resin Pipe.
   3. ASTM D2563, Classifying Visual Defects In Glass Reinforced Plastic Laminate Parts.
   4. ASTM D2583, Test for Indentation Hardness of Plastics by Means of a Barcol Impressor.
   5. ASTM D2996, Filament-Wound Reinforced Thermosetting Resin Pipe.
   6. ASTM D4024, Reinforced Thermosetting Resin Flanges.
   7. ASTM D4097, Contact Molded Glass Fiber Reinforced Thermoset Chemical Resistant Tank.

B. National Bureau of Standard's Voluntary Product Standard:
   1. NBS PS 15-69, Standard for Contact-Molded Reinforced Polyester Chemical Resistant Process Equipment.

C. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):
   1. HVAC Duct Construction Standards.
   2. Thermoset FRP Duct Construction Manual.

D. Underwriters Laboratories Inc. (UL):
   1. UL 181, Factory-Made Air Ducts and Air Connectors.
   2. UL 555, Fire Dampers.

1.3 SUBMITTALS

A. Shop Drawings: Submit the following:
   1. 1/4-inch scale duct layouts.
   2. Dimensions.
   3. Details of construction.
   4. Details of installation, hanger details and spacing.
   5. Manufacturer's literature, illustrations, specifications and Engineering data.
   6. Duct sealants.
   7. Specifications for FRP resins and reinforcing material used.
   8. Specifications for fire-retardant epoxy FRP ductwork coating and reinforcing material used.
   9. Specification of FRP ductwork laminate construction including schedule of duct sizes indicating weight per foot, wall thickness and all other data required for indicating conformance to the Specification. Submit procedures for hand layup of duct joints.
   10. Submit FRP rectangular duct schedule with sizes, thickness, vacuum pressure, and weight per foot pressure, spans, and joint type and flange data.
   11. Delegated Design: Submit all wall thickness calculations, signed and sealed by a Professional Engineer (P.E.) licensed in the State of Ohio and experienced in this type of work.
   12. Accessories.
   13. Certification that all stainless steel accessories, and hardware are of the Type specified.
   14. Electrical equipment and device coordination drawings and connection information.
   15. Existing ductwork coordination drawings and connection information.
   16. Other technical data related to the specified material and equipment as requested by ENGINEER.

B. Record Drawings:
   1. During progress of the Work keep an up-to-date set of the Drawings showing field and Shop Drawing modifications. Immediately upon completion of work submit CADD drawings showing the actual in-place installation of all ductwork and equipment installed under this Section at a scale satisfactory to the OWNER. The Drawings shall show all ductwork on plans and in sections, with all reference dimensions and elevations required for complete Record Drawings of the systems. Two paper prints shall also be furnished. The prints

and electronic copies of the CADD files shall be furnished no later than 30 days after completion of the Contract and prior to final payment.

C. Submit a letter stating that the proposed resins proposed in the fabrication of the FRP ductwork will give satisfactory performance under the specified service conditions or a corrosion resistance chart indicating same.

D. Manufacturer's certified literature indicating compliance with proposed pressure and vacuum classification.

E. Tabulation in checklist forms to indicate compliance with ASTM D2563 Table I, Level II visual acceptance levels.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications:
   1. Engage a single firm, with undivided responsibility for performance and other requirements and components of the ductwork.
   2. Engage a firm, which can show successful experience in the fabrication of ductwork systems of scope and type similar to the required Work.

B. Installer Qualifications:
   1. CONTRACTOR shall have at least five years experience in the installation of the Work specified. Contractor shall employ only trademen with specific skills and experience in this type of Work.
   2. CONTRACTOR shall have undivided responsibility as a single firm for performance and other requirements for the installation of the Work specified herein.

C. Regulatory Agencies:
   1. National Electrical Code (NEC).
   2. National Fire Protection Association (NFPA).
   3. Underwriters Laboratories, Incorporated (UL).
   4. Local and State Building Codes and Ordinances.
   5. Permits: Contractor shall obtain and pay for all required permits, fees and inspections.

1.5 GENERAL REQUIREMENTS

A. All work shall be constructed and installed properly in accordance with the recommendations given in the latest edition of the Sheet Metal & Air Conditioning Contractors National Association (SMACNA) Thermoset FRP Duct Construction Standards.

B. All ducts shall conform accurately to the dimensions indicated on the Contract Drawings, shall be straight and smooth on the inside with neatly finished joints, and shall not be decreased at any point to avoid obstructions. No piping, conduit or structural work shall be installed in or through any ductwork. All ductwork

shall be run as close as possible to structural members, walls and ceilings. Ductwork shall be as shown on the contract drawings, subject to such modifications as may be necessary to suit field conditions to clear any obstruction or conflicts with other equipment.

C. All ductwork shall be securely hung and anchored to the building structure. Unless otherwise shown or specified, hangers and stiffeners for ducts shall conform with the recommendations given in the SMACNA Thermoset FRP Duct Construction standards. Ducts shall be supported on trapeze hangers with angles or rods. Use of strap hangers and straps is prohibited.

D. Resin cure for all FRP ductwork shall be checked by Barcol hardness and acetone tests. Hardness shall be within 90 percent of resin manufacturer's specification. Barcol test shall be required for inside and outside surfaces of all fiberglass fabrications in accordance with ASTM D2583.

E. Prior to final inspection, all surfaces shall be made clean by brushing, wiping, or with a compressed-air blast to remove all loose foreign materials.

F. A thorough inspection of each piece of ductwork will be conducted upon arrival at construction site to inspect for damage incurred in transit. Any damage shall be immediately repaired by respective equipment fabricators personnel (not a sales representative)

G. Where existing walls, floors or roofs must be penetrated; CONTRACTOR shall neatly cut the required openings and patch the existing work to provide a neat and finished appearance.

H. The Drawings do not indicate, all offsets, fittings, accessories and details, which may be required. CONTRACTOR shall examine all of the General Construction, Electrical, Mechanical, Structural and other Drawings and the respective Specifications for conditions which may affect the installation of the Work, and shall arrange the Work accordingly, furnishing all required items to meet such conditions which are not specified as work "by others", to complete the systems to the true extent of the Contract Documents.

I. Coordination with existing ductwork. CONTRACTOR to examine existing ductwork that is to be reused and shall coordinate flange connections and other features to complete the FRP ductwork systems to the true extent of the Contract Documents.

1.6 FABRICATION

A. FRP ductwork and accessories shall be fabricated in a heated and well-ventilated structure protected from weather and temperature extremes (minimum 50°F). Entire fabrication, curing and assembly process of any piece of FRP equipment shall be indoors. CONTRACTOR shall submit an affidavit certifying that all FRP equipment shall be fabricated, cured and assembled as described in this Section.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Non-Metallic Ductwork:
   1. FRP Ductwork: Provide where specified in Article 3.7 of this Section.

B. All air outlets, hardware and fasteners shall be Type 316 stainless steel unless otherwise noted.

C. Sleeves: Where ductwork passes through masonry walls, partitions or floors provide minimum 16 gauge Type 316 stainless steel sleeves.

D. Access Doors:
   1. Type: Gasketed cam lock covers.
   2. Materials: FRP.
   3. Unless otherwise specified access doors shall be:
      a. 12 by 6-inches for ducts sizes 12-inches and smaller.
      b. 12 by 12-inches for ducts sizes greater than 12 inches up to 16 inches.
      c. 21 by 14-inches for ducts greater than 16 inches and up to 36 inches.
      d. 25 by 17 inches for ducts greater than 36 inches and up to 60 inches.
      e. (2) 25 by 17 inch doors for ducts larger than 61 inches.

2.2 FRP DUCTWORK AND ACCESSORIES

A. The FRP duct system shall be specifically designed, constructed, and installed to meet the required service in a wastewater treatment plant environment and shall comply with the following minimum conditions:
   1. Air Temperature, degrees F: -10 to 120.
   2. Chemical Exposure: 200 ppm Sulfuric Acid, 5 ppm Hydrogen Sulfide, 10 ppm Sodium Hypochlorite and 10 ppm Sodium Hydroxide.
   3. Pressure Ratings:
      a. Vacuum Service: -10 inches Water Gage, minimum.
      b. Pressure Service: 10 inches Water Gage, minimum.
      c. As shown on the Drawings, if different than above.

B. FRP ductwork shall be of filament wound or hand lay-up construction. FRP ductwork shall be of flame retardant material inside and outside in accordance with NFPA-91. All ducts shall be installed in accordance with manufacturer's recommendations.

C. FRP Duct Construction: Duct shall meet the applicable requirements of ASTM D2310, Type 1, Grade 1 or 2, with Class "E" liner, 20 mils minimum thickness, and be manufactured in accordance with ASTM D2996. Flanges and bolt drilling circles and diameters shall conform to NBS PS 15-69. Ductwork shall be fabricated of vinylester resin as specified below. All interior and exterior surfaces of ducts, dampers and FRP accessories shall be coated with a minimum 90 percent resin, 5 percent antimony trioxide and nexus veil reinforcement.

D. Laminates shall consist of a 10 to 20 mil chemical resistant liner with a synthetic surfacing veil embedded in a resin rich surface. The corrosion barrier shall be a minimum of 100 mils and include no less than two layers of 1-1/2 ounce mat with 25 percent glass and 75 percent resin content. The structural layer shall be of sufficient thickness to meet the minimum performance requirements specified. The exterior surface layer shall be resin rich apertured nexus veil not less than 20 mils thick. Outside finish shall have a paraffinated pigmented gel coat finish with an ultra violet inhibitor. The composition specified for the inner surface and interior layer is intended to achieve optimum chemical resistance.

E. Ductwork shall be constructed to meet Class 1 material in accordance with UL 181. Resins used in the laminate shall be premium corrosion resistant and fire retardant brominated bisphenol-A vinylester resins such as Dow Chemical Company, Derakane 510A with 5 percent antimony trioxide, Reichhold Dion 9300 FR with percent Antimony Trioxide or Ashland Chemical Company, Hetron FR 992 with 3 percent antimony trioxide or equal. The synthetic surfacing veil shall be Veil-Nexus 1012 (apertured) as manufactured by Burlington Industries.

F. All cut edges shall be sealed with a resin coating of the same resin as used in the fabrication. The resin shall contain paraffin.

G. Manufacturers: Provide products of one of the following:
   1. Perry Fiberglass.
   2. Viron International.
   3. International Reinforced Plastics.
   4. Southeastern Fiberglass Products Inc.
   5. Or equal.

H. Fittings and Joints: All fittings such as elbows, laterals, tees, and reducers shall be of the same resin and equal or superior in strength to the adjacent duct section and shall have the same internal dimensions as the adjacent duct. Duct joints shall be butt wrapped or bell and spigot joints as shown or required. Bell and spigot joints shall be sealed with a standard butt joint overlay as per PS 15-69. All interior surfaces of joint to be coated with a paraffinated resin-rich gel coat.

I. Total width of overlay for butt-wrap joints shall be not less than 6-inches for diameters from 8 inches up to and including 30-inches, 36 inch and larger shall be not less than 10 inches.

J. Standard Elbows:
   1. Standard elbow centerline radius shall be equal to 1-1/2 times the diameter.
   2. Standard elbows up to 24-inch diameter shall be smooth radius molded elbows. Standard elbows 30-inch diameter and greater may be mitered sections as specified below.
   3. 0 to 44-inch diameter elbows shall contain one mitered joint and two sections. 45 to 80-inch diameter elbows shall have a minimum of two mitered joints

and three sections. Elbows greater than 80-inch diameter shall have a minimum of four mitered joints and five sections.

4. All square elbows shall have FRP or Type 316 stainless steel double thickness turning valves with streamlined leading edges.

K. Maximum allowable deflection for any size ductwork shall be 1/2-inch between supports and for any side of duct under worse case operating conditions.

L. Tolerances:
   1. Out-of-roundness of duct shall be limited to ±1/8-inch or ±1 percent of duct inside diameter, whichever is greater for duct sizes 8-inch diameter and greater.
   2. Length of all flange pipe sections shall not vary more than ±1/8-inch at 70 degrees F.
   3. All unflanged duct shall be square on the ends in relation to the pipe axis and ±1/8-inch up to and including 24-inch diameter and ±3/16-inch for all diameters greater than 24-inch.
   4. Fittings: The tolerance on angles of all fittings shall be ±1 degree, up to and including 24-inch diameter and ±1/2 degree for 30-inch diameter and above.
   5. Flanges:
      a. Flange faces shall be perpendicular to the axis of the duct within 1/2 degree.
      b. Flange faces shall be flat to within ± 1/32-inch, up to and including 18-inch diameter and flat within ± 1/16-inch for 20-inch diameter and larger.
      c. Provide custom filler pieces as required to mate flanges squarely.

M. CONTRACTOR shall submit wall thickness calculations for review. Calculations shall include the following:
   1. Wall thickness determination shall be based on the structural fiberglass reinforced wall only.
   2. Wall thickness shall have a safety factor of 10 to 1 for pressure and 5 to 1 for vacuum service.
   3. Wall thickness shall be suitable for use up to 120 degrees F in pressure service and vacuum service.
   4. Wall thickness shall be based on a 0.50-inch maximum deflection between supports and for any side of duct under worse cast operating conditions.
   5. Rectangular duct may be reinforced with fiberglass angles, channels, tees or tubes as required to meet required pressure/vacuum service.
   6. All calculations shall be signed and sealed by a Professional Engineer (P.E.) licensed in the State of Ohio.

N. All connections to expansion joints, butterfly dampers, tanks, or other equipment shall be flanged. Gaskets shall be EPDM and bolts, nuts and washers shall be Type 316 stainless steel. Flanges shall be hand laid up to NBS PS 15-69 thickness, except that minimum thickness shall be 3/4-inch. The flange shall be hand laid-up anchored to a waxed table to achieve the flatness tolerance outlined within this

Section. The face shall be textured for use with full face gaskets, 1/8-inch minimum thickness. All FRP duct bolt holes shall be back spot faced for a washer seat. All flange bolts shall be torqued to values as recommended by manufacturer.

O. All FRP duct bolt holes shall be coordinated with those of existing ducts that are being re-used for this project.

P. Hangers and Supports:
   1. All ductwork shall be securely hung and anchored to the building structure. Unless otherwise shown or specified, hangers and stiffeners for ducts shall conform with the recommendations given in the SMACNA Thermoset FRP Duct Construction Standards and the SMACNA HVAC Duct Construction Standards. Ducts shall be supported on trapeze hangers with angles or rods. Use of strap hangers and straps is prohibited.
   2. All ductwork shall be supported from trapeze type hangers. Hanger rods shall be minimum 3/8 inch for all ducts with half perimeter up to 72 inches, and 1/2-inch diameter for all ducts with half perimeter larger than 72 inches. A pair of rods shall be provided at each duct support point. Maximum hanger spacing shall be 8 feet for ducts with half perimeter up to 72 inches and 6 feet for ducts with half perimeter larger than 72 inches.
   3. All hangers, rods, supports, bolts, nuts, washers, inserts, and appurtenances shall be FRP or Type 316 Stainless Steel.
   4. Support shall be furnished at each fitting.
   5. Conform to all requirements of Specification 23 05 29, Hangers and Supports for HVAC Piping and Equipment.

Q. There shall be not less than a 1/4-inch buildup of FRP over the duct at each support. Each support shall be furnished with a 1/8-inch thick Teflon sheet to shield the duct from the support.

R. Square or rectangular FRP ductwork shall be constructed of the same materials and conform to the same standards as specified above for round FRP ductwork. All square elbows shall have FRP or Type 316 stainless steel double thickness turning vanes.

S. Sleeves shall be Type 316 stainless steel. Install square or rectangular duct sleeves as required.

T. FRP Transition Pieces:
   1. Provide transition pieces as shown on drawings and herein specified.
   2. Construction:
      a. 1/4-inch minimum thickness FRP sheets and thickness not to be less than thickness of adjacent FRP ducting.
      b. All exposed hardware shall be Type 316 stainless steel with stainless steel screws, nuts, bolts and washers as required.
      c. Flanges shall be designed as required to connect to fan and/or duct work.

3. Pressure Classification: Manufacturer shall design transition pieces so that they shall be free from buckling, pulsing, warpage, sagging and to the following pressure ratings:
    a. Vacuum Service: -10 inches Water Gage, minimum.
    b. Pressure Service: 10 inches Water Gage, minimum.

U. Volume Dampers (for Round Ductwork):
1. Design and Performance Criteria (based on 48-inch damper diameter):
    a. Dampers shall be performance rated and certified in accordance with AMCA Standard 500-D and AMCA Publication 511.
    b. Dampers shall meet or exceed the requirements of ASTM C582 and ASTM D2583 with chemical resistance tested in accordance with ASTM C581.
    c. All resins used in the construction of damper shall be premium corrosion resistant and fire retardant vinyl ester resins and shall meet Class 1 flame spread material classification when tested in accordance with ASTM E84.
    d. Maximum Design Total Static Pressure: 30.0-inch W.G.
    e. Damper Leakage: Class 1 Leakage Rated – Not more than 11 cfm per square foot at 8-inch W.G. with blade seals.
    f. Certification: Manufacturer shall submit certified test data.
2. Product and Manufacturer: Provide one of the following:
    a. Model 914, as manufactured by Swartwout/Ruskin.
    b. Or equal.
3. Details of Construction:
    a. Material: FRP.
    b. Frame: Molded channel with minimum 3/8-inch thick flanges constructed in accordance with NBS PS 15-69.
    c. Single Section Sizes:
        1) Minimum: 4-inch diameter.
        2) Maximum: 72-inch diameter.
    d. Blades:
        1) Minimum 1/4-inch thick.
        2) Full circumference blade stop for volume dampers only.
        3) EPDM continuous edge seals with pin angle stops for motorized control dampers only.
    e. Axle: Minimum 1/2-inch, full length Type 316 stainless steel embedded in blade with 6-inch extension beyond frame.
    f. Bearings: Molded PTFE with shaft seals.
    g. Provide Type 316 stainless steel outside handle, quadrant with 2-inch standoff and approved position indicator with locking device for all volume dampers.

V. Tools, Spare Parts and Maintenance Materials:
1. The duct system shall be furnished with the following:
    a. One set of special tools required to maintain and repair the system.
    b. All materials in kit form to make or repair joints. Kits shall be in a number sufficient to repair 10 percent of the joints.

c. Names and addresses of all manufacturers of: Fiberglass reinforcements, resins, hardeners and components used to repair and maintain FRP duct system.

2. Spare parts shall be packed in sturdy containers with clear indelible identification markings and shall be stored in a dry, warm location, until transferred to the OWNER at the conclusion of the Project.

2.3 PAINTING FOR NON-METAL DUCTWORK

A. Non-metal ductwork shall be painted with an epoxy paint system equivalent to that specified below.
   1. Ductwork shall be factory painted in accordance with paint system specified below:
      a. Clean and prepare all surfaces to be painted.
      b. All piping, ductwork, supports, including FRP surfaces shall be painted with an epoxy-polyamide primer, Tnemec Series 66 Hi-Build Epoxoline 3 to 5 dry mils or equal. Final coat shall be Tnemec Series 70 or 71 Endurashield aliphatic Polyester polyurethane enamel 1.5 to 2.5 dry mils, or equal. Submit paint manufacturer's complete standard and custom color charts for color selection by the Engineer and the Owner.
   2. CONTRACTOR shall provide a sample FRP panel not less than 2 square feet shall be painted and allowed to dry for not less than 48 hours and then be checked for paint adhesion by the paint system manufacturer and submitted to the ENGINEER.

2.4 CLEANING

A. All existing interior FRP ductwork installed within the centrifuge room shall be cleaned as follows:
   1. Cleaning operations shall be performed on external surfaces only, including but not limited to the duct outer exposed diameter, dampers, screens and flanges.
   2. The cleaning operations shall be per the submitted and approved manufacturer's recommendations but shall at minimum include:
      a. Power washing significantly stained areas on existing ductwork only as described:
         1) 90 square feet of duct area total on the existing duct.
         2) Using a 2500 psi pressure washer and a brush to gently remove the dirt and grime. Use a wand distance of 12" to 18" from the surface with attention paid to close observation of the duct surface; if any damage is resulting, moving the wand further away as required.
      b. Washing down the remaining duct surfaces with the duct manufacturer's approved cleaning solution.
   3. The cleaning intent is to remove built-up dirt and grime to approximate the color of the existing ductwork when it was new.

2.5 IDENTIFICATION

A. All equipment and component identification shall be provided in accordance with Section 10 14 00, Signage.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine conditions under which materials and equipment will be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

B. Take field measurements where required prior to installation to ensure proper fitting of Work.

3.2 PREPARATION

A. Protection of Surrounding Areas/Surfaces:
   1. Openings and penetrations shall be capped to protect the building from outside conditions.
   2. Properly cap the open ends of all ductwork at the end of each day's Work or other stopping point throughout the construction. Equipment shall be tightly covered and protected against dirt, water, and chemical or mechanical damage.

3.3 INSTALLATION

A. Turning vanes shall be installed in all miter elbows to permit air to make the abrupt turns with a minimum of turbulence. The turning vanes shall be quiet and free from vibration when the system is in operation. Turning vanes shall be double thickness type.Vanes shall be installed in all short radius elbows in accordance with SMACNA standards and Industrial Duct Construction standards.

B. Rectangular manual volume dampers larger than 11 inches in any dimension shall be opposed blade type. The damper blades shall be operated by a lockable dial regulator and may be set in any position. The dial regulators shall be marked so that the "open" and "shut" positions are clearly identified. The dial regulators on insulated ductwork shall be mounted on an elevated platform which will finish flush with the surface of the insulation. Manual volume dampers shall be located at accessible points and wherever possible some distance from a duct transition or fitting. Care shall be taken during installation to make certain that sheet metal fasteners do not protrude into the duct and interfere with damper operation. Dampers shall be provided in each branch duct take off and in both ducts downstream of each trunk duct split. Manual volume dampers shall be Type 316 stainless steel or FRP construction. Splitter type dampers shall not be installed.

C. Duct access doors shall be provided adjacent to volume dampers, on the linkage side of automatic dampers, at fire dampers and at all other apparatus requiring service or inspection in the duct system. The doors shall be rigid and airtight, and provided with neoprene gaskets, hinges and sash locks. Whenever space requirements are such that a hinged access door is impractical, a screw fastened lift-out door shall be provided instead.

D. Test openings shall be installed in the ductwork at the points listed below. The openings shall be sealed by a screw cap and gasket. The test openings shall be located as follows:
   1. In the exhaust air duct adjacent to the fan.
   2. In suction side of each fan.
   3. Where indicated on Drawings.

E. Flexible connections for preventing the transmission of vibrations through the ductwork to the structure shall be installed between the ductwork and all air moving equipment and at the building joints. Flexible connections shall be EPDM sheeting fastened with straps and bolts of the same material as the ductwork. Flexible connections shall not be painted or used to correct misalignment.

F. Contractor shall furnish and install sleeves for registers, grilles, and dampers mounted in the masonry, concrete plenums or shafts. Sleeves shall be 16 gauge Type 316 stainless steel.

G. After the installation is completed, CONTRACTOR shall seal all joints air tight. Sealants and tape shall have a flame spread not greater than 25 and a smoke developed rating of not over 50.

H. All screens shall be Type 316 stainless steel. Bird screen shall conform to ASTM E437, Type 1, Class 1, 2 by 2 mesh (0.031 inch diameter stainless steel wires). Frame shall be removable Type 316 stainless steel construction.

I. All ductwork shall conform accurately to the dimensions shown, the ducts shall be straight and smooth inside with joints neatly finished; ductwork shall be installed so as to preclude the possibility of vibration under all operating conditions.

J. Exhaust ducts shall be airtight with no leakage.

K. Elbows shall have a minimum centerline radius of 1-1/2 times the width of the duct. Turning vanes shall be provided at all square elbows. Turning vanes shall be double wall and shall be quiet and free from vibration when the system is in operation.

L. Provide flexible connections at inlet and discharge of air handling equipment.

M. Provide volume dampers where indicated on the Drawings and as required to facilitate accurate volume control. The duct of the damper shall be reinforced to

prevent vibration. Volume dampers specified with air devices shall be installed in addition to those shown on the Drawings.

N. Fire dampers shall be provided and installed where indicated on the Drawings and where required by U.L. and authorities having jurisdiction, and shall be approved by local building codes and in accordance with the requirements of the NFPA.

O. Provide access doors for all dampers for inspection and maintenance.

P. Install all ductwork and accessories to provide a system free from buckling, warping, breathing or vibration.

Q. Provide flexible connections at building expansion joints. All expansion joints in ducts at building expansion joints shall be suitably supported at each end by support guides within 12 inches of joint.

R. All ducts at flexible connections with air handling equipment, and fans shall be supported at free end within 12 inches of flexible connection.

S. Provisions shall be made for supporting all ductwork, dampers, and other ductwork accessories, where necessary.

T. All ductwork shall arrive on site fully fabricated, not in two halves for field fabrication.

3.4 ADJUSTMENT

A. Set volume control devices for approximate positions in preparation for final testing and balancing.

B. Start fan system and check for excessive leaks and vibration and correct.

3.5 BALANCING

A. Systems shall be completely tested, adjusted and balanced by a qualified engineer. A complete balancing procedure shall be submitted for approval. All equipment and connections required to balance the systems shall be provided.

B. All duct systems shall be balanced in accordance with Specification Section 23 05 93, Testing, Adjusting and Balancing for HVAC.

3.6 PAINTING

A. Surface Preparation and Shop Painting:
   1. Clean and prime coat ferrous metal surfaces of equipment in the factory/shop in accordance with the requirements of Section 09 91 00, Painting.
   2. Coat polished and non-ferrous metal surfaces with corrosion prevention compound which shall be maintained during storage and until equipment begins operations.

B. Field Painting:
   1. Painting required for surfaces not otherwise specified, and finish painting of items only primed at the factory, are specified in Section 09 91 00, Painting.
   2. Field painting of exterior surfaces is under Section 09 91 00, Painting.

3.7 SCHEDULES

A. Schedule of Non-Metal Duct Construction Standards:
   1. Non-Metal ductwork shall be constructed as specified herein.
   2. All accessories shall be suitable for the pressure classification given.

B. Ductwork Material Schedule:
   1. All ductwork and plenums serving the following equipment:
      a. All ductwork located in the Sludge Handling Building:
         1) Centrifuge Room.
      b. Existing Biofilter Fan.

+ + END OF SECTION + +

SECTION 26 05 05

GENERAL PROVISIONS FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals shown, specified, and required to complete the electrical Work.
   2. Temporary Utilities: CONTRACTOR shall provide temporary power and lighting in accordance with Section 01 51 05, Temporary Utilities.
   3. Demolition: Electrical demolition shall be in accordance with Section 02 41 00, Demolition.

B. Coordination:
   1. Review installation procedures and schedules under other Specification Sections and coordinate with other trades the installation of electrical items that will be installed with or within formwork, walls, partitions, ceilings, and panels.
   2. Coordination and Intent of Electrical Drawings:
      a. Dimensions on Drawings related to equipment are based on equipment of certain manufacturers. Verify the dimensions of equipment furnished to space available at the Site and allocated to the equipment.
      b. Drawings show the principal elements of the electrical Work, and are not intended as detailed working drawings for the electrical Work. Drawings supplement and complement the Specifications and other Contract Documents relative to principal features of electrical systems.
      c. Equipment and devices provided under this Contract shall be properly connected and interconnected with other equipment and devices for successful operation of complete systems, whether or not all connections and interconnections are specifically mentioned or shown in the Contract Documents.
      d. Drawings are provided for CONTRACTOR's guidance in fulfilling the intent of the Contract Documents CONTRACTOR shall comply with Laws and Regulations, including safety and electrical codes, and provide materials, equipment, appurtenances, and specialty items necessary for complete and operable systems.
   3. Obtain from OWNER record drawings required to execute the Work.
   4. Field Coordination:
      a. Provide materials, equipment, and services to interface with existing circuits. Field-verify system and equipment requirements prior to modifying existing systems.
      b. Coordinate the interface of equipment with OWNER's personnel and field conditions.

c. Field-compare existing starter and panel control circuit terminations from record documents with existing circuits.
d. Field-trace existing circuits as required to interface the equipment provided.
e. Field-identify terminations for starters and panel controls for follow function for re-connection.

C. Related Sections:
1. Section 02 41 00, Demolition.
03 00 05, Concrete3. Section 05 05 33, Anchor Systems.
2. Section 09 91 00, Painting.
3. Section 40 61 13, Process Control Systems General Provisions.

E. Materials and Equipment Installed by CONTRACTOR but Furnished by Others:
1. None

F. Area Classifications:
1. Materials, equipment, and incidentals shall be suitable for the area classification(s) shown, specified, and required.
2. Wet Locations: Comply with NEC and NEMA requirements for wet locations. Enclosures in wet locations shall comply with NEMA 4 unless specified otherwise.
3. Corrosive Locations: Comply with NEC and NEMA requirements for corrosive locations. Enclosures in corrosive locations shall conform to NEMA 4X requirements unless specified otherwise.
4. Hazardous Locations: Comply with NEC requirements for the Class and Division designated.
5. Dusty Locations: Indoor areas not designated as hazardous, corrosive, or wet are dusty locations. Comply with NEC and NEMA 12 requirements unless specified otherwise.

1.2 QUALITY ASSURANCE

A. Qualifications:
1. Electrical Subcontractor:
a. Electrical Subcontractor shall have not less than five years experience installing electrical systems of the types required for the Project.
b. Electrical Subcontractor shall possess a valid electricians' and contractors' license in the jurisdiction where the Site is located.
c. Submit the following information for not less than three successful, completed projects: project name and location; year completed; name and contact information for: prime contractor for whom electrical Subcontractor worked, project owner, and project engineer or architect, including addresses and telephone numbers.

B. Component Supply and Compatibility:
   1. Materials and equipment similar to each other shall be from the same manufacturer for uniformity.

C. Regulatory Requirements:
   1. Permits: Refer to the General Conditions, Supplementary Conditions, and other parts of the Contract Documents for responsibilities relative to obtaining and paying for permits, licenses, and inspection fees.
   2. Codes: Refer to Section 01 42 00, References, for indication of applicable codes.

1.3 SUBMITTALS

A. General:
   1. To the extent practical, submit Shop Drawings and other CONTRACTOR submittals for each Specification Section into the smallest number of submittals possible. Do not furnish partial submittals.
   2. Review of equipment submittals does not relieve CONTRACTOR of responsibility for providing complete and successfully operating systems.

B. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Internal wiring diagram and drawings indicating all connections to components and numbered terminals for external connections.
      b. Dimensioned plan, section, elevations, and panel layouts showing means for mounting, conduit connection, and grounding.
      c. List of components including manufacturer’s name and catalog number (or part number) for each.
   2. Product Data:
      a. Manufacturer's name and product designation or catalog number.
      b. Electrical ratings.
      c. Manufacturer’s technical data and specifications.
      d. Manufacturer’s indication of compliance with applicable reference standards.
      e. Painting and coating systems proposed.
   3. Test Procedures: Proposed testing procedures and testing limitations for source quality control testing and field quality control testing.

C. Informational Submittals: Submit the following:
   1. Manufacturer’s Instructions:
      a. Installation data and instructions.
      b. Instructions for handling, starting-up, and troubleshooting.
   2. Source Quality Control Submittals: Results for required shop testing.
   3. Field Quality Control Submittals: Results for required field testing.
   4. Qualifications:
      a. Electrical Subcontractor.

D. Closeout Submittals: Submit the following:
   1. Record Documentation:
      a. System Record Drawings: Include the following:
         1) One-line wiring diagram of the electrical distribution system.
         2) Actual, in-place conduit and cable layouts with schedule of conduit sizes and number, and size of conductors.
         3) Layouts of the power and lighting arrangements and the grounding system.
         4) Control schematic diagrams, with terminal numbers and control devices identified, for all equipment.
      b. Point-to-Point Interconnection Wiring Diagram Drawings: Include the following:
         1) External wiring for each piece of equipment, panel, instrument, and other devices and wiring to control stations, lighting panels, and motor controllers.
         2) Numbered terminal block identification for each wire termination.
         3) Identification of the assigned wire numbers for all interconnections.
         4) Identification of wiring by the conduit tag in which the wire is installed.
         5) Terminal, junction, and pull boxes through which wiring is routed.
         6) Identification of equipment and the submittal transmittal number for equipment from which wiring requirements and termination information was obtained.
      c. Record documents shall indicate final equipment and field installation information.

PART 2 – PRODUCTS

A. Performance Criteria:
   1. Electrical equipment shall be capable of operating successfully at full-rated load, without failure, with ambient outside air temperature of 0 degrees F to 105 degrees F and an elevation of 1060 feet above mean sea level.
   2. Unless specified otherwise, electrical equipment shall have ratings based on 75 degrees C terminations.

B. Testing Laboratory Labels: Electrical material and equipment shall bear the label of Underwriters' Laboratories, Inc. or other nationally recognized, independent testing laboratory, where standards have been established and label service applies.

PART 3 – EXECUTION

3.1 INSPECTION

A. Examine conditions under which Work will be performed and notify ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. General:
   1. Install materials and equipment in accordance with the Contract Documents, Laws and Regulations, approved (and accepted, as applicable) Shop Drawings and other CONTRACTOR submittals, and manufacturer's recommendations.
   2. Provide tools and equipment required to trace circuits necessary for proper execution of the Work.
   3. Define and identify all wiring, circuit terminations, and equipment to be modified to ensure proper interface of components. The Contract Price includes all costs associated with field services specified for a complete and functional system.

B. Staging, Sequencing, and Coordination with Existing Facilities:
   1. Schedule, sequence, and install materials and equipment in accordance with Section 01 14 16, Coordination with Owner's Operations
   2. Perform the Work in a manner that will not interfere with the existing equipment and facilities or cause interruption of the functions of the Site, unless specified otherwise or otherwise allowed by OWNER.
   3. When operation of existing facilities and Site is disrupted due to CONTRACTOR's operations, comply with Section 01 14 16, Coordination with Owner's Operations, unless otherwise allowed by OWNER.
   4. Where the Work ties in with existing installations, take precautions and provide safeguards in connecting the Work to existing operating circuits to prevent interruption to existing circuits. Connection of Work to existing circuits shall be performed in the presence of OWNER and ENGINEER.
   5. Interruptions of existing circuits, not addressed in Section 01 14 16, Coordination with Owner's Operations, shall be coordinated with the OWNER who will determine the length of time a circuit may be de-energized to maintain the OWNER's processes in dependable and safe operation.

3.3 FIELD QUALITY CONTROL

A. Field Quality Control – General:
   1. Perform field quality control for electrical Work in accordance with the Contract Documents.

B. Site Tests:
   1. Prior to requesting certificate of Substantial Completion, demonstrate to ENGINEER that electrical systems and electrically-operated equipment installed or modified under the Contract operates in accordance with the Contract Documents and operates as required
   2. Perform the following operational tests on electrical systems:
      a. Operate power circuits to verify proper operation and connection to electrical systems materials and equipment, including mechanical key-interlocks for circuit breakers.
      b. Remove and re-apply power supply to automatic transfer equipment to verify operation. Activate standby power systems to verify their automatic start-up, proper de-energization, and cool down upon resumption of normal power supply.
      c. Operate control circuits, including pushbuttons, indicating lights, and similar devices, to verify proper connection and function. Operate all devices, such as pressure switches, flow switches, and similar devices, to verify that shutdowns and control sequences operate as required.
      d. Operate lighting systems and receptacle devices to verify proper operation and connections.
   3. Prepare and submit report on the equipment demonstration and operating field quality control tests. Report shall include complete information on the tests performed and results.

C. Manufacturer's Services:
   1. Furnish at the Site qualified, factory-trained representative(s) of equipment manufacturers for the services indicated in the Contract Documents.

+ + END OF SECTION + +

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals shown, specified, and required to furnish and install low-voltage conductors and cabling.
   2. Types of cabling required include:
      a. Insulated cable for installation in raceways.
      b. Cable for installation in cable trays.

B. Related Sections:
   1. Section 26 05 53, Identification for Electrical Systems.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. ANSI/NETA ATS, Acceptance Testing Specifications for Electrical Power Equipment and Systems.
   2. ASTM B3, Specification for Soft or Annealed Copper Wire.
   3. ASTM B8, Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard or Soft.
   4. UL 44, Thermoset-Insulated Wires and Cables.
   5. UL 1277, Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with the following:
   1. NEC Article 300, Wiring Methods.
   2. NEC Article 310, Conductors for General Wiring.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Product Data:
      a. Manufacturer’s literature, specifications, and engineering data for low volt insulated cable proposed for use.

B. Informational Submittals: Submit the following:
   1. Field Quality Control Submittals:
      a. Written results of field insulation resistance tests.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Insulated Cable in Raceways:
   1. Application: Use for circuits located indoors and outdoors.
   2. Manufacturers: Provide products of one of the following:
      a. Southwire.
      b. The Okonite Company.
      c. American Insulated Wire.
      d. General Cable.
      e. Or equal.
   3. Material: Single conductor copper cable complying with ASTM B3 and ASTM B8 with flame-retardant, moisture- and heat-resistant insulation rated for 90 degrees C in dry or wet locations, listed by UL as Type XHHW-2 or RHW-2 complying with UL 44.
   4. Wire Sizes: Not smaller than No. 12 AWG for power and lighting and No. 14 AWG for 120-volt control circuits.
   5. Stranding: 600-volt cable shall be stranded, except that solid cable, No. 10 and smaller may be used for lighting circuits.

B. Cable for Installation in Trays:
   1. Manufacturers: Provide products of one of the following:
      a. Southwire.
      b. The Okonite Company.
      c. Prysmian Cables & Systems.
      d. General Cable.
      e. Or equal.
   2. Material: Factory-assembled single- or multi-conductor control, signal, or power cable that bears UL label Type TC and are specifically approved for installation in cable trays. Overall jacket shall be sunlight-resistant PVC. Cable shall be rated for 90 degrees C wet or dry, complying with UL 44 and UL 1277.

C. Cable Connectors, Solderless Type:
   1. Products and Manufacturers: Provide products of one of the following:
      a. T&B Sta-Kon.
      b. Burndy Hylug.
      c. Or equal.
   2. For wire sizes No. 4 AWG and above, use either compression type or bolted type with silver-plated contact faces.

3. For wire sizes up to and including No. 6 AWG, use compression type. Alarm and control wire shall be terminated using forked type connectors at terminal boards.
4. For wire sizes No. 250 KCMIL and larger, use connectors with at least two cable clamping elements or compression indents and provision for at least two bolts for joining to apparatus terminal.
5. Properly size connectors to fit fastening device and wire size. Connectors shall be rated for 90 degree C, 600 volts.

D. Cable Splices:
1. Products and Manufacturers:
a. Compression-Type Splices: Provide one of the following:
1) Burndy Hylink.
2) T&B Color-Keyed Compression Connectors.
3) Or equal.
b. Spring Connectors: Provide one of the following:
1) Buchanan B-Cap.
2) T&B Wire Connector.
3) Or equal.
2. For wire sizes No. 8 AWG and larger, splices shall be made up with compression type copper splice fittings. Splices shall be taped and covered with materials recommended by cable manufacturer to provide insulation equal to that on conductors.
3. For wire sizes No. 10 AWG and smaller, splices may be made up with pre-insulated spring connectors.
4. For wet locations, splices shall be waterproof. Compression type splices shall be waterproofed by sealant-filled, thick wall, heat shrinkable, thermosetting tubing or by pouring thermosetting resin into mold that surrounds the joined conductor. Spring connector splices shall be waterproofed with sealant filler.
5. Splices shall be suitably sized for cable, rated 90 degrees C, and 600 volts.

E. Wire and Cable Markers:
1. Provide wire and cable markers in accordance with Section 26 05 53, Identification for Electrical Systems.

2.2 SOURCE QUALITY CONTROL

A. Factory Tests:
1. Factory-test wire and cable in accordance with UL standards

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install cables complete with proper terminations at both ends. Check and correct for proper phase sequence and proper motor rotation.

B. Pulling:
   1. Use insulating types of pulling compounds containing no mineral oil.
   2. Pulling tension shall be within limits recommended by wire and cable manufacturer.
   3. Use dynamometer where mechanical means are used.
   4. Cut off section subject to mechanical means.

C. Bending Radius: Limit to minimum of six times cable overall diameter.

D. Slack: Provide maximum slack at all terminal points.

E. Splices:
   1. Where possible, install cable continuous, without splice, from termination to termination.
   2. Where required, splice as shown and also where required for cable installation. Splices below grade, in manholes, handholes, and wet locations shall be waterproof.
   3. Splices are not allowed in conduits.

F. Identification:
   1. Identify conductors in accordance with Section 26 05 53, Identification for Electrical Systems.
   2. Identify power conductors by circuit number and phase at each terminal or splice location.
   3. Identify control and status wiring using numeral tagging system.

G. Color-code power cables as follows:
   1. No. 8 AWG and Smaller: Provide colored conductors.
   2. No. 6 AWG and Larger: Apply general purpose, flame retardant tape at each end, wrapped in overlapping turns to cover an area of at least two inches.
   3. Colors: Match color scheme in use at the Site. If the Site does not have an existing color scheme, use the following colors:

System	Conductor	Color
All Systems	Equipment Grounding	Green
240/120 Volts Single-Phase, Three-Wire	Grounded Neutral One Hot Leg Other Hot Leg	White Black Red

System	Conductor	Color
208Y/120 Volts Three-Phase, Four-Wire	Grounded Neutral Phase A Phase B Phase C	White Black Red Blue
240/120 Volts Three-Phase, Four-Wire Delta, Center Tap Ground on Single-Phase	Grounded Neutral Phase A High (wild) Leg Phase C	White Black Orange Blue
480Y/277 Volts Three-Phase, Four-Wire	rounded Neutral Phase A Phase B Phase C	Gray Brown Orange Yellow

3.2 FIELD QUALITY CONTROL

A. Site Tests:

1. Test each electrical circuit after permanent cables are in place, to demonstrate that circuit and equipment are connected properly and will perform satisfactorily, free from improper grounds and short circuits.
2. Individually test 600-volt cable mechanical connections after installation and before they are put in service, with calibrated torque wrench. Values shall be in accordance with manufacturer's recommendations.
3. Individually test 600-volt cables for insulation resistance between phases and from each phase to ground. Test after cables are installed and before they are put in service, with Megger for one minute at voltage rating recommended by cable manufacturer or in accordance with ANSI/NETA ATS recommendations.
4. Insulation resistance for each conductor shall not be less than value recommended by cable manufacturer. Cables not meeting recommended value or that fail when tested under full load conditions shall be replaced with a new cable for full length.
5. Where existing cables are spliced to cables provided under the Project, test existing cables prior to splicing. Test cables at 1,000 vdc for one minute. Entire spliced cable installation shall be re-tested after splice is completed. Existing cable that fails or has value less than two megohms shall be brought to attention of ENGINEER and splicing shall not proceed until condition is acceptable.

+ + END OF SECTION + +

SECTION 26 05 23

INSTRUMENTATION AND COMMUNICATION CABLES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals shown, specified, and required to furnish and install instrumentation and communication cables.
   2. Types of cables include the following:
      a. Shielded instrumentation cables.
      b. Data communication cables.

B. Related Sections:
   1. Section 26 05 33.13, Rigid Conduits.
   2. Section 26 05 53, Identification for Electrical Systems.

1.2 TERMINOLOGY

A. The following words or terms are not defined but, when used in this Section, have the following meaning:
   1. "CPE" means chlorinated polyethylene.
   2. "FEP" means fluorinated ethylene-propylene.
   3. "XLPE" means cross-linked polyethylene.

1.3 REFERENCES

A. Standards referenced in this Section are:
   1. ASTM A510, Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel.
   2. ASTM B633, Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
   3. TIA/EIA-485, Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems (known as RS-485).
   4. UL 13, Power-Limited Circuit Cables.
   5. UL 1581, Electrical Wires, Cables and Flexible Cords.
   6. UL VW-1, Vertical Wire Flame Test.
   7. UL 910, Safety Test for Flame-Propagation and Smoke-Density Values for Electrical and Optical-Fiber Cables Used in Spaces Transporting Environmental Air

1.4 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. NEC 725, Class 1, Class 2, and Class 3 Remote-Control, Signaling and Power-Limited Circuits.
   2. NEC 727, Instrumentation Tray Cable.
   3. NEC 800, Communications Circuits.

1.5 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Product Data: Manufacturer's technical information for instrumentation cables and communications cables proposed.

B. Informational Submittals: Submit the following:
   1. Field Quality Control Submittals: Written report of results of field quality control testing specified in this Section.

PART 2 – PRODUCTS

2.1 MATERIALS

A. General:
   1. Cables shall bear the UL label.

B. Single Shielded Pair Instrument Cables:
   1. Manufacturers: Provide products of one of the following:
      a. Belden Company.
      b. Okonite Company.
      c. Dekoron Wire and Cable Company.
      d. Or equal.
   2. Tinned copper, XLPE-insulated, stranded conductors, not less than no. 16 AWG, twisted pair, with overall shield, stranded tinned no. 18 AWG copper drain wire and overall PVC or CPE jacket. Rated for not less than 600 volts and complying with UL 1581.

C. Multi-Paired Shielded Instrument Cables:
   1. Manufacturers: Provide products of one of the following:
      a. Belden Company.
      b. Okonite Company.
      c. Dekoron Wire and Cable Company.
      d. Or equal.
   2. Tinned copper, XLPE-insulated stranded conductors, not less than no. 16 AWG, twisted pairs with shield over each pair, stranded tinned no. 18 AWG

copper drain wire, and overall PVC or CPE outer jacket. Rated for not less than 600 volts and complying with either UL 1581 or UL 13.

D. Multi-Conductor Shielded Instrument Cables:
   1. Manufacturers: Provide products of one of the following:
      a. Belden Company.
      b. Okonite Company.
      c. Dekoron Wire and Cable Company.
      d. Or equal.
   2. Tinned copper, XLPE-insulated stranded conductors, not less than no. 16 AWG, stranded tinned no. 18 AWG copper drain wire, with overall 100 percent foil shield and overall PVC or CPE jacket. Rated for not less than 600 volts.

E. Cable Terminals:
   1. Manufacturers: Provide products of one of the following:
      a. T&B Sta-Kon.
      b. Burndy Insulug.
      c. Or equal.
   2. Fork type copper compression terminals with nylon insulation for termination of cable at terminal blocks.

F. Horizontal Unshielded Twisted Pair (UTP) Cables:
   1. Horizontal cabling is cabling between and including the telecommunications outlet/connector and patch panel or termination block.
   2. Manufacturers: Provide products of one of the following:
      a. Bertek.
      b. Belden.
      c. Mohawk
      d. Or equal.
   3. Cables shall consist of no. 24 AWG, thermoplastic-insulated, solid conductors formed into four individually-twisted pairs and enclosed by thermoplastic jacket.
   4. Comply with ANSI/TIA/EIA-568, Part 10.2.
   5. Riser-rated where installed in conduit. Other installations shall be plenum-rated.
   6. Rated for Category 6 use.

G. Patch Cords:
   1. Patch cords are used for connecting patch panel to hub, or wall jack to equipment.
   2. Manufacturer: Provide products of one of the following:
      a. Bertek.
      b. Belden.
      c. Mohawk
      d. Or equal.

3. Cables shall consist of no. 24 AWG, thermoplastic-insulated, stranded conductors formed into four individually-twisted pairs and enclosed by thermoplastic jacket.
4. Cables shall be riser-rated.
5. Rated for Category 6 use.
6. Cables shall incorporate integral strain relief into the connector at each end. Connectors shall be RJ45 plugs.
7. Provide the following patch cords:
    a. One 10-foot cable per wall jack installed.
    b. One 3-foot cable per every two wall jacks installed.
    c. One 5 foot cable per every two wall jacks installed.

H. Connecting Hardware for Unshielded Twisted Pair (UTP) Cables:
1. Hardware used to terminate UTP cable shall comply with ANSI/TIA/EIA-568, Part 10.4.
2. Connecting hardware shall be compatible with wiring specified in the Contract Documents.
3. Rated for Category 6 use.
4. Connecting hardware shall utilize 110-type terminal blocks to coordinate with patch panels and termination blocks specified the Contract Documents.
5. Telecommunications Outlets/Connectors:
    a. Manufacturers: Provide products of one of the following:
        1) Hubbell.
        2) Or equal.
    b. Outlets and connectors shall utilize RJ45 (eight-pin modular) plug/receptacle configuration.
    c. Outlets and connectors shall utilize T568B pin/pair assignments, and be coordinated with wire type (solid or stranded conductor).
    d. Outlets shall be flush-mount type or surface-mount type, as indicated on the Drawings.

I. Patch Panels:
1. Manufacturers: Provide products of one of the following:
    a. Black Box.
    b. Or equal.
2. Patch panels shall utilize RJ45 (eight-pin modular) plug/receptacle configuration, and utilize T568B pin/pair assignments for receptacles.
3. Coordinate patch panel terminations with wire type (solid or stranded conductor).
4. Patch panels shall be wall-mount type or rack-mount type, as indicated on the Drawings.
5. Listed as Category 6.
6. Provide quantity of ports not less than the quantity of wall jacks installed in the building/area served, plus 50 percent additional as spares.

J. Allen Bradley DH (Blue Hose) Cables:
   1. Products and Manufacturers: Provide one of the following:
      a. Belden 3072F.
      b. Or equal.
   2. Cables shall consist of two tinned copper, no. 18 AWG, stranded conductors, polyolefin-insulated and twisted into a single pair, with 100-percent aluminum-polyester shield, 55-percent tinned copper braided shield, no. 20 AWG stranded tinned copper drain wire, and overall PVC jacket.
   3. When plenum rating is required, cable insulation and jacket shall be FEP in lieu of insulation and jacket materials otherwise specified in this Section for Allen Bradley DH (blue hose) cables.
   4. When portion of cable run is not contained in conduit or appropriate enclosure, cables shall be plenum- or riser-listed and marked in accordance with NEC 800.

K. ControlNet Cables:
   1. Products and Manufacturers:
      a. Non-Plenum-Rated ControlNet Cables: Provide one of the following:
         1) Allen-Bradley 1786-RG6.
         2) Belden 3092A.
         3) Or equal.
      b. Plenum-Rated ControlNet Cables: Provide one of the following:
         1) Belden 3093A.
         2) Or equal.
   2. Cables shall be RG-6/U-type coaxial cables.
   3. Cables shall consist of no. 18 AWG solid, bare copper covered steel conductor, foam polyethylene-insulated, with four-layer shield: 100-percent aluminum-polyester, 60-percent tinned copper braided, 100-percent aluminum-polyester, 40-percent tinned copper braided, with overall PVC jacket.
   4. When plenum rating is required, cable insulation shall be foam FEP and jacket shall be fluoro-copolymer, in lieu of insulation and jacket materials otherwise specified in this Section for ControlNet cables.
   5. When portion of cable run is not contained in conduit or appropriate enclosure, cables shall be plenum- or riser-listed and marked in accordance with NEC 800.

L. Devicenet (Thick) Cables:
   1. Product and Manufacturers: Provide one of the following:
      a. Belden 3082A.
      b. Or equal.
   2. Cables shall consist of two tinned copper, no. 15 AWG, stranded power conductors, PVC-insulated, with 100-percent aluminum-polyester shield, two tinned copper no. 18 AWG stranded data conductors, foam polyethylene-insulated, and twisted into a single pair, with 100-percent aluminum-polyester shield, with no. 18 AWG stranded tinned copper drain wire. Cables shall be

covered by overall 65-percent tinned copper braided shield, and sunlight- and oil-resistant overall PVC jacket.

3. When portion of cable run is not contained in conduit or appropriate enclosure, cables shall be plenum- or riser-listed and marked in accordance with NEC 800.

M. Devicenet (Thin) Cables:
   1. Products and Manufacturers: Provide one of the following:
      a. Belden 3084A.
      b. Or equal.
   2. Cables shall consist of two tinned copper, no. 22 AWG, stranded power conductors, PVC-insulated with 100-percent aluminum-polyester shield, two tinned copper no. 24 AWG stranded data conductors, foam polyethylene-insulated, and twisted into single pair, with 100-percent aluminum-polyester shield, with no. 22 AWG stranded tinned copper drain wire. Cables shall be covered by overall 65-percent tinned copper braided shield, and sunlight- and oil-resistant overall PVC jacket.
   3. When portion of cable run is not contained in conduit or appropriate enclosure, cables shall be plenum- or riser-listed and marked in accordance with NEC 800.

PART 3 – EXECUTION

3.1 INSPECTION

A. Examine conditions under which materials and equipment will be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. General:
   1. Install cables complete with proper terminations at both ends.
   2. Install in conduit separate from power cables, unless shown or indicated otherwise.
   3. Ground shield on shielded cables at one end only and as recommended by instrument manufacturer.
   4. Identify conductors in accordance with Section 26 05 53, Identification for Electrical Systems.
   5. Install and terminate Supplier-furnished cable in accordance with equipment manufacturer requirements and cable manufacturer's recommendations.
   6. Install in accordance with Laws and Regulations, including NEC.

3.3 FIELD QUALITY CONTROL

A. Site Tests:
   1. Test shielded instrumentation cable shields with ohmmeter for continuity along full length of cables, and for shield continuity to ground.
   2. Connect shielded instrumentation cables to calibrated 4 to 20 mA dc signal transmitter and receiver. Test at 4 and 20 mA transmitter settings.
   3. Replace with new cables the full length of cables that fail test.
   4. Test equipment shall be provided by CONTRACTOR.
   5. For testing of communications cables, test equipment used shall comply with the following:
      a. Equipment shall consist of a "master" and a "remote" unit.
      b. Test of all aspects of cables shall be automatic and initiated with a single command. Test over entire frequency range. Test unit shall be capable of accepting cable identification tag for reporting. Test unit shall return "pass/fail" status for cables and, if "fail", shall indicate reason for failure.
      c. Test unit shall be capable of storing all test results internally and printing the results later.
      d. For unshielded twisted pair cables, test unit shall be specifically designed and manufactured to certify cabling relative to Category 6 compliant.

+ + END OF SECTION + +

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install complete grounding for electrical systems, structures, and equipment.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. ANSI/NETA ATS, Acceptance Testing Specifications for Electrical Power Equipment and Systems.
   2. ASTM B8, Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard or Soft.
   3. UL 467, Grounding and Bonding Equipment.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements
   1. National Electrical Code, (NEC).
      a. NEC Article 250, Grounding and Bonding.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Listing of grounding connector types identifying where each will be used.
      b. Layouts of each structure's ground grid.
      c. Test point construction details.
   2. Product Data:
      a. Manufacturer's technical information for grounding materials proposed for use.
   3. Testing Plans:
      a. Ground resistance test procedure.

B. Informational Submittals: Submit the following:
   1. Field Quality Control Submittals
      a. Results of ground resistance tests at each test point.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Bare Ground Cable:
   1. Manufacturers: Provide products of one of the following:
      a. Cablec Corporation.
      b. General Cable Corporation.
      c. Southwire Cable Company.
      d. Or equal.
   2. Material: Soft-drawn, bare copper stranded cable complying with ASTM B8. No. 4/0 AWG minimum size unless otherwise shown or indicated on the Drawings.

B. Ground Rods:
   1. Manufacturers: Provide products of one of the following:
      a. Copperweld, Bimetallics Division.
      b. ITT Blackburn Company.
      c. Or equal.
   2. Material: Copper-clad rigid steel rods, 3/4-inch diameter, ten feet long.

C. Grounding Connectors:
   1. Products and Manufacturers: Provide one of the following:
      a. Pressure Connectors:
         1) O.Z./Gedney, Division of General Signal Corporation.
         2) Burndy Corporation.
         3) Or equal.
      b. Welded Connections:
         1) Cadweld by Erico Products, Incorporated.
         2) Therm-O-Weld by Burndy Corporation.
         3) Or equal.
   2. Material: Pressure connectors shall be copper alloy castings, designed and fabricated specifically for items to be connected and assembled with Durium or silicone bronze bolts, nuts, and washers. Welded connections shall be by exothermic process utilizing molds, cartridges, and hardware designed specifically for connection to be made.

D. Ground system components shall comply with UL 467.

PART 3 – EXECUTION

3.1 INSPECTION

A. Examine conditions for the Work and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with Work until unsatisfactory conditions are corrected.

3.2 STRUCTURE GROUND SYSTEM

A. Provide ground grids as shown and indicated on the Drawings.

B. Provide No. 4/0 bare copper cable around exterior perimeter of structures at not less than 2.5 feet below grade, unless otherwise shown or indicated on the Contract Documents.

C. For structures with steel columns, provide No. 4/0 ground cable from grid to each column around perimeter of structure. Connect cable to steel with exothermic welds.

D. Connect grids to continuous underground water pipe system, when practical.

E. For new structures with concrete foundation or footings, connect structure's reinforcing steel or other concrete-encased electrode to grounding grid.

F. Provide accessible test points for measuring the ground resistance of each grid.

G. Weld all buried connections except for test points.

3.3 EQUIPMENT GROUNDING

A. Ground electrical equipment in compliance with Laws and Regulations and the Contract Documents.

B. Equipment grounding conductors shall be bare stranded copper cable of adequate size installed in metal conduit where required for mechanical protection. Ground conductors, pulled into conduits with non-grounded conductors, shall be insulated. Insulation shall be green.

C. Control panels grounding conductors shall be bare stranded copper cable of adequate size to ground grid from AC ground bus, and an insulated stranded copper cable of adequate size to ground grid from DC ground bus.

D. Connect ground conductors to conduit with copper clamps, straps, or with grounding bushings.

E. Connect to piping by welding or brazing. Use copper bonding jumpers on gasketed joints.

F. Connect to equipment by means of lug compressed on cable end. Bolt lug to equipment frame using holes or terminals provided on equipment specifically for grounding. Do not use hold-down bolts. Where grounding provisions are not included, drill suitable holes in locations recommended by equipment manufacturer or designated by ENGINEER.

G. Connect to motors by bolting directly to motor frames, not to soleplates or supporting structures.

H. Connect to service water piping by means of copper clamps. Use copper bonding jumpers on gasketed joints.

I. Scrape bolted surfaces clean and coat with conductive oxide-resistant compound.

3.4 FIELD QUALITY CONTROL

A. Site Tests:
   1. Test completed grounding systems for resistance to ground using an electrical three-terminal ground resistance tester. Test all grounded cables and metal parts for continuity of connection. ENGINEER and OWNER will witness the testing.
   2. Grounding system maximum resistance shall not exceed five ohms under normally dry conditions when measured by resistance tester. Resistance values above five ohms shall be brought to ENGINEER's attention. Provide additional ground rods as required to attain a resistance to ground of less than five ohms for each ground grid. Add grounding additive installing additional ground rods to increase their effectiveness.

+ + END OF SECTION + +

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install hangers and supports for electrical systemns.
   2. Area Classifications: Materials shall by suitable for the area classification(s) shown or indicated on the Drawings, and specified in Section 26 05 05, General Provisions for Electrical Systems.

B. Related Sections:
   1. Section 05 05 33, Anchor Systems.
   2. Section 26 05 05, General Provisions for Electrical Systems.
   3. Section 26 05 33.13, Rigid Conduits.

1.2 REFERENCES

A. Standards referenced in this section are:
   1. ASTM A123/A123M, Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   2. ASTM A1011/A1011M, Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
   3. ASTM E84, Test Method For Surface Burning Characteristics of Building Materials

1.3 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Detailed installation drawings showing dimensions and compatibility with proposed layout.
   2. Product Data:
      a. Manufacturer’s name, product designation, and catalog number of each material item proposed for use.
      b. Manufacturer’s specifications including material, dimensional and weight data, and load capacity for each supporting system component proposed for use.
      c. Pictorial views and corresponding identifying text of each component proposed for installation.

d. Documentation that confirms product compatibility with Laws and Regulations.

B. Informational Submittals: Submit the following:
   1. Certifications:
      a. Submit certifications required under this Section.
   2. Manufacturer's Instructions:
      a. Manufacturer's installation instructions, including recommended tightening torque values for all nuts and bolts.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Provide products of one of the following:
   1. B-Line.
   2. Kindorf.
   3. Unistrut
   4. Or equal.

2.2 MATERIALS

A. Strut, Fittings, and Accessories:
   1. General
      a. Unless otherwise shown or indicated, strut shall be 1-5/8 inches by 1-5/8 inches. Double struts shall be two pieces of the same strut, welded back-to-back at the factory.
      b. Attachment holes, when required, shall be factory-punched on hole centers approximately equal to the cross-sectional width and shall be 9/16-inch diameter.
      c. Fittings, braces, brackets, hardware, and accessories shall be Type 316 stainless steel.
      d. Strut nuts shall be spring captured Type 316 stainless steel.
      e. Square and round washers shall be Type 316 stainless steel.
   2. Strut materials shall be suitable for area classifications indicated in Section 26 05 05, General Provisions for Electrical Systems, and shown or indicated on the Drawings.
      a. Dusty Locations:
         1) Strut shall be 12-gage carbon steel, hot-dip galvanized after fabrication, complying with ASTM A123/A123M.
      b. Wet Locations:
         1) Strut shall be 12-gage Type 316 stainless steel.
      c. Corrosive Locations:
         1) Strut shall be 12-gage Type 316 stainless steel.

B. Hanger Rods:
   1. Material:
      a. Dry Locations: All-thread, zinc-coated.
      b. Wet, Corrosive, or Hazardous Areas: Stainless steel.
   2. Size: Not less than 3/8-inch diameter, unless otherwise shown on the Drawings or specified.

C. Beam Clamps for Attaching Threaded Rods or Bolts to Beam Flanges for Hanging Struts or Conduit Hangers:
   1. Beam clamps shall be stainless steel equipped with stainless steel square-head set screw, and shall include threaded hole sized for attaching the all-thread rod or threaded bolt.

D. Miscellaneous Hardware:
   1. Bolts, screws, and washers shall be stainless steel.
   2. Hex Nuts: Shall be stainless steel and include nylon inserts.

PART 3 – EXECUTION

3.1 INSPECTION

A. Examine conditions under which the Work will be installed and notify ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Provide hangers and supports for electrical systems with necessary channels, fittings, brackets, and related hardware for mounting and supporting materials and equipment. Provide anchor systems, concrete inserts, and associated hardware for proper support of electrical systems.

B. Install equipment and devices on hangers and supports as shown on the Drawings, as specified, and as required.

C. Install hangers and supports level, true, free of rack, and parallel and perpendicular to building walls and floors, so that the hangers and supports are installed in a neat, professional, workmanlike manner.

D. Holes in suspended ceilings for rods for hangers and supports and other equipment shall be provided adjacent to bars, where possible, to facilitate removal of ceiling panels.

E. Coordinate installation of hangers and supports with equipment, cabinets, consoles, panels, enclosures, boxes, conduit, cable tray, wireway, busway,

cablebus, piping, ductwork, lighting fixtures, and other systems and equipment. Locate hangers and supports clear of interferences and access ways.

F. Anchor Bolts, Expansion Anchors, and Concrete Inserts: Shall be in accordance with Section 05 05 33, Anchor Systems, and requirements of this Section.

G. Mounting of Conduit:
   1. Provide space of not less than 1/4-inch between conduit surfaces and abutting or near surfaces except struts, cable trays, steel beams, and columns.
   2. Fasten conduit to struts, cable trays, steel beams, and columns using specified clamps and straps as shown, specified, and required.
   3. Devices shall be compatible with size of conduit and type of support. Following installation, size identification shall be visible and legible.
   4. Install conduit supports and fasteners in accordance with Section, 26 05 33.13, Rigid Conduits.

H. Supports for Cabinets, Consoles, Panels, Enclosures, and Boxes:
   1. Freestanding: Unless otherwise specified or shown on the Drawings, provide supports for floor-mounted equipment, cabinets, consoles, panels, enclosures, and boxes. Such supports shall be 3.5-inch high concrete equipment base with a 45 degree chamfered edge. Base shall extend two inches beyond outside dimensions of equipment on all sides.
   2. Wall-Mounted:
      a. Provide space not less than 1/4-inch between cabinets, consoles, panels, enclosures, and boxes and the surface on which each is mounted. Provide non-metallic or stainless steel spacers as required.
      b. Do not mount equipment, enclosures, panels, and boxes directly to beams or columns. Mount struts to beams or columns using beam clamps, and mount equipment, enclosures, panels, and boxes to the struts.
   3. Floor Stand Rack:
      a. Where equipment, cabinets, consoles, panels, enclosures, and boxes cannot be wall-mounted, provide an independent floor stand rack.
      b. Floor stand rack shall consist of struts, plates, brackets, connection fittings, braces, accessories, and hardware assembled in a rigid framework suitable for mounting of intended materials and equipment.
      c. Equip floor stand racks with brackets and bases for rigidly-mounting the framework to the ceiling or floor, as applicable; or equip floor stand racks with beam clamps, angle plates, washers, and bolts for fastening to beam flanges, as applicable.
      d. When equipment, cabinets, consoles, panels, enclosures, and boxes weigh more than 100 pounds:
         1) Main vertical supports of floor stand rack assemblies shall be back-to-back struts.
         2) Bracing, clamping and anchoring of each floor stand rack shall be sufficient to ensure rigidity of the floor stand rack with the intended

equipment, enclosures, conduit, cable tray, busway, cablebus, and wireway installed. Floor stand racks shall not be deflected more than 1/8-inch by a 100-pound force applied at any point on the floor stand rack in any direction.

I. Drilling into beams or columns is not allowed unless authorized by ENGINEER.

J. Tighten nuts and bolts to the manufacturer's recommended torque values.

K. Field Cutting:
   1. Cut edges of strut and hanger rod shall have rounded corners, edges beveled, and burrs removed. If field cutting the strut is required, use clean, sharp, dedicated tools. Remove oil, shavings, and other residue of cuttings prior to installation.
   2. Coatings: To prevent corrosion:
      a. Coat cut edges with epoxy-base touchup paint.
      b. Coat cut edges with zinc-rich paint.

+ + END OF SECTION + +

SECTION 26 05 33.13

RIGID CONDUITS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals shown, specified, and required to furnish and install conduit and fittings to form complete, coordinated and grounded raceway systems.
   2. When specific, detailed conduit routings for various systems within buildings and other areas are not be shown on the Drawings, CONTRACTOR shall establish routings based on single-line, riser, and interconnection diagrams and other information on the Drawings. CONTRACTOR shall provide for the proper installation of conduits in each system.
   3. Conduit types and the installation methods shall comply with the following, unless otherwise shown or indicated in the Contract Documents:
      a. Use steel conduit (rigid steel) for exposed indoor conduit runs in non-corrosive areas.
      b. Use PVC-coated rigid steel or aluminum conduit for exposed interior or exterior conduit runs in hazardous, wet, and corrosive locations.
      c. Use PVC-coated rigid steel conduit for individual conduits direct-buried in the ground.
      d. Use Schedule 40 PVC or steel conduit for concrete-encased duct bank runs.
      e. Use steel or Schedule 40 PVC conduit for conduit runs embedded in structural concrete slabs.
      f. Use steel conduit for plant monitoring and control (PMCS) systems, system control and data acquisition (SCADA) systems, and communication systems, regardless of the installation. Conduit shall be PVC coated rigid steel in hazardous, wet, and corrosive locations.

B. Coordination:
   1. Conduit runs shown are diagrammatic. Coordinate conduit installation with piping, ductwork, light fixtures, and other systems and equipment and locate to avoid interferences.
   2. For conduits to be embedded in concrete slabs, confirm adequate slab thickness and coordinate location of conduits with placement of reinforcing steel, waterstops, expansion joints, and other features of the concrete slab.

C. Related Sections:
   1. Section 05 05 33, Anchor Systems.
   2. Section 26 05 29, Hangers and Supports for Electrical Systems.

3. Section 26 05 53, Identification for Electrical Systems.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. ANSI C80.1, Standard for Rigid Electrical Steel Conduit (ERSC).
   2. ANSI/NEMA FB1, Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable.
   3. NEMA TC2, Electrical Polyvinyl Chloride (PVC) Conduit.
   4. NEMA TC3, Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing.
   5. NEMA TC14, Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.
   6. UL 6, Electrical Rigid Metal Conduit – Steel.
   7. UL 514B, Conduit, Tubing, and Cable Fittings.
   8. UL 651, Safety Schedule 40 and 80 Rigid PVC Conduit and Fittings.
   9. UL 886, Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations.
   10. UL 1242, Electrical Intermediate Metal Conduit – Steel.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with the following:
   1. NEC Article 342, Intermediate Metal Conduit
   2. NEC Article 344, Rigid Metal Conduit.
   3. NEC Article 352, Rigid Nonmetallic Conduit.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Assembly details of conduit racks and other conduit support systems.
      b. Layout drawings showing proposed routing of exposed conduits, conduits embedded in structural concrete, and conduits directly buried in the ground. Shop Drawings shall show locations of pull and junction boxes and penetrations in walls and floors. Shop Drawings of embedded conduits shall include cross-sections showing thickness of concrete slabs and locations of conduits relative to reinforcing steel, waterstops, and other features of the slab.
   2. Product Data:
      a. Manufacturer's catalog cuts and product data for conduit, fittings, and appurtenances.

B. Informational Submittals: Submit the following:
   1. Manufacturer's Instructions:
      a. When requested by ENGINEER, provide copies of manufacturer's recommendations for handling and installing products.

2. Site Quality Control Submittals:
    a. When requested by ENGINEER, provide copies of results of specified Site quality control testing.

C. Closeout Submittals: Submit the following:
1. Record Drawings:
    a. Show actual routing of exposed and concealed conduit runs in record documents in accordance with Section 01 78 39, Project Record Documents.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Rigid Steel Conduit, Elbows, and Couplings:
1. Manufacturers: Provide products of one of the following:
    a. Allied Tube and Conduit.
    b. Wheatland Tube Company.
    c. Western Tube and Conduit Corporation.
    d. Or equal.
2. Material: Rigid, heavy-wall, mild steel, hot-dip galvanized, smooth interior, tapered threads and carefully reamed ends; 3/4-inch NPS minimum size.

B. PVC-coated Rigid Steel Conduit, Elbows, and Couplings:
1. Manufacturers: Provide products of one of the following:
    a. Robroy Industries.
    b. Perma-Cote Industries.
    c. OCAL, Inc.
    d. Or equal.
2. Material: Rigid, heavy-wall, mild steel, hot-dip galvanized, smooth urethane interior coating, tapered threads, carefully reamed ends, 3/4-inch NPS minimum size with factory exterior coating of 40-mil thick PVC.
3. Color: Color of coating shall be the same on all conduit and fittings.

C. Aluminum Conduit, Elbows, and Couplings:
1. Manufacturers: Provide products of one of the following:
    a. Allied Tube and Conduit.
    b. Wheatland Tube Company.
    c. Or equal.
2. Material: Rigid, heavy-wall aluminum, smooth interior, tapered threads and carefully reamed ends; 3/4-inch NPS minimum size.

D. Metallic Conduit Fittings, and Outlet Bodies:
1. Manufacturers: Provide products of one of the following:
    a. Crouse-Hinds Company.
    b. Appleton Electric Company.

c. Or equal.

2. Material and Construction: Cast gray iron alloy, cast malleable iron or aluminum bodies and covers consistent with conduit material. Units shall be threaded type with five full threads. Materials shall comply with ANSI/NEMA FB1 and be listed by UL. Do not use "LB" fittings. Use type "LBD" fittings where use of fittings is unavoidable.

3. Use: Conduits shall be gasketed and watertight in hazardous, wet, and corrosive locations.

E. PVC-coated Conduit Fittings, and Outlet Bodies:

1. Manufacturers: Provide products of one of the following:
   a. Robroy Industries.
   b. Perma-Cote Industries.
   c. OCAL, Inc.
   d. Or equal.
2. Material and Construction: Cast gray iron alloy, cast malleable iron bodies and covers with factory coating of 40-mil thick PVC and smooth urethane interior coating. Units shall be threaded type with five full threads. Material shall comply with ANSI/NEMA FB1 and be listed by UL. Do not use "LB" fittings. Use type "LBD" fittings where use of fittings is unavoidable.
3. Use: Provide PVC-coated or aluminum conduit fittings and outlet bodies in hazardous, wet, and corrosive locations. Fitting material shall be consistent with conduit material.

F. Non-metallic Conduit and Fittings:

1. PVC Plastic Conduit:
   a. Manufacturers: Provide products of one of the following:
      1) Amoco Chemicals Corp.
      2) Carlon Electrical Products.
      3) Or equal.
   b. Material: Schedule 40 PVC, rated for 90 degrees C, complying with NEMA TC3 and UL 514B and 651.
   c. Fittings: Form elbows, bodies, terminations, expansions, and fasteners of same material and manufacturer as base conduit. Provide cement by same manufacturer as base conduit.

G. Conduit Hubs:

1. Manufacturers: Provide products one of the following.
   a. Myers Electrical Products Company.
   b. Or equal.
2. Material: Threaded conduit hub, vibration-proof, weatherproof, with captive O-ring seal, zinc metal with insulated throat and bonding screw.
3. Use: Provide for all conduit terminations to boxes, cabinets, and other enclosures in areas designated as wet locations.

H. PVC-coated Conduit Hubs:
   1. Manufacturers: Provide products one of the following:
      a. Robroy Industries.
      b. Perma-Cote Industries.
      c. OCAL, Inc.
      d. Or equal.
   2. Material: Threaded conduit hub, vibration-proof, weatherproof, with captive O-ring seal, zinc metal with insulated throat and bonding screw, and factory coating of 40-mil thick PVC and smooth urethane interior coating.
   3. Use: Provide for PVC-coated steel or aluminum conduit terminations to boxes, cabinets, and other enclosures in areas designated as corrosive location.

I. Conduit Bushings and Locknuts:
   1. Manufacturers: Provide products one of the following:
      a. O-Z/Gedney.
      b. Appleton Electric Company.
      c. Or equal.
   2. Insulated Bushings: Malleable iron body with plastic liner. Threaded type with steel clamping screw. Provide with bronze grounding lug, as required.
   3. Locknuts: Steel for sizes 3/4-inch through two-inch diameter and malleable iron for sizes 2.5-inch through four-inch diameter.
   4. Use: Provide for all conduit terminations to boxes, cabinets and other enclosures except threaded type in areas designated as dusty locations.

J. Thruwall Seals
   1. For new construction through exterior subsurface walls and exterior concrete walls.
      a. Manufacturer: Provide one of the following:
         1) Type WSK and WSCS by O-Z/Gedney.
         2) Or equal.
   2. For new construction passing through concrete floors and floor slabs.
      a. Manufacturer: Provide one of the following:
         1) Type FSK and FSCS floor seals by O-Z/Gedney.
         2) Or equal.
   3. For conduits passing through new exterior masonry block walls or through core-drilled holes in existing exterior subsurface walls, exterior concrete walls, floor slabs and roof slabs, and for conduits passing through existing interior concrete walls or floors and interior masonry block walls.
      a. Manufacturer: Provide one of the following:
         1) Type CSMI sealing bushing at the inside of the structure and Type CSMC sealing bushing at the outside of the structure by O-Z/Gedney.
         2) Or equal.

2.2 ACCESSORIES

A. Fasteners: To the extent possible, fastener material shall be consistent with conduit material. For PVC-coated rigid steel conduit runs, fasteners shall have factory applied PVC coating or be stainless steel. Fasten raceway systems to supporting structures using the following:
   1. To Wood: Wood screws.
   2. To Hollow Masonry Units: Toggle bolts, in accordance with Section 05 05 33, Anchor Systems.
   3. To Brick Masonry: Expansion bolts by Price, or equal.
   4. To Concrete: Anchors in accordance with Section 05 05 33, Anchor Systems.
   5. To Steel: Beam clamps in accordance with Section 26 05 29, Hangers and Supports for Electrical Systems.

B. Duct Sealing Compound
   1. Soft, fibrous, slightly tacky, non-hardening sealing compound.
   2. Remains workable at all temperatures.
   3. Manufacturer:
      a. Type DUX by O-Z/Gedney.
      b. Or equal.

2.3 IDENTIFICATION

A. Conduit Labels:
   1. Provide conduit labels in accordance with Section 26 05 53, Identification for Electrical Systems.

B. Warning Tape:
   1. Provide warning tape in accordance with Section 26 05 53, Identification for Electrical Systems.

PART 3 – EXECUTION

3.1 INSPECTION

A. Examine conditions under which the Work will be performed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Install in accordance with Laws and Regulations.

B. Supports:
   1. Rigidly support conduits by clamps, hangers, or Unistrut-type channels. Conduit supports and accessories shall be in accordance with Section 26 05 29, Hangers and Supports for Electrical Systems.
   2. Support single conduits by means of one-hole pipe clamps in combination with one-screw back plates, to raise conduits from the support surface. Support multiple runs of conduits on trapeze type hangers.

C. Fastenings: Fasten raceway systems rigidly and neatly to supporting structures using specified materials.

D. Exposed Conduit:
   1. Install parallel or perpendicular to structural members or walls.
   2. Where possible, run in groups. Provide conduit racks of suitable width, length, and height, arranged to suit field conditions. Provide support every ten feet, minimum.
   3. Install on structural members in protected locations.
   4. Locate clear of interferences.
   5. Provide six inches of clearance from hot fluid lines and 1/4-inch from walls.
   6. Install vertical runs plumb. Unsecured drop length shall not exceed 12 feet.

E. Empty Conduits:
   1. Install nylon pull wire in each empty conduit and cap conduits not terminating in boxes with permanent fittings designed for the purpose.

F. Field Bends: No indentations. Diameter of conduit shall not vary more than 15 percent at bends.

G. Joints:
   1. Apply conductive compound to joints before assembly.
   2. Make up joints tight and ground thoroughly.
   3. Use standard tapered pipe threads for conduit and fittings.
   4. Cut conduit ends square and ream to prevent damaging wire and cable.
   5. Use full threaded couplings. Split couplings are not allowed.
   6. Use strap wrenches and vises to install conduit. Replace conduit with wrench marks.
   7. Apply zinc-rich paint to exposed threads and other areas of galvanized conduit system where base metal is exposed.

H. Terminations:
   1. Install insulated bushings on conduits entering boxes or cabinets, except when threaded hubs are used.
   2. Provide locknuts on both inside and outside of enclosure, except when threaded hubs are used.
   3. Use of bushings in lieu of locknuts is not allowed.
   4. Install conduit hubs on conduits entering boxes or cabinets in wet and corrosive areas.

I. Moisture Protection:
   1. Plug or cap conduit ends at time of installation to prevent entrance of moisture and foreign materials.
   2. Underground and embedded conduit connections shall be watertight.
   3. Thruwall Seals and Conduit Sealing Bushings: Install for conduits passing through concrete slabs, floors, walls, or concrete block walls.
   4. Drainage: Conduit runs shall be fully drainable. Where possible install conduit runs to drain to one end and away from building. Avoid pockets or depressions in conduit runs.
   5. Seal conduit openings within control and instrumentation panels and distribution equipment with duct sealing compound to provide watertight seal.

J. Corrosion Protection:
   1. Conduit Curb:
      a. For conduits routed in concrete slabs or floors and stub-ups through floor, provide four-inch high concrete curb, extending two inches from outer surface of conduit penetrating floor, to prevent corrosion. For floor-mounted equipment, concrete equipment base shall be in lieu of concrete curb.
      b. Conduit stub-ups shall be 90-degree, PVC-coated, rigid, galvanized steel conduit elbow. PVC-coated elbow shall extend a minimum of 1/2-inch above top of concrete curb or equipment base. Should elbow not reach specified height, provide PVC-coated conduit extension to accommodate specified requirements. Provide coupling or fitting for transition from rigid galvanized steel conduit or PVC conduit in slab to PVC-coated elbow.
      c. For conduits stubbing up and terminating at equipment enclosure mounted on concrete base, provide insulated grounding bushing on PVC-coated rigid steel elbow.
      d. For conduits stubbing up and extending to boxes, cabinets, and other enclosures above the concrete curb in wet and dusty areas, provide conduit coupling/fittings between the PVC-coated rigid steel elbow and rigid steel conduit for transition between the two conduit types.
      e. For conduits stubbing up and extending to boxes, cabinets, and other enclosures above the concrete curb or equipment base in corrosive areas, continue conduit system with PVC-coated rigid steel conduit
   2. Dissimilar Metals:
      a. Prevent occurrence of electrolytic action between dissimilar metals.
      b. Do not use copper products in connection with aluminum, and do not use aluminum in locations subject to drainage of copper compounds on bare aluminum.
      c. Back paint aluminum in contact with masonry or concrete with two coats of aluminum-pigmented bituminous paint.

K. Reused Existing Conduits:
   1. Pull rag swab through conduits to remove water and to clean conduit prior to installing new cable.
   2. Repeat swabbing until all foreign material is removed.
   3. Pull mandrel through conduit, if necessary, to remove obstructions.

L. Core drill for individual conduits passing through existing concrete slabs and walls. Notify ENGINEER in writing in advance of core drilling. Prior to core drilling, drill sufficient number of small exploratory holes to establish that the area to be core drilled is free of existing embedded conduits. Seal spaces around conduit as indicated in Paragraph 3.2.K.3 of this Section.

M. Non-metallic Conduit:
   1. Install in accordance with manufacturer's recommendations.
   2. Provide manufacturer's recommended adhesives or sealants for watertight connections.
   3. Provide expansion fittings for expansion and contraction to compensate for temperature variations. Fittings shall be watertight and suitable for direct burial.
   4. Transition to PVC-coated rigid steel conduit before making turn up to enclosures.

N. PVC-coated Rigid Steel Conduit:
   1. Install in accordance with manufacturer's recommendations.
   2. Install with manufacturer's installation tools to avoid damage to PVC coating.
   3. Repair damaged PVC coating with manufacturer's recommended touch-up compound.

O. Identify conduits, including spares, in accordance with Section 26 05 53, Identification for Electrical Systems.

3.3 FIELD QUALITY CONTROL

A. Site Tests:
   1. Test conduits by pulling through each conduit a cylindrical mandrel with length not less than two pipe inside diameters, having an outside diameter equal to 90 percent of conduit's inside diameter.
   2. Maintain a record, by number, of all conduits successfully tested.
   3. Repair or replace conduits that do not successfully pass testing, and re-test.

+ + END OF SECTION + +

SECTION 26 05 33.16

FLEXIBLE CONDUITS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals shown, specified, and required to furnish and install flexible metallic conduit and fittings.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. UL 360, Liquid-Tight Flexible Steel Conduit.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with the following:
   1. NEC Article 350, Liquid-Tight Flexible Metal Conduit.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Product Data:
      a. Manufacturer's literature and technical information for flexible conduit and fittings proposed for use.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Flexible Conduit (Non-hazardous Areas and Class 1, Division 2, Hazardous Areas):
   1. Material: Flexible galvanized steel core with smooth, abrasion-resistant, liquid-tight, polyvinyl chloride cover. Continuous copper ground built in for sizes 3/4-inch through 1.25-inch. Material shall be UL-listed.
   2. Products and Manufacturers: Provide one of the following:
      a. Anaconda Sealtite Type UA by Anamet Electrical, Inc.
      b. Liquatite Type L.A. by Electric-Flex Company.
      c. Or equal.

B. Flexible Conduit Fittings:

1. Material and Construction: Malleable iron with cadmium finish. Fittings shall adapt the conduit to standard threaded connections, shall have an inside diameter not less than that of the corresponding standard conduit size and shall be UL listed.
2. Manufacturers: Provide products of one of the following:
   a. Crouse-Hinds Company.
   b. Appleton Electric Company.
   c. Or equal.
3. Use: Provide on flexible conduit in non-hazardous and Class 1, Division 2 hazardous areas.

C. PVC-Coated Conduit Fittings:
1. Material and Construction: Malleable iron with standard finish and 40-mil PVC exterior coating. Fittings shall adapt the conduit to standard threaded connections, and shall have an inside diameter not less than that of the corresponding standard conduit size.
2. Manufacturers: Provide products of one of the following:
   a. Robroy Industries.
   b. Permacote Industries.
   c. OCAL, Inc.
   d. Or equal.
3. Use: Provide on flexible conduit in areas designated as corrosive locations.

PART 3 – EXECUTION

3.1 INSPECTION

A. Examine conditions under which the Work will be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Install at motors, transformers, field instruments, and equipment subject to vibration or require movement for maintenance purposes. Provide necessary reducer where equipment furnished cannot accept 3/4-inch diameter flexible conduit. Limit flexible conduit length to three feet maximum.

B. Install in conformance with the Laws and Regulations.

+ + END OF SECTION + +

SECTION 26 05 33.26

EXPANSION/DEFLECTION FITTINGS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install conduit expansion and deflection fittings.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. UL 514B, Conduit, Tubing, and Cable Fittings.
   2. UL 467, Grounding and Bonding Equipment.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with the following:
   1. NEC Article 300, Wiring Methods.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Listing of locations where fittings are required.
   2. Product Data:
      a. Manufacturer's literature and technical information for expansion and deflection fittings proposed for use.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Products and Manufacturers: Provide one of the following:
   1. Type DX for expansion/deflection or AX for expansion only, by O-Z Gedney Company.
   2. Type XD for expansion/deflection or XJ for expansion only, by Crouse Hinds Company.
   3. Type DF for expansion/deflection or XJ for expansion only, by Appleton Electric Company.
   4. Or equal.

B. Cast gray iron alloy or bronze end couplings, malleable iron, or hot-dipped galvanized body, stainless steel clamps and tinned copper braid bonding jumper. Fitting shall be watertight, corrosion-resistant, UL-listed, and compatible with the conduit system.

C. Features:
   1. Expansion/Deflection Fittings:
      a. Axial expansion or contraction up to 3/4-inch.
      b. Angular misalignment up to 30 degrees.
      c. Parallel misalignment up to 3/4-inch.
   2. Expansion Fittings:
      a. Expansion/Contraction: Eight-inch total movement.

D. Expansion/Deflection fittings shall comply with UL 514B and UL 467.

PART 3 – EXECUTION

3.1 INSPECTION

A. Examine conditions under which the Work will be performed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Install fittings in accordance with Laws and Regulations.

B. Provide expansion fittings on exposed conduit runs crossing structural expansion joints and where necessary to compensate for thermal expansion and contraction. Provide expansion fittings on exposed conduit runs exceeding 200 feet.

C. Provide expansion/deflection fittings on embedded conduit runs crossing structural expansion joints. Provide fittings above waterstops.

D. Unless specifically shown or indicated otherwise, when crossing structural expansion joints larger than one inch, provide expansion fitting together with expansion/ deflection fitting. Install fittings on each conduit run in accordance with manufacturer's recommendations to accommodate additional movement necessary.

E. Provide expansion/deflection fittings for underground conduit runs at penetrations of buildings, manholes, handholes, and outdoor concrete equipment pads.

F. Where required in non-metallic conduit and duct systems, provide rigid metal conduit nipples and metal rigid-to-PVC adapters for connection to fittings. Ensure that joints exposed to water or other liquid are made watertight.

+ + END OF SECTION + +

SECTION 26 05 33.33

PULL, JUNCTION, AND TERMINAL BOXES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install pull, junction, and terminal boxes.

B. Related Sections:
   1. Section 26 05 05, General Provisions for Electrical Systems.
   2. Section 26 05 29, Hangers and Supports for Electrical Systems.
   3. Section 26 05 53, Identification for Electrical Systems.

1.2 REFERENCES

A. Standards referenced in this Section are.
   1. AASHTO, Standard Specifications for Highway Bridges.
   2. UL 886, Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. NEC Article 314, Outlet, Device, Pull and Junction Boxes; Conduit Bodies; Fittings; and Handhole Enclosures.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Product Data:
      a. Manufacturer's technical information for pull, junction, and terminal boxes proposed for use.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Pull, Junction, and Terminal Boxes:
   1. General – Applicable to All Boxes:
      a. Description and Performance Criteria:
         1) Provide pull, junction, and terminal boxes rated at not less than NEMA 12. Boxes shall be appropriate for each location in

accordance with NEMA requirements and as required for area classifications specified in Section 26 05 05, General Provisions for Electrical Systems.

2) For flush-mounted pullboxes in slabs or pavement potentially subject to vehicular traffic, boxes and covers shall be constructed for H-20 loading in accordance with AASHTO Standard Specifications for Highway Bridges.

b. Manufacturers: Provide products of one of the following:
   1) Appleton Electric Company.
   2) Crouse-Hinds Company.
   3) Hoffman Engineering Company.
   4) Or equal.

c. Materials: Pull boxes embedded in concrete slabs shall be cast iron.

d. Terminal strips and terminal blocks in terminal boxes shall be mounted on terminal box sub-panels.

e. Identification: Boxes shall be identified in accordance with Section 26 05 53, Identification for Electrical Systems.

2. Materials and Construction – Dusty Locations:
   a. Material: Welded and galvanized sheet steel of USS gage.
   b. Gasket: Oil-resistant gasket.
   c. Access: Lift-off hinges and quick-release latches.
   d. Material Thickness:
      1) Boxes with dimension two feet and smaller shall be 14-gage.
      2) Boxes with dimension between two and three feet shall be 12 gage.
      3) Boxes with dimension of three feet or more in any direction shall be 10-gage.

3. Materials and Construction - Wet, Corrosive, or Hazardous Locations:
   a. Rating:
      1) Pull boxes in wet, corrosive, or outdoor areas shall be NEMA 4X.
      2) Boxes for areas classified as hazardous locations, where required by NEC, shall be explosion-proof and comply with UL 886.
   b. Material:
      1) Cast gray iron alloy with hot-dip galvanized finish, or cast malleable iron bodies and covers.
      2) Large boxes not generally available in cast iron construction shall be copper-free aluminum alloy or Type 316 stainless steel, as required by location.
      3) In corrosive locations, where the conduit system is PVC-coated, boxes shall be cast metal with factory-applied 40-mil PVC coating, Type 316 stainless steel, or non-metallic thermoplastic or fiberglass reinforced plastic material.
   c. Gasket:
      1) Provide neoprene gaskets for wet and corrosive locations.
      2) Gaskets shall be an approved type designed for the purpose. Improvised gaskets are not acceptable.
   d. Access: Stainless steel cover bolts.
   e. Features:
      1) External mounting lugs.

2) Drilled and tapped conduit holes.
3) Boxes where conduits enter building or structure below grade shall have 1/4-inch drain hole at bottom of the box.
4) Provide threaded connections for explosion proof boxes.

B. Terminal Blocks:
   1. Products and Manufacturers: Provide one of the following:
      a. Allen-Bradley Company, Bulletin, Model 1492.
      b. General Electric Company, Model CR151K.
      c. Or equal.
   2. Material and Construction:
      a. NEMA-rated nylon modular terminal blocks.
      b. 600-volt rated.
      c. Control and alarm circuit terminals shall be screwed type with permanently affixed numeric identifiers beside each connection.
      d. Power terminals shall be copper and rated for the circuit ampacity.

PART 3 – EXECUTION

3.1 INSPECTION

A. Examine conditions under which the Work will be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Mount boxes so that sufficient access and working space is provided and maintain clearance of not less than 1/4-inch from walls.

B. Securely fasten boxes to walls or other structural surfaces on which boxes are mounted. Provide independent supports that comply with Section 26 05 29, Hangers and Supports for Electrical Systems, where boxes will not be mounted on walls or other structural surface.

C. Install pull boxes where shown or indicated, and provide pull boxes where one or more of the following conditions exist:
   1. Conduit runs containing more than three 90-degree bends.
   2. Conduit runs exceeding 200 feet in length.

D. Provide removable, flame-retardant, insulating cable supports in boxes with any dimension exceeding three feet.

E. Field-apply PVC touch-up to scratched PVC boxes damaged during installation. Touch-up work shall be in accordance with manufacturer’s recommendations and instructions.

F. Size junction, pull, and terminal boxes in accordance with NEC Article 314 and other Laws and Regulations.

G. Provide terminal blocks in boxes where shown and where cable terminations or splices are required.

+ + END OF SECTION + +

SECTION 26 05 33.36

OUTLET BOXES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install outlet boxes for mounting wiring devices and lighting fixtures.

B. Related Sections:
   1. Section 26 05 05, General Provisions for Electrical Systems.
   2. Section 26 05 29, Hangers and Supports for Electrical Systems.
   3. Section 26 05 53, Identification for Electrical Systems.
   4. Section 26 27 26.13, Low-Voltage Receptacles.
   5. Section 26 27 26.23, Snap Switches.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with the following:
   1. NEC Article 314, Outlet, Device, Pull and Junction Boxes; Fittings; and Handhole Enclosures.
   2. NEC Article 501, Class I locations.
   3. UL 514A, Metallic Outlet Boxes.
   4. UL 514B, Fittings for Conduit and Outlet Boxes.

1.3 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Product Data:
      a. Manufacturer’s technical information for outlet boxes proposed for use.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Device Boxes:
   1. Manufacturers: Provide products of one of the following:
      a. Crouse-Hinds Company.
      b. Appleton Electric Company.
      c. Or equal.

2. Material:
    a. In Wet Locations: Cast gray iron alloy or cast malleable iron with zinc electroplate finish, or aluminum bodies consistent with conduit material.
    b. In Dusty Locations: Zinc-coated sheet steel or aluminum bodies consistent with conduit material.
    c. Where conduit is installed concealed, boxes shall include suitable extension rings and covers, as required.
    d. Where used with PVC-coated conduit system, boxes shall include factory applied 40-mil-thick PVC coating.
    e. Cast boxes shall be hub-type and include external mounting lugs.
    f. Metallic outlet boxes shall comply with UL 514A.
    g. Fittings for outlet boxes shall comply with UL 514B.
3. NEMA rating of box shall be as required for area classifications specified in Section 26 05 05, General Provisions for Electrical Systems.
4. Cover Plates:
    a. Type 302 stainless steel alloy for indoor finished areas.
    b. Plates in corrosive locations shall include factory-applied 40-mil PVC coating.
    c. Stainless steel screws and hardware.
    d. For receptacle and switch cover plates, comply with Section 26 27 26.13, Low-Voltage Receptacles, and Section 26 27 26.23, Snap Switches.

PART 3 – EXECUTION

3.1 INSPECTION

A. Examine conditions under which the Work is to be installed and notify ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Fasten boxes rigidly and neatly to supporting structures.

B. Securely fasten equipment to walls or other surfaces on which materials or equipment is mounted. Provide independent supports complying with Section 26 05 29, Hangers and Supports for Electrical Systems, where boxes are not mounted on walls or other surface capable of supporting the materials or equipment.

C. For units mounted on masonry or concrete walls, provide suitable 1/2-inch spacers to prevent mounting back of box directly against wall.

D. Leave no open conduit holes in boxes. Close unused openings with capped bushings.

E. Label each circuit in boxes and identify each circuit in accordance with Section 26 05 53, Identification for Electrical Systems.

F. Install outlet boxes in accordance with NEC Article 314.

+ + END OF SECTION + +

SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals shown, specified, and required to furnish and install identification for electrical apparatus and electrical Work.

B. Related Sections:
   1. Section 26 05 19, Low Voltage Electrical Power Conductors and Cables.
   2. Section 40 61 13, Process Control Systems General Provisions.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with the following:
   1. NEC Article 110, Requirements for Electrical Installation.
   2. NEC Article 210, Branch Circuits.
   3. NEC Article 215, Feeders.
   4. NEC Article 504, Intrinsically Safe Systems.
   5. 40 CFR 1910.145 (OSHA) – Specification for Accident Prevention Signs and Tags.
   6. NFPA 70E, Electrical Safety in the Workplace.

1.3 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings: Submit the following:
      a. Complete description and listing of proposed electrical identification and electrical identification devices for associated equipment or systems.
      b. Conduit and wire identification numbering system and equipment signage.
   2. Product Data:
      a. Manufacturer’s literature, cut sheets, specifications, dimensions and technical data for all products proposed under this Section.

PART 2 – PRODUCTS

2.1 MANUFACTURED UNITS

A. Engraved Identification Devices (Nameplates and Legend Plates):
   1. Nameplates:
      a. Laminated thermoset plastic, 1/16-inch thick, engraved condensed block black lettering on white background, square corners, and beveled front edges, or match existing.
      b. Size: As required.
      c. Letter Size: Minimum 3/16-inch.
      d. Nameplates one-inch or less in height shall have one mounting hole at each end. Nameplates greater than one-inch in height shall have mounting holes in the four corners.
   2. Legend Plates:
      a. Legend plates for pushbuttons, pilot lights, selector switches, and other panel-mounted devices shall be large size with dimensions of approximately 2-7/16 inches wide by 2-13/32 inches tall (Allen Bradley large automotive size), plastic, custom engraved with black letters on white background.
         1) Provide standard-size legend plates where devices are mounted on motor control centers and spacing of devices precludes using automotive-size legend plates.
      b. Lettering size and line weight shall be the same for all legend plates on the same panel or enclosure. Maximum size shall be 1/4-inch and minimum size shall be 1/8-inch.

B. Safety Signs and Voltage Markers:
   1. Provide high voltage signs for equipment operating over 600 volts.
   2. High-Voltage Safety Signs for Outdoor Applications:
      a. Products and Manufacturers: Provide one of the following:
         1) B-120-45471 by Brady.
         2) Or equal.
      b. Unless otherwise shown or indicated, high voltage safety signs shall be not less than 10 inches high by 14 inches wide, of fiberglass reinforced plastic, and shall comply with 40 CFR 1910.145. Signs shall resist fading from exposure to temperature extremes, ultraviolet light, abrasive, and corrosive environments, and shall read, "DANGER – HIGH VOLTAGE – KEEP OUT"
      c. Mounting hardware shall be Type 316 stainless steel.
   3. High-Voltage Safety Signs for Indoor Applications:
      a. Products and Manufacturers: Provide one of the following:
         1) B-302-84084 by Brady.
         2) Or equal.
      b. High voltage safety signs for installation on indoor equipment shall be either pressure-sensitive acrylic or vinyl, and shall be not less than 10 inches high by 14 inches wide, shall comply with 40 CFR

1910.145, and shall read, "DANGER – HIGH VOLTAGE – KEEP OUT".

4. Cable Tray Safety Signs:
    a. Products and Manufacturers: Provide one of the following:
        1) B-302-86139 by Brady.
        2) Or equal.
    b. Cable tray safety signs shall be pressure-sensitive vinyl conforming to 40 CFR 1910.145, 5 inches by 3.5 inches in size, and shall read, "DANGER – HIGH VOLTAGE"
5. Low-Voltage Safety Signs:
    a. Products and Manufacturers: Provide one of the following:
        1) B-302-86060 by Brady.
        2) Or equal.
    b. Low voltage safety signs shall be pressure-sensitive vinyl complying with 40 CFR 1910.145, five inches by 3.5 inches in size, and shall read, "DANGER – 480 VOLTS".
6. Low-Voltage Markers:
    a. Products and Manufacturers: Provide one of the following:
        1) CV442xx by Brady.
        2) Or equal.
    b. Low voltage markers shall be either pressure-sensitive vinyl or vinyl cloth with black lettering on orange background and shall read, "120 VOLTS", "208 VOLTS", "120/208 VOLTS", or "240 VOLTS" as required.

C. Arc-flash Safety Signs:
1. Products and Manufacturers: Provide one of the following:
    a. Brady.
    b. Or equal.
2. Warning signs shall be adhesive-backed polyester.
3. Warning signs shall read, "Warning – Arc Flash and Shock Hazard. Appropriate PPE Required. Arc flash warning signs shall indicate the flash protection boundary, incident energy in calories per square centimeter, hazard level, description of required protective clothing, shock hazard, limited approach boundary, restricted approach boundary, prohibited approach boundary, and equipment name.

D. Voltage System Identification Directories:
1. General:
    a. Directories shall be laminated thermoset plastic, 1/16-inch thick, engraved block black letters on white background, square corners, and beveled front edges.
    b. Directories shall identify all voltage systems within building or structure.
    c. Directories shall list the colors that identify ungrounded and grounded conductors of each system.

d. Colors shall be in accordance with Section 26 05 19, Low Voltage Electrical Power Conductors and Cables, Section 26 05 13.23, 15KV Cable, and Section 26 05 13.26, 5KV Cable.
e. Example Directory Text:

Voltage System Identification		
System	**A, B, C**	**Neutral**
277/480	Brown, Orange, Yellow	Gray
120/208	Black, Blue, Red	White

2. Large directories for rooms shall have text height not less than 1/2-inch.
3. Small directories for equipment shall have text height of not less than 1/4-inch.

E. Conduit Labels:
1. Products and Manufacturers: Provide one of the following:
a. B-915-xxxxx by Brady.
b. Or equal.
2. Shall be pre-tensioned acrylic/vinyl construction coiled to completely encircle conduit for conduit up through five-inch diameter, or pre-molded to conform to circumference of conduit six-inch diameter and larger.
3. Attach strap-on style for six-inch diameter conduit with stainless steel springs.
4. Shall be blank for use with custom printed labels.
5. Custom Labels:
a. Shall have black lettering on yellow background.
b. Shall not contain abbreviations in legend.
c. Shall be custom printed on continuous tape with permanent adhesive using thermal printer specified below.

F. Wire Identification:
1. Heat Shrinkable Wire and Cable Labeling System:
a. Products and Manufacturers: Provide one of the following:
1) B-341 PS-xxx-2W by Brady.
2) Or equal.
b. White heat-shrinkable irradiated polyolefin shrink-on sleeves. Labels shall be thermal printed. Labels shall be not less than two inches wide.
2. Wrap-Around Wire and Cable Labeling System:
a. Products and Manufacturers: Provide one of the following:
1) THT-XX-427 by Brady.
2) Or equal.
b. Self-laminating white/transparent self extinguishing vinyl strips. Length shall be sufficient to provide at least 2.5 wraps. Labels shall be thermally printed and not less than two inches wide.

H. Thermal Printing System:
1. Utilize thermal transfer process to provide non-smearing labels and markers.

2. Wire and Cable Markers:
    a. Portable, Products and Manufacturers: Provide one of the following:
        1) TLS2200 by Brady.
        2) Or equal.
    b. Desktop, Products and Manufacturers: Provide one of the following:
        1) 200M by Brady.
        2) Or equal.
3. Cable Markers:
    a. Portable, Products and Manufacturers: Provide one of the following:
        1) Handimark by Brady.
        2) Or equal.
    b. Desktop, Products and Manufacturers: Provide one of the following:
        1) Labelizer PLUS by Brady.
        2) Or equal.

2.2 FABRICATION

A. Engraved Identification Devices (Nameplates and Legend Plates):
    1. Nameplate and legend plate text is preliminary and subject to change pending final review and approval of nomenclature by ENGINEER after start-up and testing.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Provide electrical identification in accordance with manufacturer recommendations and as required for proper identification of equipment and materials.

B. Engraved Identification Devices (Nameplates and Legend Plates):
    1. Unless otherwise indicated in the Contract Documents, attach permanent nameplates with permanent adhesive and with 3/16-inch diameter, round head, stainless steel machine screws into drilled and tapped holes.
    2. Provide nameplate with 1.5-inch high letters to identify each console, cabinet, panel, or enclosure as shown or indicated.
    3. Provide nameplates for field-mounted motor starters, disconnect switches, manual starter switches, pushbutton stations, and similar equipment operating components, which shall describe motor or equipment function and circuit number.
    4. Provide nameplates with 1/2-inch high letters to identify each junction and terminal box shown or indicated.

5. On switchgear, provide nameplates for each main and feeder circuit including control fuses, and for each indicating light and instrument.
    a. Provide nameplate with 1.5-inch high letters giving switchgear designation, voltage rating, ampere rating, short circuit rating, manufacturer's name, general order number, and item number.
    b. Identify individual door for each compartment with nameplate giving item designation and circuit number.
6. Motor Control Centers:
    a. Provide nameplate with 1.5-inch letters with motor control center designation.
    b. Identify individual door for each unit compartment with nameplate identifying controlled equipment.
7. Except conduit, all electrical appurtenances including lighting panels, convenience outlets, fixtures, and lighting switches, shall be provided with nameplates indicating appropriate circuit breaker number(s).
8. Push Buttons:
    a. Provide legend plates for identification of functions.
    b. Provide nameplates for identification of controlled equipment.
    c. Provide red buttons for stop function.
    d. Provide black buttons for other functions.
9. Pilot Lights:
    a. Provide legend plates for identification of functions.
    b. Provide nameplates for identification of controlled equipment.
    c. Shall have lens colors as shown or indicated. Where no color is indicated, provide the following lens colors:

Color	**Legend**
Green	Running, Open
Red	Stopped, Closed
Amber	Alarm
Blue	Power
White	Status

10. Selector Switches:
    a. Provide legend plates for identification of functions.
    b. Provide nameplates for identification of controlled equipment.
11. Panel Mounted Instruments:
    a. Provide nameplates for identification of function.
12. Interiors of Cabinets, Consoles, Panels, Terminal Boxes, and Other Enclosures:
    a. Provide nameplates for identification.
    b. Provide each item inside cabinet, console, panel, terminal box, or enclosure with laminated plastic nameplate as shown on approved Shop Drawings and CONTRACTOR"s other submittals. Install nameplates with adhesive.
    c. Interior items requiring nameplates include:
        1) Terminal blocks and strips.

2) Bus bars.
3) Relays.
4) Rear of face-mounted items.
5) Rear of door-mounted items.
6) Interior mounted items that require identification when mounted externally.

d. Circuit Breaker Directory:
1) Provide engraved laminated plastic directory listing function and load controlled for each circuit breaker within panel used for power distribution.

13. Re-label existing equipment whose designation have changed.

C. Safety Signs and Voltage Markers:
1. Provide safety signs and voltage markers on and around electrical equipment as shown or indicated.
a. Install rigid safety signs using stainless steel fasteners.
b. Clean surfaces before applying pressure-sensitive signs and markers.
2. Install high voltage safety signs on all equipment doors providing access to uninsulated conductors, including terminal devices, greater than 600 volts.
3. Provide cable tray safety signs on both sides of cable trays at maximum intervals of 20 feet. Install signs on side rails of tray as acceptable to ENGINEER.
a. Label cable trays that contain conductors greater than 600 volts with cable tray safety signs.
b. Cable trays that contain conductors greater than 208 volts and less than 600 volts shall be labeled with low voltage safety signs.
c. Cable trays that contain conductors of 120/208 volts shall be labeled with low voltage markers.
d. Do not label cable trays that contain only instrument signal cables.
e. Label cable trays that contain intrinsically safe wiring or cables in accordance with NEC Article 504.
4. Install low voltage safety signs on equipment doors that provide access to uninsulated 480-volt conductors, including terminal devices.
5. Install low voltage markers on each terminal box, safety disconnect switch, and panelboard installed, modified, or relocated as part of the Work and containing 120/208 volt conductors.

D. Voltage System Identification Directories:
1. Provide voltage system identification directories as required by NEC Article 210 and NEC Article 215.
2. Provide in each electrical room voltage system identification directory mounted on wall or door at each entrance to room.

3. For panelboards, switchboards, motor control centers, and other branch circuit or feeder distribution equipment that are not located in electrical rooms, provide voltage system identification directory mounted on equipment.
    a. Directories shall be affixed using epoxy glue. Screws or bolts shall not penetrate equipment enclosures.
    b. Directories shall be readily visible and not obscure labels and other markings on equipment.

E. Arc-flash Safety Signs:
1. Provide arc-flash safety signs as required by NEC Article 110.
2. Provide signs for switchboards, panelboards, motor control centers, and industrial control panels. Provide signs for control panels that contain 480 volt equipment. Provide arc flash warning signs on other equipment where the incident energy is greater than 1.2 calories per square centimeter.

F. Conduit Labels:
1. Provide conduits with conduit labels unless otherwise shown or indicated.
2. Do not label flexible conduit.
3. Do not label exposed single conduit runs of less than 25 feet between local disconnect switches and their associated equipment.
4. Conduit labels shall indicate the following information:
    a. Contract Number: Alphanumeric, three or four digits, as applicable.
    b. Conduit Number: Alphanumeric as shown on the Drawings, as assigned by CONTRACTOR for unlabelled conduits, and in accordance with approved submittals.
5. Conduits that contain intrinsically safe wiring shall have an additional pipe marker provided that has blue letters on white background and reads, “INTRINSICALLY SAFE WIRING”.
    a. Install intrinsically safe pipe markers in accordance with NEC Article 504 along entire installation. Spacing between labels shall not exceed 25 feet.
6. Provide conduit labels at the following locations:
    a. Where each conduit enters and exits walls, ceilings, floors, or slabs.
    b. Where conduit enters or exits boxes, cabinets, consoles, panels, or enclosures, except pull boxes and conduit bodies used for pull boxes.
    c. At maximum intervals of 50 feet along length of conduit.
7. Orient conduit labels to be readable.

G. Wire and Cable Identification:
1. Color-coding of insulated conductors shall comply with Section 26 05 19, Low Voltage Electrical Power Conductors and Cables.
2. Use heat-shrinkable wire labels where wire or cable is terminated. Use wrap-around labels where wire or cable is to be labeled but is not terminated.

3. Do not provide labels for the following:
    a. Bare (uninsulated) conductors, unless otherwise shown or indicated as labeled.
4. Provide wire and cable labels for the following:
    a. New, rerouted, or revised wire or cable.
    b. Insulated conductors.
    c. Wire and cable terminations:
        1) Wire labels shall be applied between 1/2-inch and one inch of completed termination
        2) Apply cable labels between 1/2-inch and one inch of cable breakout into individual conductors.
            a) Label individual conductors in a cable after breakout as specified for wires.
    d. Wire or cable exiting cabinets, consoles, panels, terminal boxes, and enclosures.
        1) Label wires or cables within two inches of entrance to conduit.
    e. Wire or cable in junction boxes and pull boxes
        1) Label wires or cables within two inches of entrance to conduit.
    f. Wire and cable installed in cable tray.
        1) Wire and cable shall have labels at maximum intervals of 20 feet.
    g. Wire and cable installed without termination in electrical manholes.
        1) Wire and cable shall have wrap-around labels applied within one foot of exiting manhole.
5. Wire and Cable Identification System:
    a. Wire and cable labels shall be imprinted with an identifying designator.
        1) Wire and cable extending between two devices or items and that does not undergo a change of function shall be identified by a single unique designator as specified below.
    b. Field Wiring:
        1) Wire or cable designator shall consist of:
            a) Three left-most characters shall consist of the Contract number under which wiring or cable was installed.
            b) Fourth character from the left shall be an asterisk (*), a plus sign (+) or a hyphen (-). Do not use other punctuation symbols in a wire designator.
            c) Remaining characters shall be alphanumeric and make wire designator unique.
            d) Numbering shall reflect actual designations used in the Work and shall be documented in record documents.
    c. Cabinet, Console, Panel, and Enclosure Wiring, Internal:
        1) New Cabinets, Consoles, Panels, and Enclosures:
            a) Wire and cable inside cabinets, consoles, panels, and enclosures shall have designators as specified in Section 40 61 13, Process Control Systems General Provisions.

6. Modified Cabinets, Consoles, Panels, and Enclosures:
    a. New or rerouted wire or cable in existing cabinets, consoles, panels, and enclosures shall be labeled as shown on the Drawings or be assigned a ten-character designator equivalent to field wire designator.

H. Terminal Strip Labeling:
1. Label panel side of terminal to match panel wire number.
2. Label field side of terminal to match field wire number. Terminal number shall not include the Contract number.

+ + END OF SECTION + +

SECTION 26 05 73

ELECTRICAL POWER DISTRIBUTION SYSTEM STUDIES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, professional services, and incidentals required to perform electrical power distribution system studies.
   2. Motor starting and transformer information used in electrical power distribution system studies shall be based on equipment provided by CONTRACTOR and, where applicable, existing equipment ratings and settings.
   3. Electrical power distribution system studies shall include the following, as specified in this Section:
      a. Short-circuit study.
      b. Protective device evaluation study.
      c. Protective device coordination study.
      d. Arc flash analysis.

B. Related Sections:
   1. Section 26 05 53, Identification for Electrical Systems.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. ANSI/IEEE C37.91, Guide for Protective Relay Applications to Power Transformers
   2. ANSI/NCSL Z540.3 Requirements for the Calibration of Measuring and Test Equipment.
   3 IEEE 141, Recommended Practice for Electric Power Distribution in Industrial Plants (IEEE Red Book).
   4. IEEE 242, Recommended Practice for Protection and Coord. of Industrial and Commercial Power Systems (IEEE Buff Book).
   5. IEEE 399, Analysis (IEEE Brown Book), Recommended Practice for Power System Analysis.
   6. IEEE 1584, Guide for Performing Arc-Flash Hazard Calculations.
   7. NFPA 70E, Electrical Safety in the Workplace.

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Professional Engineer:
      a. Engage a registered professional engineer legally qualified to practice in the jurisdiction where the Project is located and experienced in providing engineering services of the kind indicated. Professional engineer may be employed by independent consulting firm or manufacturer of power distribution equipment.
      b. Professional engineer shall have not less than five years of experience performing electrical power distribution system studies similar in scope and size to the studies required for the Project.
      c. Submit qualifications data.
      d. Responsibilities include but are not necessarily limited to:
         1) Performing or supervising the performance of electrical power distribution system studies and related field services.
         2) Preparing or supervising the preparation of test plans and test reports, and interpretation and engineering analysis of test data. Test reports shall bear the seal and signature of the professional engineer. State of licensure, license number, and professional engineer's name shall be clearly legible on the seal.
         3) Certifying that tests performed and results achieved conform to the Contract Documents.
   2. Field Engineer:
      a. Field engineer performing protective device testing shall be experienced in type of testing required and testing equipment used on the Project.
      b. Field engineer may be an employee of the protective device equipment manufacturer.

B. Test equipment and instrument calibration shall comply with accuracy standards of NIST and ANSI/NCSL Z540.3.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Studies:
      a. Calculations and results of the short-circuit study, protective device evaluation, and coordination studies in report format. Report shall be sealed and signed by the professional engineer retained for the studies. Submit preliminary reports (when specified) and final reports.
      b. Time current curves for protective devices included within the power system studies.
      c. Calculations and results of arc-flash analysis in report format sealed and signed by professional engineer retained for the studies. Submit preliminary reports (when specified) and final reports.

2. Testing Plan: Submit work plan for field testing. Submit and obtain ENGINEER's approval prior to performing tests. Plan shall indicate schedule of field testing, time frames for tests, and duration of equipment outage for testing. Submit shutdown requests for each outage in accordance with Section 01 14 16, Coordination with Owner's Operations.
3. Field Survey Plan: Submit work plan for field survey and data gathering prior to beginning work. Plan shall indicate the schedule of work, time frames for data collection, and duration that equipment will be temporarily out of service. Submit shutdown requests for each outage in compliance with Section 01 14 16, Coordination with Owner's Operations.

B. Informational Submittals: Submit the following:
   1. Test Reports:
      a. Results of field testing.
   2. Qualifications Statements:
      a. Professional engineer.
      b. Field engineer, when required by ENGINEER.

C. Closeout Submittals: Submit the following:
   1. Final settings of protective devices. Submit compilation of final settings for each equipment lineup within 10 days of programming the associated protective devices.
   2. Electronic Files:
      a. Protective Devices:
         1) Settings for all microprocessor-based protective devices.
         2) Software versions used to program the protective devices.
      b. Electrical Power Distribution System Studies:
         1) Upon ENGINEER's approval or acceptance, as applicable, of submittals required under this Section, submit for OWNER's use all electronic files developed for the Work under this Section associated with the approved or accepted, as applicable, submittal to ENGINEER.
         2) Electronic files submitted for OWNER's use shall become OWNER's property.
         3) Source files for power studies performed under this Section.

1.5 ELECTRICAL POWER DISTRIBUTION SYSTEM STUDIES

A. General:
   1. Perform a current and complete short-circuit study, protective device evaluation study, and protective device coordination study for the Site's electrical distribution system. Perform studies in accordance with IEEE 141, IEEE 242, and IEEE 399.
   2. Studies shall include all portions of high-, medium-, and low-voltage electrical power distribution systems, from the normal and alternate sources of power through low-voltage distribution system. Thoroughly cover in the

study normal system operating method, alternate operation, and operations that could result in maximum fault conditions.

3. Perform a complete study to evaluate both new and existing devices, and include recommendations on required adjustments. Studies shall include both the normal utility supply and standby systems.
4. Promptly bring to attention of ENGINEER and OWNER problem areas and inadequacies in equipment.
5. Perform both preliminary and final short-circuit and coordination studies. Preliminary study shall verify adequacy of equipment's short-circuit ratings and establish preliminary settings required prior for energizing equipment. Perform final short-circuit and coordination study and arc flash analysis after ENGINEER's acceptance of preliminary study, but not later than the date when equipment installed under the Project is placed into service. Study data shall include the following:
    a. Preliminary Short-circuit and Coordination Study: Base the evaluation on the worst case operating mode. Base the evaluation on estimated cable lengths, and proposed equipment and protective devices.
    b. Final Short-circuit and Coordination Study: Base the evaluation on utility-confirmed contribution. Evaluate the distribution system under each of the various operating modes. Base the evaluation on actual confirmed cable lengths, and installed equipment and protective devices.

B. Short-circuit Study:
1. Perform short-circuit evaluation using computer software specifically designed for such use.
2. Input data shall include electric utility company's short-circuit, single-, and three-phase contributions, with reactance/resistance (X/R) ratio, resistance and reactance components of each branch impedance, motor and generator contributions, base quantities selected, and other applicable circuit parameters.
3. Calculate short-circuit momentary duties and interrupting duties on the basis of maximum available fault current at each switchgear bus, switchboard, motor control center, distribution panelboard, pertinent branch circuit panelboards, and other significant locations through the system.
4. Short-circuit tabulations shall include symmetrical fault currents and X/R ratios. For each fault location, total duty on the bus and individual contribution from each connected branch, including motor back electro-motive force (EMF) current contributions, shall be listed with its associated X/R ratio.

C. Protective Device Evaluation Study:
1. Determine adequacy of circuit breakers, controllers, surge arresters, busways, switches, and fuses by tabulating and comparing short-circuit ratings of these devices with the available fault currents.

2. Apply appropriate multiplying factors based upon system X/R ratios and protective device rating standards.

D. Protective Device Coordination Study:
   1. Perform study to select or to check selections of power fuse ratings, protective relay characteristics and settings, ratios and characteristics of associated voltage and current transformers, and low-voltage breaker trip characteristics and setting.
   2. Overcurrent device settings estimated in the protective device coordination study shall provide complete, 100 percent selectivity. Selectively coordinate system such that only the device nearest a fault will operate to remove the faulted circuit. System selectively shall be based on both the magnitude and duration of a fault current.
   3. Study shall include all voltage classes of equipment starting at electric utility's incoming line protective device, down to and including medium- and low-voltage equipment. Phase and ground overcurrent and phase and ground fault protection shall be included, and settings for other adjustable protective devices.
   4. Plot time-current characteristics of installed protective devices on appropriate log-log paper. Maintain reasonable coordination intervals and separation of characteristic curves. Provide coordination plots for phase and ground protective devices for complete system. Use sufficient curves to clearly indicate selective coordination achieved through electric utility's main breaker, power distribution feeder breakers, and overcurrent devices at each major load center.
   5. Show maximum of eight protective devices per plot. Appropriately title each plot and include the following information as required for the circuits shown:
      a. Representative one-line diagram, legends, and types of protective devices selected.
      b. Power company's relays or fuse characteristics.
      c. Significant motor starting characteristics.
      d. Parameters of transformers, magnetizing inrush and withstand curves in accordance with ANSI C37.91.
      e. Operating bands of low-voltage circuit breaker trip curves, and fuse curves.
      f. Relay taps, time dial and instantaneous trip settings.
      g. Cable damage curves.
      h. Symmetrical and asymmetrical fault currents.
   6. Provide selection and settings of protective devices separately in tabular format listing circuit identification, IEEE device number, current transformer ratios, manufacturer, type, range of adjustment, and recommended settings. Provide a tabulation of recommended power fuse selection for all fuses in system.

E. Arc-Flash Analysis:
   1. Conduct arc flash analysis after acceptance by ENGINEER of short-circuit study and coordination study. Perform arc flash analysis for each operating mode of the system, in accordance with IEEE 1584 and NFPA 70E.
   2. Document the protection and calculation procedures and coordination review in testing report. Present analysis results in tabular format showing the following:
      a. Bus and protection device name.
      b. Bolted and arcing fault values.
      c. Protective device trip times.
      d. Arc flash boundary, working distance, and incident energy.
      e. Required protective flame-resistant (FR) clothing class.

1.6 STUDY REPORT

A. Summarize results of electrical power distribution system studies in a typed or computer-printed report that includes the following:
   1. Description, purpose, basis, written scope, and single-line diagram of power distribution systems evaluated.
   2. Tabulations of circuit breaker, fuses, and other equipment ratings versus calculated short-circuit duties. Evaluation of short-circuit calculations and identification of underrated equipment.
   3. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip settings, and fuse selection. Include an evaluation and discussion of logical compromises for proposed protection.
   4. Fault current tabulation including definition of terms and guide for interpretation.
   5. Tabulation of appropriate tap settings for relay seal-in units.
   6. Tabulation of equipment survey information.

B. Electrical power distribution system studies report shall include a separate section addressing arc flash analysis. In addition to protection and calculation procedures, and coordination review and analysis results, report shall include protective device evaluation for each high-incident energy case to determine if adjustments can improve system performance relative to arc flash hazard level.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 PREPARATION

A. General:
   1. Coordinate with professional engineer performing the studies and assist professional engineer with collecting information necessary to complete the specified studies.
   2. Prior to performing studies, obtain information pertaining to existing system necessary for performing studies.

3.2 FIELD SERVICES

A. CONTRACTOR's professional engineer shall conduct an equipment survey and data gathering of existing devices and information necessary to perform electrical power distribution system studies.

B. To the extent applicable, perform survey that includes the following information:
   1. Manufacturer, type, and size of each power fuse.
   2. Manufacturer, type, model, and settings for each protective relay, trip unit, and circuit breaker.
   3. Current transformer ratios for each protective relay.
   4. Appropriate data for motors and transformers included with the study.

C. CONTRACTOR's professional engineer shall confirm and establish proper settings for protective devices. Professional engineer shall collect data and coordinate with equipment Suppliers to establish proper settings for the devices provided. Document in the study all devices and settings.

3.3 FIELD TESTING

A. Site Tests:
   1. Provide protective device field testing in accordance with manufacturers' recommendations. Field testing shall be by CONTRACTOR's field engineer, after submittal of and ENGINEER's acceptance of electrical power distribution system studies. Field testing results shall be documented in a report that shall include final settings of protective devices.
   2. Field engineer shall provide necessary tools and equipment and adjust, set, calibrate, and test protective devices. Protective relays and meters in medium- and low-voltage equipment shall be set, adjusted, calibrated, and tested in accordance with manufacturers' recommendations and the coordination study. Provide minor adjustments, repairs, and lubrication necessary for proper operation.
   3. Electromechanical protective relays provided in accordance with the Contract Documents shall be set and tested for acceptance. Testing shall include visual and mechanical inspection. Testing shall include overcurrent time and pick-up tests.

4. Solid state and multi-function trip devices shall be set, including required programming necessary for the protection required. Devices shall be checked, configured, and tested for setting and proper operation.

3.4 MAINTENANCE OF OPERATIONS

A. Field testing may require that certain equipment be temporarily taken out of service. CONTRACTOR shall perform the Work with due regard to the need of OWNER for continuance of operations and in accordance with sequencing required in the Contract Documents, and in accordance with Section 01 14 16, Coordination with Owner's Operations. Submit testing procedures and schedules and obtain acceptance by ENGINEER prior to starting testing and related Work.

3.5 INSTALLATION

A. Provide personnel protective equipment labels in accordance with Section 26 05 53, Identification for Electrical Systems.
   1. Supplier Services: Provide training for OWNER's operation and maintenance personnel in personnel protection equipment. Provide at least eight hours of training, in accordance with Section 01 79 23, Instruction of Operations and Maintenance Personnel.

+ + END OF SECTION + +

SECTION 26 24 13

SWITCHBOARDS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, services, and incidentals as shown, specified, and required to furnish and install switchboards.

B. Related Sections:
   1. Section 26 05 53, Identification for Electrical Systems.
   2. Section 26 05 73, Electrical Power Distribution System Studies.
   3. Section 26 43 00, Surge Protective Devices.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. NEMA PB2, Dead-Front Distribution Switchboards.
   2. UL 891, Dead-Front Switchboards.

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer: Shall have not less than five years experience manufacturing and servicing materials and equipment substantially similar to those required and upon request shall submit documentation of not less than five installations in satisfactory operation for at least five years each.
   2. Manufacturer shall manufacture circuit protective devices within the assembly.

B. Component Supply and Compatibility:
   1. Obtain all materials and equipment included in this Section regardless of component manufacturer from a single switchboard manufacturer.
   2. Switchboard manufacturer shall review and approve or prepare all Shop Drawings and other submittals for all components furnished under this Section.
   3. Components shall be suitable for the specified service conditions and shall be integrated into overall assembly by switchboard manufacturer.

C. Regulatory Requirements: Comply with the following:
   1. NEC Article 408, Switchboards and Panelboards.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Three-line diagrams.
      b. Dimensional information including front view elevation and plan view.
      c. Construction details of enclosures with conduit entry locations and connection details between assemblies.
      d. Components list and nameplate schedule.
      e. Summary sheets with schedules of equipment.
      f. Key interlock scheme and sequence of operation.
   2. Product Data:
      a. Manufacturer’s technical information, including catalog information.
      b. Manufacturer's technical specifications with assembly and component ratings.
      c. Time current curves for protective devices.
   3. Testing Plans, Procedures, and Testing Limitations:
      a. At least thirty days prior to factory testing, submit description of proposed factory testing methods, procedures, and apparatus.
      b. At least thirty days prior to field testing, submit description of proposed testing methods, procedures, and apparatus.

B. Informational Submittals: Submit the following:
   1. Certificates:
      a. Certifications required in this Section, including seismic requirements.
   2. Source Quality Control Submittals:
      a. Report of results of testing and inspections performed at manufacturer’s shop.
   3. Site Quality Control Submittals:
      a. Report of results of field testing.
   4. Supplier Reports:
      a. Submit written report of results of each visit to Site by Supplier’s service technician, including purpose and time of visit, tasks performed, and results obtained. Submit within two days of completion of visit to the Site.
   5. Qualifications Statements:
      a. Manufacture, when requested by ENGINEER.

C. Closeout Submittals: Submit the following:
   1. Operations and Maintenance Data:
      a. Submit in accordance with Section 01 78 23, Operations and Maintenance Data.
      b. Include acceptable test reports, maintenance data and schedules, description of operation, wiring diagrams, and list of spare parts recommended for one year of operation with current price list.

c. Include record drawings of control schematics, with point-to-point wiring diagrams.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Delivery:
   1. Upon delivery, check for evidence of water that may have entered equipment during transit.

B. Handle equipment in accordance with manufacturer's instructions. One copy of these instructions shall be furnished with equipment at time of delivery.

C. Storage:
   1. Store switchboards equipment in a clean, dry location with controls for uniform temperature and humidity. Protect equipment with coverings and maintain environmental controls.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Provide equipment of one of the following:
   1. Eaton/Cutler-Hammer.
   2. General Electric.
   3. Schneider Electric/Square D Company.
   4. Or equal.

2.2 SWITCHBOARD EQUIPMENT

A. Ratings:
   1. Switchboard shall be 600-volt class, suitable for operation on three-phase, 60-Hertz system.
   2. System operating voltage, number of wires, bus ampacity, and short circuit withstand capability and interrupting rating shall be as shown on the Drawings, or as otherwise indicated in the Contract Documents.

B. General:
   1. Switchboards shall be dead-front type with individual and group-mounted devices, front-accessible.
   2. Arrange switchboards with number of sections and compartments required for distribution arrangement shown.
   3. Provide switchboard in accordance with the arrangement shown on the Drawings. Switchboard shall consist of bus system, structure, circuit breakers, metering, surge protective device (SPD), and enclosure.
   4. Switchboards shall be in accordance with NEMA PB2, UL 891, and NEC Article 408.

5. Switchboard shall be service entrance type and UL-labeled as such. Equip service entrance switchboards with bonding jumper to bond enclosure and ground bus to the neutral bus, and a barrier to isolate service bus bars and terminals.

C. Bus Bars:
   1. Switchboard bus bars shall be tin-plated copper, supported with high-impact, non-tracking insulating material. Secure bus joints with Belleville type washers, and braced bus joints for mechanical forces exerted during short circuit conditions. Mount main horizontal bus bars with all three phases arranged in the same vertical plane.
   2. Bus bar sizes shall be based upon a maximum temperature rise of 65 degrees C over a 40-degree C ambient in accordance with NEMA PB2 and UL 891.
   3. Provide copper ground bus, minimum size of 1/4-inch by two inches, secured to each vertical section and extending entire length of equipment. Ground bus current capacity shall equal one-half the capacity of main power bus.
   4. Conductor hardware shall be high-tensile strength and zinc-plated. Provide bus joints with conical spring-type washers.

D. Structure:
   1. Equipment structure shall be completely self-supporting and shall include required number of vertical sections bolted together to form a single metal-enclosed enclosure.
   2. Enclosure shall be rated NEMA 1.
   3. Enclosure structure frame shall be die-formed, 12-gauge steel bolted together and reinforced.
   4. Equipment shall have identifying nameplates in accordance with Section 26 05 53, Identification for Electrical Systems. Provide nameplates for each breaker circuit and provide typewritten directory of circuits.
   5. Cover sides and rear of enclosure with removable, bolt-on covers. Edges of front covers or hinged front panels shall be formed. Provide adequate ventilation within enclosure.
   6. Sections of switchboard shall be front- and rear-aligned with depth as shown on the Drawings. Devices shall be front-removable and load connections shall be front-accessible.
   7. Provide assembly with adequate lifting means so that assembly is capable of being moved to its installation position.
   8. Conduit entry and exit shall be bottom entry and coordinated by CONTRACTOR.
   9. Quantity of conduits and cables associated with each feeder shall be as shown or indicated on the Drawings.

E. Circuit Breakers:
   1. Circuit breakers shall be molded case type with quantity of poles, voltage, and current ratings shown.

2. Breakers shall be manually-operated thermal magnetic type, including inverse-time overload and instantaneous short-circuit protection. Contacts shall be non-welding silver alloy and arc extinction shall be accomplished by arc chutes.
3. Breakers shall be operated by a toggle-type handle and shall have quick-make/quick-break over-center switching mechanism that is mechanically trip-free. Automatic tripping of breakers shall be clearly indicated by handle position.
4. Where shown or required due to capacity, breakers shall be insulated case type. Insulated case breakers shall be manually-operated with stored energy mechanisms. Breakers shall include open-close pushbuttons, five-cycle close time, and rotary operated stored energy handle mechanism providing quick make/quick-break protection.
5. Breakers shall have 100-amp frames, minimum. Provide overload protection on all poles, with trip settings as shown. Breakers with frame sizes 250 amps and below shall have thermal-magnetic trip units and inverse time-current characteristics, or equal.
6. Provide breakers 400-amp frame and larger with an electronic solid state programmable trip unit. For four-wire power systems and circuits, provide a neutral current transformer, and trip unit shall be suitable to accept neutral input. Provide push-to-trip button on front of circuit breaker to provide local manual means of exercising trip mechanism. Electronic trip system shall include:
    a. Plug-in protection programmer, flux shift trip device, and current sensor package. Construct programmer, sensor, and flux-shifting trip device as integral elements of breaker, requiring no externally mounted assemblies for proper operation.
    b. Solid state, microprocessor-based, nine-function programmer shall provide true RMS current sensing and include adjustable continuous and instantaneous current elements with adjustable long time, short time, zero sequence ground fault pickup and delay and zone selective interlocking. Main, tie and feeder circuit breakers shall be connected for zone selective interlocking to allow instantaneous bus protection.
7. Where shown, provide breakers with shunt trips, bell alarms, and auxiliary devices.

F. Provide main meter device as shown on the Drawings, and in accordance with the following.
    1. Type 2 Microprocessor-based Monitoring Device:
        a. Device shall provide complete electrical metering in one package. Device shall include self-contained potential transformers and self-protected internal fuses.
        b. Mount device on compartment door to allow operator access to meter menu and display.

c. Device shall include trend analysis, event logging, and recording. Device shall include the following direct reading metered values:
   1) Volts: 0.2 percent accuracy.
   2) Amperes: 0.2 percent accuracy.

3. Control power shall be drawn from the monitored incoming AC line. Device shall have non-volatile memory and not require battery backup. During power failure, device shall retain preset parameters.

G. Wiring/Terminations:
1. Provide small wiring, necessary fuse blocks, and terminal blocks in switchboard as required. Control components mounted in assembly, such as fuse blocks, relays, pushbuttons, switches, and other components, shall be suitably marked for identification corresponding to appropriate designations on manufacturer's wiring diagrams.
2. Provide mechanical-type terminals for all line and load terminations suitable for copper or aluminum cable rated for 75 degrees C of size indicated on the Drawings.
3. Provide lugs in incoming line section for connection of main grounding conductor. Provide additional lugs for connection of other grounding conductors as indicated on Drawings.
4. Control wire shall be Type SIS, bundled and secured with nylon ties. Provide insulated locking spade terminals for all control connections, except where saddle type terminals are provided integral to a device. Current transformer secondary leads shall first be connected to conveniently accessible short-circuit terminal blocks before connecting to another device. Provide groups of control wires leaving switchboard with terminal blocks with suitable numbering strips. Provide wire markers at each end of all control wiring.

H. Accessories:
1. Provide a surge protective device in accordance with Section 26 43 00, Surge Protective Devices, for each switchboard bus shown or indicated on the Drawings. Each surge protective device shall be included and factory-mounted within switchboard-by-switchboard manufacturer. Surge protective device monitoring and display shall be visible from switchboard front.

I. Miscellaneous Devices:
1. Provide control power transformers with primary and secondary protection, as indicated on the Drawings or as required for proper operation of equipment.

J. Finishing:
1. Exterior and interior steel surfaces of switchboard shall be properly cleaned and provided with rust-inhibiting phosphatized coating by switchboard manufacturer. Color and finish of switchboard shall be light gray.

2.3 SOURCE QUALITY CONTROL

A. Tests:
   1. Factory-test switchboards in accordance with NEMA PB2 and UL 891
   2. Perform factory tests on equipment prior to shipment. Tests shall consist of the manufacturer's standard tests, and shall include:
      a. Physical inspection and checking of all components.
      b. Operation and device function tests under simulated service conditions to verify accuracy of wiring and functioning of all equipment.
      c. Primary, control, and secondary wiring hi-pot tests.

PART 3 – EXECUTION

3.1 INSPECTION

A. Examine conditions under which materials and equipment will be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Install equipment so that sufficient access and working space is provided for ready and safe operation and maintenance.

B. Install equipment on concrete pad, as shown. Coordinate pad dimensions to fit equipment furnished.

C. Install in accordance with Laws and Regulations, manufacturer's recommendations, and the Contract Documents. Do not energize equipment without permission of OWNER.

3.3 FIELD QUALITY CONTROL

A. Site Tests:
   1. After installation, inspect and perform field testing of each switchboard. Testing and inspections shall by Supplier's factory-trained representative, in accordance with manufacturer's recommendations. Inform OWNER and ENGINEER when Supplier's representative indicates that equipment is correctly installed.
   2. Perform the following tests and checks before energizing equipment:
      a. Verify proper installation.
      b. Inspect all mechanical and electrical devices for proper operation.
      c. Check tightness of bolted connections.
      d. Measure insulation resistance of each bus section, phase-to-phase and phase-to-ground.

e. Measure insulation resistance of each circuit breaker, pole-to-pole and from pole-to-ground.
f. Check for proper anchorage, required area clearances, physical damage, and proper alignment.
g. Clean and lubricate as required.
h. Perform other tests and adjustments recommended by equipment manufacturer.

B. Manufacturer's Services: Provide services of qualified, factory-trained serviceman to perform the following:
1. Instruct CONTRACTOR in installing equipment.
2. Inspect and adjust equipment after installation and ensure proper operation.
3. Instruct operations and maintenance personnel in operation and maintenance of the equipment.
4. Manufacturer's technician shall make visits to the Site as follows:
a. First visit shall be for instructing CONTRACTOR in proper equipment installation, and assisting in installing equipment. Minimum number of hours on-Site: 8 hours.
b. Second visit shall be for checking completed installation, start-up of system; and performing field quality control testing. Minimum number of hours on-Site: 4 hours.
c. Third visit shall be to instruct operations and maintenance personnel:
1) Furnish services of manufacturer's qualified, factory-trained specialists to instruct OWNER's operations and maintenance personnel in recommended operation and maintenance of equipment.
2) Training requirements, duration of instruction and qualifications shall be in accordance with Section 01 79 23, Instruction of Operations and Maintenance Personnel.
3) Number of hours on-Site shall be in accordance with Section 01 79 23, Instruction of Operations and Maintenance Personnel.
d. Technician shall revisit the Site as often as necessary until installation is acceptable.
5. All costs, including expenses for travel, lodging, meals and incidentals, and cost of travel time, for visits to the Site shall be included in the Contract Price.

3.4 ADJUSTING

A. Calibrate, set and program protective devices. Coordinate the protective devices furnished under this Section and provide proper settings of devices per the results of the study specified in Section 26 05 73, Electrical Power Distribution System Studies.

+ + END OF SECTION + +

SECTION 26 27 26.13

LOW-VOLTAGE RECEPTACLES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install low-voltage receptacles.

B. Related Sections:
   1. Section 26 05 05, General Provisions for Electrical Systems.
   2. Section 26 05 53, Identification for Electrical Systems.
   3. Section 26 05 33.36, Outlet Boxes.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. UL 498, Standard for Attachment Plugs and Receptacles.
   2. UL 514D, Cover Plates for Flush-Mounted Wiring Devices.
   3. UL 943, Standard for Ground-Fault Circuit-Interrupters.
   4. UL 1010, Standard for Receptacle-Plug Combinations for Use in Hazardous (Classified) Locations.
   5. UL 1449, Standard for Surge Protective Devices.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with the following:
   1. Americans with Disabilities Act.
   2. NEC Article 406, Receptacles, Cord Connectors, and Attachment Plugs (Caps).

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Product Data: Manufacturer's technical information for receptacles and cover plates proposed for use.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Receptacles:
1. Grounding receptacle, two-pole, three-wire, NEMA 5-20R configuration, ivory color.
a. Single:
1) Products and Manufacturers: Provide one of the following:
a) HBL5361I by Hubbell, Inc.
b) 5361-I by Pass & Seymour.
c) Or equal.
b. Duplex:
1) Products and Manufacturers: Provide one of the following:
a) HBL5362I by Hubbell, Inc.
b) PS5362-I by Pass & Seymour.
c) Or equal.
c. Weather-resistant Duplex:
1) UL-listed as weather-resistant.
2) Products and Manufacturers: Provide one of the following:
a) HBL5362IWR by Hubbell, Inc.
b) WR5362-I by Pass & Seymour.
c) Or equal.
2. Corrosion-resistant grounding receptacle, two-pole, three-wire, yellow color.
a. Single, 125-volt, 20 ampere, NEMA 5-20R configuration:
1) Products and Manufacturers: Provide one of the following:
a) HBL53CM61 by Hubbell, Inc.
b) CR6301 by Pass & Seymour.
c) Or equal.
b. Duplex, 125-volt, 20 ampere, NEMA 5-20R configuration:
1) Products and Manufacturers: Provide one of the following:
a) HBL53CM62 by Hubbell, Inc.
b) CR6300 by Pass & Seymour.
c) Or equal.
c. Single, 125-volt, 30 ampere, NEMA 5-30 configuration:
1) Products and Manufacturers: Provide one of the following:
a) HBL9308 by Hubbell, Inc.
b) 3802 by Pass & Seymour.
c) Or equal.
3. Grounding receptacle, two-pole, three-wire, 250-volt, 20 ampere, NEMA 6-20 configuration, brown color.
a. Single:
1) Products and Manufacturers: Provide one of the following:
a) HBL5461 by Hubbell, Inc.
b) 5871 by Pass & Seymour.
c) Or equal.

b. Duplex:
1) Products and Manufacturers: Provide one of the following:
a) HBL5462 by Hubbell, Inc.
b) 5862 by Pass & Seymour.
c) Or equal.

4. Provide Type 302 stainless steel cover-plate conforming to UL 514D. Provide weatherproof-while-in-use cover where shown on the Drawings as "WP" or "WPU", and provide where receptacles are located in wet or corrosive location.
5. Receptacles shall comply with UL 498.

B. Ground Fault Interrupting Receptacles:
1. Duplex grounding receptacle, two-pole, three-wire, NEMA 5-20R configuration, 125-volt AC, 20 amperes, gray color with ground fault circuit interrupting (GFCI) protection.
2. Ground fault interrupting receptacles shall comply with UL 943.
3. Provide Type 302 stainless steel cover-plate conforming to UL 514D. Provide weatherproof-while-in-use cover where shown on the Drawings as "WP" or "WPU", and provide where located in wet or corrosive location.
4. Products and Manufacturers: Provide one of the following:
a. GFR5362SGY by Hubbell, Inc.
b. 2091-GRY by Pass & Seymour.
c. Or equal.
5. Weather-resistant Ground Fault Interrupting Receptacles
a. Products and Manufacturers: Provide one of the following:
1) 2095TRWRGRY by Pass & Seymour.
2) Or equal.

C. Weatherproof-While-in-Use Covers:
1. Where receptacles are shown on the Drawings as "WP" or "WPU", and where receptacles are installed in wet locations as defined in area classification portion of Section 26 05 05, General Provisions for Electrical Systems, provide receptacles as specified in Paragraphs 2.1A through 2.1D of this Section, as applicable, with weatherproof-while-in-use covers as specified below.
2. Provide covers that are UL-listed, weatherproof while receptacle is in use, and are of ultraviolet-resistant construction suitable for outdoor use in accordance with NEC 406.
3. Material:
a. Non-metallic box with hinged, non-metallic cover.
b. Sealing gaskets between box and cover.
c. Stainless steel screws and hardware.
d. Color: Gray finish
4. Products and Manufacturers: Provide one of the following:
a. TayMac Corporation.
b. Pass and Seymour Type WIU
c. Or equal.

PART 3 – EXECUTION

3.1 INSPECTION

A. Examine conditions under which the Work is to be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Non-hazardous Locations: Install receptacles at locations shown, in outlet or device boxes in accordance with Section 26 05 33.36, Outlet Boxes.

B. Hazardous Locations: Install receptacles in rigid metallic conduit systems.

C. Install receptacles with ground pole in the down position.

D. Mount receptacles 18 inches above finished floor in non-hazardous locations and 4.5 feet above finished floor in hazardous locations, in accordance with the Americans with Disability Act, unless otherwise shown or indicated in the Contract Documents.

E. Install in conformance with Laws and Regulations.

F. Identification:
   1. Identify each conductor with circuit number and lighting panel number in accordance with Section 26 05 53, Identification for Electrical Systems.
   2. Identify each receptacle with permanent phenolic tag. Tags shall include circuit number and lighting panel number.

+ + END OF SECTION + +

SECTION 26 27 26.23

SNAP SWITCHES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install snap switches for lighting and other systems.

B. Related Sections:
   1. Section 26 05 53, Identification for Electrical Systems
   2. Section 26 05 33.36, Outlet Boxes.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:
   1. UL 20, General Use Snap Switches.
   2. UL 894, Switches for Use in Hazardous (Classified) Locations.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements
   1. Americans with Disabilities Act

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Product Data: Manufacturer’s technical information for switches proposed for use.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Switches for Non-Hazardous Locations:
   1. Single pole AC toggle switch, quiet type, 120/277-volt AC, 20 amperes, Ivory, specification grade.
      a. Products and Manufacturers: Provide one of the following:
         1) Catalog No. 1221-I, by Harvey Hubbel, Inc.
         2) Catalog No. 1991-I, by Arrow-Hart, Inc.
         3) Catalog No. 20AC1-I, by Pass & Seymour
         4) Or equal.

2. Single pole, three-way AC toggle switch, quiet type, 120/277-volt AC, 20 amperes, Ivory, specification grade.
    a. Products and Manufacturers: Provide one of the following:
        1) Catalog No. 1223-I, by Harvey Hubbell, Inc.
        2) Catalog No. 1993-I, by Arrow-Hart, Inc.
        3) Catalog No. 20AC3-I, by Pass & Seymour
        4) Or equal.
3. Two-pole AC toggle switch, quiet type, 120/277-volt AC, 20 amperes, Ivory, specification grade.
    a. Products and Manufacturers: Provide one of the following:
        1) Catalog No. 1222-I, by Harvey Hubbel, Inc.
        2) Catalog No. 1992-I, by Arrow-Hart, Inc.
        3) Catalog No. 20AC2-I, by Pass & Seymour
        4) Or equal.
4. Switches in non-hazardous areas shall be UL-listed in accordance with UL 20.

B. Switch Covers:
1. Indoor covers shall be Type 304 stainless steel.
2. Outdoor, wet, or corrosive location covers shall be weatherproof and corrosion resistant.

C. Key Operated On-Off Switches:
1. Key operated switches shall be complete with legend plate and NEMA 4 enclosure and two keys for each switch.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine conditions under which the Work is to be installed and notify ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install switches at locations as shown or indicated in the Contract Documents in outlet or device boxes, in accordance with Section 26 05 33.36, Outlet Boxes.

B. Mount wall switches 4.0 feet above finished floor, in accordance with the Americans with Disability Act, unless otherwise noted.

C. Identify each conductor with circuit number and lighting panel number. Identification shall be in accordance with Section 26 05 53, Identification for Electrical Systems.

+ + END OF SECTION + +

SECTION 26 28 16.33

DISCONNECT SWITCHES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install disconnect switches.

B. Related Sections:
   1. Section 26 05 05, General Provisions for Electrical Systems.
   2. Section 26 05 53, Identification for Electrical Systems.
   3. Section 26 27 26.23, Snap Switches.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. UL 98, Enclosed and Dead-Front Switches.
   2. NEMA KS 1, Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
   3. NEMA 250, Enclosures for Electrical Equipment (1000 Volts Maximum).

1.3 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. NEC Article 404, Switches.
   2. Disconnect switches shall bear the UL label.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Listing of each switch to be furnished, including location, rating, and NEMA enclosure type for each.
   2. Product Data:
      a. Manufacturer’s technical information for disconnect switches proposed for use.

B. Maintenance Material Submittals: Submit the following:
   1. Extra Stock Materials:
      a. Furnish one set of spare fuses for each fused disconnect switch to be installed.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Provide products of one of the following:
   1. Square-D Company.
   2. Cutler-Hammer.
   3. General Electric Company.
   4. Siemens.
   5. Or equal.

2.2 MATERIALS

A. Service Disconnect Switches:
   1. Type: Fused, heavy-duty, single throw, quick-make, quick-break mechanism, visible blades in “OFF” position and safety handle.
   2. Rating: Voltage, current and short circuit ratings and number of poles as shown or indicated on the Drawings. Switch shall bear UL label indicating suitability for use as service equipment and shall comply with UL 98, NEMA KS 1, and NEMA 250.
   3. Provide auxiliary dry contacts to indicate switch position where shown on the Drawings.

B. Single Throw, Circuit Disconnect Switches:
   1. Type: Fused or unfused, horsepower rated, heavy-duty, single throw, quick-make, quick-break mechanism, visible blades in the "OFF" position and safety handle.
   2. Rating: Voltage and current ratings and number of poles as required for motor or equipment circuits being disconnected. Switches shall bear a UL label and shall comply with the requirements of UL 98, NEMA KS 1 and NEMA 250.
   3. Provide auxiliary dry contacts to indicate switch position.

C. Disconnect Switches for 120-volt, Single-phase Circuits:
   1. Refer to Section 26 27 26.23, Snap Switches.

D. Enclosures: NEMA rating shall be as required for area classifications specified in Section 26 05 05, General Provisions for Electrical Systems.

E. Identification:
   1. Identify enclosures in accordance with Section 26 05 53, Identification for Electrical Systems.
   2. Provide nameplate to identify the equipment served by disconnect switch and associated source of power.

PART 3 – EXECUTION

3.1 INSPECTION

A. Examine conditions under which the Work will be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Install equipment so that sufficient access and working space is provided for ready and safe operation and maintenance.

B. Securely fasten equipment to walls or other structural supports on which they are mounted. Provide independent stainless steel supports where no wall or other structural surface exists. Mount disconnect enclosures at a height not exceeding six feet.

C. Provide suitable 1/4-inch spacers to prevent mounting enclosure directly against walls.

+ + END OF SECTION + +

SECTION 26 29 23

LOW-VOLTAGE VARIABLE FREQUENCY DRIVES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, services, and incidentals as shown, specified, and required to furnish and install low-voltage variable frequency drives, complete and operational.
   2. Variable frequency drives required under this Section are low-voltage, voltage source inverter, pulse width modulated. Variable frequency drives shall be customized.
   3. Low-voltage variable frequency drives included in this Section are associated with the following equipment:
      a. Section 46 76 33, Dewatering Centrifuges.

B. Related Sections:
   1. Section 26 05 29, Hangers and Supports for Electrical Systems.
   2. Section 26 05 53, Identification for Electrical Systems.
   3. Section 46 76 33, Dewatering Centrifuges.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. IEEE 519, Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems.
   2. ISO 9000, Quality Management Systems, Fundamentals and Vocabulary.
   3. ISO 9001, Quality Management Systems, Requirements.
   4. ISO 9002, Quality Systems, Model for Quality Assurance in Production, Installation and Servicing.
   5. NEMA ICS 2, Controllers, Contactors and Overload Relays Rated 600 Volts.
   6. NEMA ICS 7, Industrial Control and Systems Adjustable Speed Drives.
   7. NEMA MG 1, Motor and Generators.
   8. UL 489, Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures.
   9. UL 508, Industrial Control Equipment.

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer:
      a. Low-voltage variable frequency drive manufacturer shall have not less than five years of experience designing and regularly manufacturing

and servicing substantially similar equipment to that required, and upon ENGINEER's request shall submit documentation of not less than five installations in satisfactory operation for not less than five years each.

b. Manufacturer shall be certified under ISO 9000, ISO 9001, or ISO 9002 for materials and equipment specified.

c. For all required factory tests, low-voltage variable frequency drive manufacturer shall use a factory test facility that has calibrated its testing apparatus in the previous twelve months, and is staffed by qualified, experienced technicians.

B. Component Supply and Compatibility:

1. Drives specified under this Section employ a low switching frequency or pattern to minimize instantaneous rate of voltage change over time (dv/dt), and the adverse effects of potential bearing currents. Where alternate manufacturers are proposed, obtain manufacturer recommendations regarding bearing currents and provide equipment required at no additional cost to OWNER.

2. Each low-voltage variable frequency drive shall be fully compatible with associated driven equipment and motors. Variable frequency drives shall be matched to specific load requirements for each system. Operation of variable frequency drive shall not overstress motor insulation.

3. To centralize responsibility and to ensure that all equipment is properly coordinated, variable drives specified under this Section shall be obtained from the Supplier of the associated driven equipment.

4. Similar components of drives associated with each system shall be products of a single manufacturer.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:

a. Dimensional information and construction details of enclosures. Enclosure details shall consist of exterior and interior front door with nameplate legends, interior door front and rear views, and terminal block layout.

b. Three-line power and control schematic diagrams.

c. Wiring diagrams showing the interconnection of conductors to all devices with terminal assignments for remote devices.

d. Functional description of system operation.

e. VFD heat dissipation at full load, including heat rejection/cooling system.

2. Product Data:

a. Manufacturer's technical specifications.

b. Manufacturer's catalog cuts and product literature.

3. Testing Plans:
    a. Not less than thirty days prior to source quality control testing, submit descriptions of proposed shop testing methods, procedures, apparatus, and limitations.
    b. Not less than thirty days prior to field quality control testing, submit descriptions of proposed field testing methods, procedures, and apparatus.

B. Informational Submittals: Submit the following:
1. Certificates:
    a. Certification letters from low-voltage variable frequency drive manufacturer and motor manufacturer that the approved driven equipment has been reviewed and that variable frequency drive units and motors are compatible, and shall be provided in accordance with the Contract Documents and requirements of the driven equipment.
2. Source Quality Control Submittals:
    a. Within five days of completing source quality control tests and inspections, submit test results with indication of whether all criteria of the Contract Documents for the specified equipment were met.
3. Field Quality Control Submittals:
    a. Within five days of completing field quality control tests and inspections, submit test results with indication of whether all criteria of the Contract Documents for the specified equipment were met.
4. Manufacturer Reports:
    a. Within five days of each visit to the Site by manufacturer's representative, submit written report of reason for visit, problems encountered, solutions implemented, and remaining work.
5. Qualifications Statements:
    a. Manufacturer, when requested by ENGINEER.

C. Closeout Submittals: Submit the following:
1. Operation and Maintenance Data:
    a. Submit complete installation, operation and maintenance manuals including test reports, maintenance data and schedules, description of operation, list of recommended spare parts, and spare parts ordering information.
    b. Manuals shall include record drawings of control schematics, including point-to-point wiring diagrams.
    c. Include a listing of all programmable drive parameters and their settings at Substantial Completion. Submit parameters as both printed pages in the operations and maintenance manual and in electronic format on compact disc that can be directly uploaded to the drive in event of drive replacement or repair.
    d. Comply with Section 01 78 23, Operations and Maintenance Data.

D. Maintenance Materials Submittals: Submit the following:
   1. Spare Parts and Extra Stock Materials:
      a. Furnish, tag, and box for shipment and long-term storage spare parts and special tools for low-voltage variable frequency drives. Each set of spare parts and tools shall include manufacturer's recommended spare parts inventory for one year and include, at minimum, the following:

Item	Quantity per Four VFDs per HP Rating
1) Transistor and diode modules with accessories	One set
2) Power supply module	One
3) Fans	One set
4) Power fuses	One set of each size and type used
5) Control power fuses	Two sets of each size and type used
6) Pilot lights	Two per ten of each type used

      b. Furnish a list of recommended spare parts for an operating period of one year. Describe each part, the quantity recommended, and current unit price.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packing, Shipping, Handling, and Unloading:
   1. Packing:
      a. Inspect prior to packing to ensure that assemblies and components are complete and undamaged.
      b. Protect mating connections.
      c. Cover all openings into enclosures with-vapor inhibiting, water-repellent material.
      d. Indoor containers shall be bolted to skids.
   2. Upon delivery, check materials and equipment for evidence of water that may have entered equipment during transit.
   3. Handling:
      a. Lift, roll or jack low-voltage variable frequency drive equipment into locations shown.
      b. Variable frequency drives shall be equipped for handling required for installation. Handle equipment in accordance with manufacturer's requirements.

B. Storage and Protection:
   1. Store low-voltage variable frequency drive equipment in a clean, dry location with controls for uniform temperature and humidity. Protect equipment with coverings and maintain environmental controls.

PART 2 – PRODUCTS

2.1 EQUIPMENT PERFORMANCE

A. System Performance:
   1. Driven equipment to be controlled by a low-voltage variable frequency drive shall be provided with a customized variable frequency drive. Each drive unit shall include an adjustable frequency controller with associated controls for continuous speed adjustment and protection of the driven equipment. Output speed control of motor shall be continuous throughout speed range of two to 60 Hertz under variable torque load or constant torque as specified for the driven equipment.
   2. Low-voltage variable frequency drives associated with each set of driven equipment shall be similar to each other.
   3. Variable frequency drives shall be UL-listed or ETL-listed and designed, built, and tested in accordance with UL 489, NEMA ICS 2, NEMA ICS 7, and UL 508.

2.2 MANUFACTURERS

A. Provide low-voltage variable frequency drives by one of the following:
   1. Allen Bradley, Inc.
   2. Siemens-Robicon Corporation.
   3. Danfoss Inc.
   4. ABB.
   5. Or equal.

2.3 ENCLOSURE

A. Provide each low-voltage variable frequency drive with freestanding, front-access, NEMA 1, filtered and gasketed enclosure. Enclosure shall house all components required for the associated variable frequency drive.

B. Enclosure shall provide adequate cooling for components within and include positive ventilation.

C. Enclosure shall include circuit breaker disconnect switch. Circuit breakers shall be in accordance with UL 489. Switch handle shall be suitable for padlocking and be through-the-door type with handle height not exceeding six feet. Operation of switch shall remove the service supply from all internal components. Power devices shall be suitable for interrupting capacity of (300) RMS symmetrical amperes. Include current limiting semi-conductor fuses where required for protection of solid state components.

D. Enclosure door shall include an operator interface for access to controller's digital keypad and display.

E. Equip enclosure front with nameplates for identification of equipment and operating functions. Nameplates shall be in accordance with Section 26 05 53, Identification for Electrical Systems.

F. Equip enclosure with phenolic type terminal blocks suitably labeled for all internal and remote wiring requirements, plus twenty percent spare.

2.4 ADJUSTABLE FREQUENCY CONTROLLER

A. General:
   1. Adjustable frequency controller shall be microprocessor-based, pulse width modulated design, suitable for operation on a 480-volt, three-phase supply. Controller shall produce an adjustable AC voltage/frequency output to vary speed of driven equipment. Controller shall consist of the following sections:
      a. Eighteen-pulse diode bridge converter input section.
      b. Fixed DC bus section.
      c. Eighteen-pulse power transistor inverter output section.
   2. Controller switching frequency shall be adjustable and allow operation at 5,000 Hertz or less. Controller technology shall include a switching scheme that reduces the dv/dt of output supply.
   3. Equip controller with a three-percent DC bus reactor or input line reactor.
   4. Controller's solid state converter input section switching devices shall have 1600 volt PIV rating.
   5. Overload rating of 110 percent variable torque, 150 percent constant torque for one minute.
   6. RMS harmonic content of output current shall be less than five percent of fundamental current.
   7. Able to withstand output terminal line-to-line short circuits without component failure.

B. Operating Criteria:
   1. Operating criteria shall be in accordance with the following:
      a. Ambient temperature range of zero to 40 degrees C.
      b. Operational humidity of up to 90 percent non-condensing.
      c. Altitude up to 3,300 feet above sea level.
      d. Nominal voltage of 480-volts plus or minus ten percent, three-phase, three-wire. Include an under-voltage feature to allow trip-free operation down to 35 percent undervoltage.
      e. Nominal frequency of 60 Hertz plus or minus three Hertz.
      f. Input power factor of 95 percent displacement power factor at all operating speeds.
      g. Efficiency of 96 percent at full speed and full load.

C. Features:
   1. Controller shall have the following features:
      a. Digital keypad and display module shall provide parameter setting, adjustments, and monitoring of control functions and faults. Display messages shall be in English.
      b. Serial communication port shall allow connecting to programmable controller interface using manufacturer standard protocol.
      c. Independent acceleration/deceleration rates shall provide two to 600 seconds minimum. When called to stop, motor shall decelerate to minimum speed before stopping.
      d. Power loss feature shall allow five cycle ride through capability for input supply interruptions.
      e. Time delay automatic restart shall allow restart after controller fault conditions with programmable attempts.
      f. Coasting motor restart shall allow controller to restart into a coasting motor without damage or tripping. Coasting motor restart feature shall allow switching from bypass mode to low-voltage variable frequency drive mode while operating, without shutdown.
      g. Isolated control inputs and outputs.

D. Protection:
   1. Controller shall have protective functions as follows:
      a. Input line metal oxide varistor transient protection.
      b. Electronic over-current trip instantaneous and inverse time overload protection with thermal memory retention.
      c. Over-temperature trip temperature protection.
      d. Current limit trip protection.
      e. Input line over- and under-voltage trip protection.
      f. Ground fault trip protection.

2.5 OUTPUT FILTER

A. General:
   1. Provide output filter to prevent overstressing motor insulation system. Provide output filter with each low-voltage variable frequency drive, when cable length between motor and variable frequency drive exceeds the following based on noted switching frequencies.
      a. One KHZ switching frequency, 200 feet cable length.
      b. Three KHZ switching frequency, 175 feet cable length.
   2. Provide output filters in all other cases, based on recommendations of low-voltage variable frequency drive and motor manufacturers, when actual voltage peaks at motor terminals exceed NEMA MG 1 limits.

B. Features and Criteria:
   1. Filter shall be three-phase, 600-volt class motor-protecting type consisting of suitable values of inductance, capacitance and resistance to form a damped, low pass filter.

2. Filter shall be low-loss type specifically designed to reduce voltage wave form dv/dt. Filter shall allow cable lengths at minimum exceeding actual application distances with waveform resulting in voltage spikes at motor terminal that are within NEMA MG 1 Part 31 voltage stress levels.
3. Filter shall be suitable for mounting within low-voltage variable frequency drive enclosure.

2.6 CONTROLS

A. General:
1. Equip each low-voltage variable frequency drive control system with relays, switches, fuses, indicating lights, and components required for a complete, functional system.
2. Variable frequency drive control shall be powered from a suitably sized and protected control power transformer.
3. Variable frequency drive control shall include status indicators, controller, and system fault condition displays and operating controls. Provide status indicators and operating controls associated with drive control on front door of enclosure.
4. Control arrangement shall be such that variable frequency drive internal electronic supply voltage is isolated from field wiring.

B. Control and Pilot Devices:
1. Relays shall be standard, latching type, and pneumatic or solid state time delay type. Provide relays with contacts rated ten amps, quantity as required.
2. Pilot devices shall be heavy duty type, rated 10 amps continuous. Indicating lights shall be push-to-test transformer type with 12-volt secondaries.

C. Operation:
1. Controls for each low-voltage variable frequency drive shall consist of all devices necessary for the following:
   a. Stop/Start and Speed Control: Stop/start and speed control shall respond to drive-mounted selector switch. With switch in "REMOTE" position, stop/start and speed control shall be based on a stop/start contact and four- to 20-mADC speed signal from remote process control panel. With switch in "LOCAL" position, stop/start control shall be based on remote stop/start pushbuttons located adjacent to driven equipment, and speed control shall be based on drive-mounted speed potentiometer.
   b. Emergency Stop Control: Emergency stop control shall respond to remote stop pushbutton located adjacent to driven equipment. When activated driven equipment shall stop immediately in all operating modes.
   c. Motor Over-temperature Shutdown: Motor over-temperature control shall respond to remote contact that activates on motor over-temperature. When over-temperature is detected, driven equipment

shall stop. Include provisions to remotely supply 120-volt power to thermistor control module located at motor.

d. Motor Space Heater Control: Motor space heater control shall energize remote motor's internal heater when driven equipment is stopped. Include provisions to supply 120-volt power to heater.

D. Auxiliary Features:
   1. Provide each low-voltage variable frequency drive with the following:
      a. Status Indicators: Status indicators shall include separate pilot lights for indication of motor run (red), and bypass mode (blue).
      b. Shutdown Indicators: Shutdown indicators shall include separate pilot lights (amber) for each shutdown condition. Arrange shutdown indication circuitry so that, when activated, indicator requires manual reset.
      c. Contact Outputs: Contact outputs shall include separate dry contacts for remote indication of motor run, seal water alarm for equipment with seal water systems, each shutdown condition, and controller faults.
      d. Speed Output: Speed output shall include four- to 20-mADC signal for remote indication of motor speed.

E. Wiring and Device Identification:
   1. Provide control wiring and device identification for each low-voltage variable frequency drive:
      a. Identify all control conductors with permanent type wire markers. Each wire shall be identified by a unique number and shall be attached to wire at each termination point.
      b. Identify each control device with permanent type marker. Each device shall be identified by a unique number and shall be attached to each device.
      c. Numbering system for each wire and control device shall be identified on wiring diagrams and shall reflect actual designations used in the Work.

2.7 SOURCE QUALITY CONTROL

A. Tests:
   1. Perform factory tests on each low-voltage variable frequency drive prior to shipping. Tests shall consist of simulating expected load to be driven by operating load through speed ranges specified for driven equipment, for minimum of two hours per drive unit.
   2. Provide factory control and alarm tests on each drive unit by simulating each control signal and each alarm function to verify proper and correct drive unit action.
   3. Perform specified tests in addition to standard factory tests typically performed.

PART 3 – EXECUTION

3.1 INSPECTION

A. Examine conditions under which the Work will be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Install equipment in accordance with manufacturer's recommendations and instructions and in conformance with Laws and Regulations, and the Contract Documents.

B. Unless otherwise shown or indicated, install equipment on concrete bases (Section 26 05 29, Hangers and Supports for Electrical Systems).

C. Install equipment with sufficient access and working space provided for ready and safe operation and maintenance.

D. For installations against masonry walls, provide an insulation board, 1/4-inch minimum thickness, between equipment and wall for corrosion protection. Trim board neatly within outline of equipment.

E. Install all terminations, lugs, and required appurtenances necessary to properly terminate power supplies.

F. Install control wiring terminations and appurtenances necessary to complete installing control and monitoring devices.

G. Immediately prior to Substantial Completion, replace all enclosure filters and frames provided under this Contract with new filters and frames, except expanded metal filter types. Immediately prior to Substantial Completion, clean expanded metal filters.

3.3 FIELD QUALITY CONTROL

A. Site Tests:
   1. After installation, inspect, adjust, and test each low-voltage variable frequency drive at the Site. Testing and inspection shall be in accordance with manufacturer's recommendations and be performed by manufacturer's factory-trained representative. Through CONTRACTOR, manufacturer's factory-trained representative shall inform OWNER and ENGINEER when equipment is correctly installed and ready to be energized. Do not energize equipment without permission of OWNER.

2. Perform the following equipment inspection and testing and provide reports documenting procedures and results.
    a. Verify all device settings and drive adjustments.
    b. Inspect all mechanical and electrical interlocks and controls for proper operation.
    c. Test each drive through specified speed ranges and loads for a minimum of two hours per drive unit.
    d. Test each drive by using actual control signal for remote and local operation.
    e. Test each drive alarm function.
    f. Perform other tests recommended by equipment manufacturer.

B. Manufacturer Services:
    1. Unloading and Installation: Manufacturer's factory-trained representative shall be present during unloading of equipment and installation at equipment's final location. Representative shall train installing personnel in advance in the proper handling and rigging of equipment. Services by manufacturer's representative under this paragraph shall be at least (1) eight-hour days at the Site.
    2. Post-installation Check: Manufacturer's factory-trained representative shall check and approve the installed equipment before initial operation. Manufacturer shall calibrate, set and program low-voltage variable frequency drives provided. Services by manufacturer's representative under this paragraph shall be at least 1) eight-hour days at the Site.
    3. Manufacturer's factory-trained representative shall adjust the system to final settings as specified in Article 3.5 of this Section.
    4. Manufacturer's factory-trained representative shall test the system as specified in Paragraph 3.3A of this Section. Representative shall operate and test the system in presence of ENGINEER and verify that equipment is in conformance with the Contract Documents. Services by manufacturer's representative under this paragraph shall be at least (1) eight-hour days at the Site.
    5. Representative shall revisit the Site as often as necessary until all deficiencies are corrected, prior to readiness for final payment.
    6. Provide services of manufacturer's factory-trained representatives to correct defective Work within 72 hours of notification by OWNER during the correction period specified in the General Conditions as may be amended by the Supplementary Conditions.
    7. Replacement parts or equipment provided during the correction period shall be equal to or better than original.
    8. Training: Provide services of qualified factory trained specialists from manufacturer to instruct OWNER's operations and maintenance personnel in recommended operation and maintenance of equipment. Training requirements, duration of instruction, and other qualifications shall be in accordance with Section 01 79 23, Instruction of Operations and Maintenance Personnel.

3.4 ADJUSTING

A. Immediately prior to Substantial Completion, when testing is acceptably completed and low-voltage variable frequency drives are operating, manufacturer's representative shall return to the Site and make final adjustments as required to each variable frequency drive furnished under this Section.

+ + END OF SECTION + +

SECTION 26 29 33

CONTROL STATIONS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install control stations, including pushbuttons, selector switches, and other control stations elements.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before control stations Work.

C. Related Sections:
   1. Section 26 05 05, General Provisions for Electrical Systems.
   2. Section 26 05 29, Hangers and Supports for Electrical Systems.
   3. Section 26 05 53, Identification for Electrical Systems.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. NEMA ICS 2, Controllers, Contactors and Overload Relays Rated 600 Volts.
   2. NEMA ICS 5, Industrial Control and Systems: Control-Circuits and Pilot Devices.
   3. NEMA ICS 6, Industrial Control and Systems Enclosures.
   4. NEMA 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
   5. UL 508, Industrial Control Equipment.

1.3 QUALITY ASSURANCE

A. Component Supply and Compatibility:
   1. Obtain all control stations furnished under this Section from a single control station manufacturer.
   2. Components shall be suitable for the specified application and shall be integrated into the overall assembly by control station manufacturer.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Listing of control stations to be furnished with their location, rating, and NEMA enclosure type for each.

2. Product Data:
    a. Manufacturer's technical information and specifications for control stations proposed for use.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Control Stations:
1. Manufacturers: Provide products of one of the following:
    a. Cutler-Hammer.
    b. General Electric Company.
    c. Allen Bradley Company.
    d. Square-D Company.
    e. Or equal.
2. Type: 30.5 mm industrial, heavy duty, oil-tight construction with clearly-marked legend plates.
3. Emergency Stop or Lockout Stop: Lockout stop pushbuttons shall be two-position, push-pull type with maintained contact and mushroom head. Provide control stations with padlocking attachment and legend plate reading "PUSH-TO-STOP, PULL-TO-START".
4. Pushbuttons: Momentary or maintained types, NEMA A600 contact rating.
5. Selector Switches: Rotary type with round or oval handles and positioning device to securely hold switch in selected position for maintained type and for spring return from left, right, or both left and right to maintained position.
6. Control stations shall comply with NEMA ICS 2, NEMA ICS 5, and UL 508, and shall bear the UL label.
7. Indicating Lights: 120 VAC LED module, push-to-test. Lens color shall be in accordance with Section 26 05 53, Identification for Electrical Systems.
8. Enclosures: As required for area classifications specified in Section 26 05 05, General Provisions for Electrical Systems, and complying with NEMA 250 and NEMA ICS 6.
9. Identification: Identify enclosures in accordance with Section 26 05 53, Identification for Electrical Systems. Devices shall include front-mounted nameplates identifying function and equipment controlled, if not readily apparent.

PART 3 – EXECUTION

3.1 INSPECTION

A. Examine conditions under which the Work will be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Install equipment as shown and indicated, and provide sufficient access and working space for ready and safe operation and maintenance.

B. Securely fasten equipment to walls or other surfaces on which equipment is mounted. Provide independent supports where no wall or other surface exists, in accordance with Section 26 05 29, Hangers and Supports for Electrical Systems.

+ + END OF SECTION + +

SECTION 26 36 23

MANUAL TRANSFER SWITCHES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install manual transfer switches.

B. Related Sections:
   1. Section 26 05 05, General Provisions for Electrical Systems.
   2. Section 26 05 53, Identification for Electrical Systems.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. UL 98, Enclosed and Dead-Front Switches.
   2. NEMA KS 1, Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
   3. NEMA 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
   4. UL 1008 Optional Standby Transfer Switches (Manual Transfer Switches).

1.3 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Manual Transfer switches shall bear the UL label.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Listing of each switch to be furnished, including location, rating, and NEMA enclosure type for each.
   2. Product Data:
      a. Manufacturer’s technical information for disconnect switches proposed for use.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Provide products of one of the following:
   1. ASCO.
   2. Russelectric.
   3. Or equal.

2.2 MATERIALS

A. Manual Transfer Switch General Requirements:
   1. Type: Transfer switch unit shall be manually operated and mechanically held. Switch shall be interlocked to ensure one of three switch positions: Source 1, Source 2, or Center Off.
   2. Rating: Voltage, current and short circuit ratings and number of poles as shown or indicated on the Drawings. Switch shall bear UL label and shall comply with UL 1008.
   3. Switch shall be positively locked an unaffected by momentary outages, with contact pressure maintained at a constant value, and temperature rise at contacts minimized for maximum reliability and operating life.
   4. All main contacts shall be silver composition. Switches rated 600 amperes and above shall have segmented blow-on construction for high withstand current capability and be protected by separate arcing contacts.
   5. Provide front access for inspection of all contacts from front of switch without disassembly of operating linkages and without requiring disconnection of power conductors.
   6. Components such as molded-case circuit breakers, contactors or other parts which are not intended for continuous duty, repetitive switching or transfer between two active power sources are not allowed.
   7. Where neutral conductors are to be solidly connected, a neutral terminal plate with fully rated AL-CU pressure connectors shall be provide.
   8. The manual transfer switch shall be tested in accordance with UL 1008 for transfer switches. Switch ratings below 400 amperes shall have endurance rating of 6000 cycles. 400 ampere switches shall have endurance rating of 4000 cycles, and 600-1200 ampere switches shall have endurance rating of 3000 cycles.

B. Manual Transfer Switch Features:
   1. Mechanical position indicators (yellow) visible to the operator shall be included for Source 1, Source 2, and Center Off (Disconnected).
   2. LED indicators shall be provided for switch positions listed in 1).
   3. Auxiliary position indicating contacts, rated 10 amps, 250 VAC shall be provided consisting of one closed when MTS is connected to Source 1, once contact closed when MTS is connected to Source 2.

4. A Form A contact shall be provided for indication that switch is in the Center Off (disconnected) position.
5. Transfer switch shall be arranged for manually actuated manual operation.
6. Transfer switch shall be actuated via a mechanical operating mechanism.
7. Manual operating handle shall be capable of external operation without opening the enclosure door.
8. Contact speed shall be similar to automatic transfer switch operation.
9. Switch position when connected to Source 1 or Source 2 shall be pad-lockable.
10. Switch withstand and closing rating shall be 65,000A. Switch shall be rated to close on and withstand the available RMS symmetrical short circuit current at the MTS terminals.

C. Enclosures:
1. NEMA rating shall be as required for area classifications specified in Section 26 05 05, General Provisions for Electrical Systems
2. Free standing, floor mounted. Code gauge steel per UL 50 with ANSI #61 powder coat finish.

D. Identification:
1. Identify enclosures in accordance with Section 26 05 53, Identification for Electrical Systems.
2. Provide nameplate to identify the equipment served by disconnect switch and associated source of power.

PART 3 – EXECUTION

3.1 INSPECTION

A. Examine conditions under which the Work will be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Install equipment so that sufficient access and working space is provided for ready and safe operation and maintenance.

B. Securely fasten equipment to concrete pad or other structural supports on which they are mounted. Provide independent stainless steel supports where no wall or other structural surface exists. Mount disconnect enclosures at a height not exceeding six feet.

C. Provide suitable 1/4-inch spacers to prevent mounting enclosure directly against walls.

3.3 FIELD QUALITY CONTROL

A. Site Tests:
   1. After installation, inspect and perform field testing of each switchboard. Testing and inspections shall by Supplier's factory-trained representative, in accordance with manufacturer's recommendations. Inform OWNER and ENGINEER when Supplier's representative indicates that equipment is correctly installed.
   2. Perform the following tests and checks before energizing equipment:
      a. Verify proper installation.
      b. Inspect all mechanical and electrical devices for proper operation.
      c. Check tightness of bolted connections.
      d. Measure insulation resistance of each bus section, phase-to-phase and phase-to-ground.
      e. Measure insulation resistance of each circuit breaker, pole-to-pole and from pole-to-ground.
      f. Check for proper anchorage, required area clearances, physical damage, and proper alignment.
      g. Clean and lubricate as required.
      h. Perform other tests and adjustments recommended by equipment manufacturer.

B. Manufacturer's Services: Provide services of qualified, factory-trained serviceman to perform the following:
   1. Instruct CONTRACTOR in installing equipment.
   2. Inspect and adjust equipment after installation and ensure proper operation.
   3. Instruct operations and maintenance personnel in operation and maintenance of the equipment.
   4. Manufacturer's technician shall make visits to the Site as follows:
      a. First visit shall be for instructing CONTRACTOR in proper equipment installation and assisting in installing equipment. Minimum number of hours on-Site: 4 hours.
      b. Second visit shall be for checking completed installation, start-up of system; performing field quality control testing, and provide instruction to operations and maintenance personnel. Minimum number of hours on-Site: 4 hours.
         1) Furnish services of manufacturer's qualified, factory-trained specialists to instruct OWNER's operations and maintenance personnel in recommended operation and maintenance of equipment.
         2) Training requirements, duration of instruction and qualifications shall be in accordance with Section 01 79 23, Instruction of Operations and Maintenance Personnel.
         3) Number of hours on-Site shall be in accordance with Section 01 79 23, Instruction of Operations and Maintenance Personnel.
      c. Technician shall revisit the Site as often as necessary until installation is acceptable.

5. All costs, including expenses for travel, lodging, meals and incidentals, and cost of travel time, for visits to the Site shall be included in the Contract Price.

+ + END OF SECTION + +

SECTION 26 43 00

SURGE PROTECTIVE DEVICES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install surge protective devices (SPD).
   2. SPDs furnished under this Section shall be ANSI/UL 1449 Type 2 integrating both surge suppression and high-frequency noise filtering suitable for use on low-voltage distribution systems.

B. Related Sections:
   1. Section 26 05 05, General Provisions for Electrical Systems.
   2. Section 26 24 13, Switchboards.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. ANSI/UL 1449, Surge Protective Devices.
   2. IEEE C62.11, Metal-Oxide Surge Arresters for AC Power Circuits (>1 kV)
   3. IEEE C62.41, Recommended Practice on Surge Voltages in Low-voltage AC Power Circuits.
   4. IEEE C62.45, Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1,000 V and Less) AC Power Circuits.
   5. UL 1283, Electromagnetic Interference Filters.

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer: Shall have at least five years experience manufacturing and servicing products substantially similar to those required and shall be able to submit documentation of at least five installations in satisfactory operation for at least five years each.

B. Component Supply and Compatibility:
   1. Obtain all products included in this Section regardless of component manufacturer from a single SPD manufacturer.
   2. SPD manufacturer shall review and approve or prepare all Shop Drawings and other submittals for all components furnished under this Section.
   3. Components shall be suitable for the specified service conditions and shall be integrated into overall assembly by SPD manufacturer.

C. Regulatory Requirements: Comply with the following:
   1. NEC 110.9, Requirements for Electrical Installations, Interrupting Rating.
   2. NEC 240.21, Overcurrent Protection, Location in Circuit.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Electrical and mechanical drawings for each type of unit, showing electrical ratings, dimensions, mounting provisions, connection details, and layout diagrams.
      b. Components list and nameplate schedule.
      c. Summary sheets with schedules of equipment.
   2. Product Data:
      a. Manufacturer’s technical information, including catalog information.
      b. Manufacturer's technical specifications with assembly and component ratings.

B. Informational Submittals: Submit the following:
   1. Certifications:
      a. Certification that SPD devices comply with standards referenced in this Section.
   2. Source Quality Control Submittals:
      a. Report of results of testing and inspections performed at manufacturer’s shop.
   3. Supplier Reports:
      a. Submit written report of results of each visit to Site by Supplier’s service technician, including purpose and time of visit, tasks performed, and results obtained. Submit within two days of completion of visit to the Site.
   4. Qualifications Statements:
      a. Manufacturer, when requested by ENGINEER.

C. Closeout Submittals: Submit the following
   1. Operations and Maintenance Data:
      a. Submit in accordance with Section 01 78 23, Operations and Maintenance Data.
      b. Include acceptable test reports, maintenance data and schedules, description of operation, wiring diagrams, and list of spare parts recommended for one year of operation with current price list.
   2. Warranty Documentation: Submit example warranty at time of shipment of the equipment. Include final warranty accepted by ENGINEER in the operations and maintenance manual for the equipment.

1.5 DELIVERY, STORAGE, AND HANDLING.

A. Delivery:
   1. Upon delivery, check for evidence of water that may have entered equipment during transit.

B. Storage:
   1. Store SPD equipment in a clean, dry location with controls for uniform temperature and humidity. Protect equipment with coverings and maintain environmental controls.
   2. Protect equipment from corrosion and deterioration.

1.6 WARRANTY

A. General Warranty: The special warranty specified in this Article shall not deprive OWNER of other rights or remedies OWNER may otherwise have under the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by CONTRACTOR under the Contract Documents. The obligations of CONTRACTOR under the Contract Documents shall not be limited in any way by the provisions of the specified special warranty.

B. Special Warranty on Materials and Equipment:
   1. Provide manufacturer's written warranty, running to the benefit of OWNER, agreeing to correct, or at option of OWNER, remove or replace materials or equipment specified in this Section found to be defective during a period of five years after the date of Substantial Completion.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Provide equipment of one of the following:
   1. General Electric.
   2. Schneider Electric/Square-D Company.
   3. Eaton/Cutler-Hammer.
   4. Or equal.

2.2 EQUIPMENT

A. General:
   1. SPD shall be modular, high-energy, parallel design with fast-acting transient voltage suppression using metal oxide varistors. Equipment shall provide noise attenuation with electromagnetic interference filter.
   2. SPD shall comply with requirements of the following:
      a. ANSI/UL 1449.
      b. UL 1283.

c. IEEE C62.11, IEEE C62.41 and IEEE C62.45.

3. SPD shall be suitable for operation under the following environmental conditions:
   a. Relative Humidity: Zero to 95 percent, non-condensing.
   b. Frequency: 47 to 63 Hertz.
   c. Temperature: Zero to 149 degrees F.
4. SPD operating voltage and IEEE C62.41 and IEEE C62.45 Category A, B, and C application environments shall be suitable for the associated SPD location(s) shown or indicated on the Drawings.
5. SPD shall be suitable for internal and external mounting. Where shown on the Drawings, SPD shall be factory-mounted and integrated into distribution equipment as specified under the respective equipment Sections.

B. SPD shall include a surge suppression path for each mode as required for the system configuration shown on the Drawings. Each mode shall be individually fused and equipped with thermal cutouts. SPD short-circuit rating shall be 200 kA. Protection modes shall include, to the extent applicable, the following:
   1. Line-to-line.
   2. Line-to-neutral.
   3. Line-to-ground.
   4. Neutral-to-ground.

C. SPD shall include electromagnetic interference/radio frequency interference (EMI/RFI) noise rejection filter with attenuation up to 30 dB from 10 kHz to 100 MHz.

D. SPDs and components in the operating path shall have maximum continuous operating voltage greater than 115 percent of nominal system operating voltage.

E. ANSI/UL 1449 minimum withstand rating shall be 20 kA per pole, and ANSI/UL 1449 voltage protection rating for SPD shall not exceed the following:

Modes	208Y/120	480Y/277
L-N,L-G, N-G	800	1200
L-L	1200	2000

F. SPD surge capacity based upon IEEE C62.41 location category shall, as a minimum, be the following:

Category	Application	Per Phase	Per Mode
C	Service entrance	240 kA	120 kA
B	High exposure locations (distribution equipment)	160 kA	80 kA
A	Branch locations	120 kA	60 kA

2.3 ACCESSORIES

A. Provide SPD equipped with the following accessories:
   1. Surge counter with display for indicating the number of surges detected.
   2. LED indicators for monitoring device status.
   3. Audible alarm and silence switch for indicating an inoperative condition.
   4. Dry contacts, "Form C", for remote annunciation of unit status.
   5. Indicators, counter, alarm, and silence switch shall be visible and accessible from front of the SPD. When SPD is integral to switchgear, motor control center, panelboard, or other equipment, indicators, counter, alarm, and silence switch shall be visible and accessible from front of the equipment in which the SPD is installed.
   6. Enclosure for each externally-mounted SPD: NEMA rating shall be as required for area classifications specified in Section 26 05 05, General Provisions for Electrical Systems.

2.4 SOURCE QUALITY CONTROL

A. Perform manufacturer's standard factory tests on equipment. Tests shall be in accordance with IEEE C62.45 and ANSI/UL 1449.

PART 3 – EXECUTION

3.1 INSPECTION

A. Examine conditions under which materials and equipment will be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Install SPD at locations shown on the Drawings in accordance with equipment manufacturer's recommendations, Laws, and Regulations, and the Contract Documents.

B. Conductor length between suppressor and connection point shall be as short and as straight as possible.

+ + END OF SECTION + +

SECTION 26 50 00

LIGHTING

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install lighting fixtures and associated controls.

B. Coordination:
   1. Coordinate location of fixtures with piping, ductwork, openings, and other systems and equipment and locate clear of interferences.
   2. Coordinate fixtures to be mounted in hung ceilings with the ceiling suspension system proposed.

C. Related Sections:
   1. Section 26 05 05, General Provisions for Electrical Systems.
   2. Section 26 05 53, Identification for Electrical Systems.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. UL 8750, LED Equipment for use in Lighting Products.
   2. IP 66, Ingress Protection Classification.
   3. UL 1598, Safety of Luminaires.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with the following:
   1. NEC Article 410, Luminaires, Lampholders, and Lamps.
   2. IESNA LM-79 and LM-80.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Schedule of light fixtures to be furnished, indicating fixture type and location for each.
      b. Customized wiring diagrams.
   2. Product Data:
      a. Manufacturer’s technical information, specifications, standard wiring diagrams, and catalog cuts for lighting fixtures proposed.

b. Fixture construction details.
c. ETL photometric and isocandle curves for each fixture proposed.
d. Verification that recessed fixtures to be mounted in hung ceilings are compatible with ceiling suspension system proposed.

B. Informational Submittals: Submit the following:
1. Manufacturer's Instructions:
a. Instructions and recommendations for handling, storing, and protecting the equipment.
b. Installation instructions for for the equipment, including setting drawings, templates, and directions and tolerances for installing anchorage devices.

C. Maintenance Material Submittals: Submit the following:
1. Spare Parts and Extra Stock Materials: Furnish spare parts for each type of unit required as indicated in Part 2 of this Section.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery:
1. Upon delivery, inspect equipment for evidence of water that may have entered equipment during transit.

B. Storage:
1. Store lighting fixtures, controls, related materials and equipment in clean, dry location with controls for uniform temperature and humidity. Protect materials and equipment with coverings and maintain environmental controls.
2. Store materials and equipment for easy access for inspection and identification. Keep materials and equipment off ground, using pallets, platforms, or other supports. Protect materials and equipment from corrosion and deterioration.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Type: Lighting fixtures required shall be in accordance with the Lighting Fixture Schedule on the Drawings. Fixtures shall be complete with supports, ballasts, lamps, and incidentals, as required.

B. Lamps:
1. Light Emitting Diode (LED): Characteristics as shown on the fixture schedule. Fixtures shall be UL listed. Fixtures shall also have a minimum 5-year performance warranty including LED board and driver..
2. Spare Parts and Extra Stock Materials: Ten percent spare lamps of each type and wattage.

C. Hardware: Provide necessary hangers, supports, conduit adaptors, reducers, hooks, brackets, and other hardware required for safe fixture mounting. Hardware shall have protective, non-corrosive finish.

PART 3 – EXECUTION

3.1 INSPECTION

A. Examine conditions under which the Work will be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. General:
   1. Fixture mounting heights and locations indicated on the Drawings are approximate and are subject to revision in the field where necessary to clear conflicts and obstructions.
   2. Mounting Heights: Mounting heights or elevations are to bottom of fixture or to centerline of device.
   3. Install fixtures in accordance with Laws and Regulations, the Contract Documents, and manufacturer instructions and recommendations.
   4. Mount fixtures so that sufficient access is available for ready and safe maintenance.
   5. Securely fasten equipment to walls or other surfaces on which equipment is mounted.

B. Suspended Fixtures:
   1. Pendant-mount using 1/2-inch diameter conduit stems.
   2. Ground to outlet box.
   3. Attach mounting to building structure with expansion anchors.
   4. Fixtures shall not be dependent on the outlet box cover screws for support.

C. Surface Mounted Fixtures:
   1. Attach to appropriate outlet box.
   2. Attach to surface using fasteners and sealing washers when mounting fixture in damp or wet locations.

D. Boxes and Fixtures:
   1. For units mounted against masonry or concrete walls, provide suitable 1/4-inch spacers to prevent mounting back of box directly against wall.
   2. Bolt units rigidly to building with expansion anchors, toggle bolts, hangers, or Unistrut.
   3. Do not install boxes with open conduit holes.
   4. Cable each circuit and identify with tag.

E. Re-lamp all fluorescent fixtures provided under this Contract with new lamps following Substantial Completion.

+ + END OF SECTION + +

SECTION 40 05 05

EXPOSED PIPING INSTALLATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified, and required to install and test all exposed piping, fittings, and specials. The Work includes the following:
      a. All types and sizes of exposed piping, except where exposed piping installations are specified under other Sections or other contracts.
      b. Unless otherwise shown or specified, this Section includes all piping beginning at the outside face of structures or structure foundations and extending into the structure. Piping embedded in concrete within a structure or foundation shall be considered as exposed and is included herein. Piping that is permanently or intermittently submerged, or installed in sub-aqueous environments, is considered as exposed and is included in this Section.
      c. Work on or affecting existing exposed piping.
      d. Installation of all jointing and gasket materials, specials, flexible couplings, mechanical couplings, harnessed and flanged adapters, sleeves, tie rods, and all Work required for a complete exposed piping installation.
      e. Supports, restraints, and other anchors.
      f. Field quality control, including testing.
      g. Cleaning and disinfecting.
      h. Incorporation of valves, meters, and special items shown or specified into the piping systems per the Contract Documents and as required

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate installation of items that must be installed with or before exposed piping Work.
   2. Coordinate with appropriate piping Sections of Division 40, Process Integration.

C. Related Sections:
   1. Section 09 91 00, Painting.
   2. Section 10 14 00, Signage.
   3. Section 40 05 06, Couplings, Adapters, and Specials for Process Piping.
   4. Section 40 05 07, Pipe Hangers and Supports.
   5. Section 40 05 08, Wall Pipes, Floor Pipes and Pipe Sleeves.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. ASME B31.3, Process Piping.
   2. American Society for Non-Destructive Testing (ASNT), ASNT-TC-1A, Recommended Practice, Personnel Qualification, and Certification in Non-destructive Testing.
   3. ASTM A380, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems
   4. ASTM B32, Specification for Solder Metal.
   5. ASTM D4174, Standard Practice for Cleaning, Flushing, and Purification of Petroleum Fluid Hydraulic Systems
   6. ANSI/AWWA C111, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
   7. AWWA M23, PVC Piping - Design and Installation.
   8. AWWA M41, Ductile-Iron Pipe and Fittings.
   9. SAE J1227, Method for Assessing the Cleanliness Level of New Hydraulic Fluid.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Comply with requirements and recommendations of authorities having jurisdiction over the Work.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Detailed drawings in plan and, as applicable, section.
      b. Details of piping, valves, supports, accessories, specials, joints, harnessing, and main anchor supports, and connections to existing piping, structures, equipment, and appurtenances.
   2. Testing Plans, Procedures, and Testing Limitations:
      a. Submit description of proposed testing methods, procedures, and apparatus, and obtain ENGINEER's approval prior to testing.

B. Informational Submittals: Submit the following:
   1. Certificates:
      a. Submit a certificate, signed by manufacturer of each product, certifying that product complies with applicable referenced standards.
   2. Source Quality Control Submittals:
      a. Submit copies of testing report for each test.
   3. Site Quality Control Reports:
      a. Submit copies of testing report for each test.

C. Closeout Submittals: Submit the following:
   1. Record Documentation:
      a. Maintain accurate and up-to-date record documents showing field and Shop Drawing modifications. Record documents for exposed piping Work shall show actual location of all piping and appurtenances on a copy of the Drawings, unless otherwise approved by ENGINEER.
      b. Record documents shall show piping with elevations referenced to the project datum and dimensions from permanent structures. For straight runs of pipe provide offset dimensions as required to document pipe location.
      c. Include section drawings with exposed piping record documents when the Contract Documents include section Drawings.
      d. Conform to Section 01 78 39, Project Record Documents.

1.5 DELIVERY, STORAGE AND HANDLING

A. Delivery:
   1. Deliver products to Site to ensure uninterrupted progress of the Work.
   2. Upon delivery, inspect pipe and appurtenances for cracked, gouged, chipped, dented, and other damage and immediately remove damaged products from Site.
   3. Conform to requirements of Section 01 65 00, Product Delivery Requirements.

B. Storage:
   1. Store products for convenient access for inspection and identification. Store products off the ground using pallets, platforms, or other supports. Protect packaged products from corrosion and deterioration.
   2. Pipe and fittings other than thermoplastic materials may be stored outdoors without cover. Thermoplastic pipe and fittings stored outdoors shall be covered.
   3. Conform to requirements of Section 01 66 00, Product Storage and Handling Requirements.

C. Handling:
   1. Handle pipe, fittings, specials, and accessories carefully with approved handling devices. Do not drop or roll material of delivery vehicles. Do not otherwise drop, roll, or skid piping.
   2. Avoid unnecessary handling of pipe.
   3. Keep pipe interiors free of dirt and foreign matter.
   4. Protect interior linings and exterior coatings of pipe and fittings from damage. Replace pipe and fittings with damaged lining regardless of cause of damage. Repair damaged coatings.
   5. Conform to requirements of Section 01 65 00, Product Delivery Requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Piping materials are specified in the Exposed Piping Schedule at the end of this Section. Piping materials shall conform to Specification for each type of pipe and piping appurtenances in applicable sections of Division 40, Process Integration.

B. Markings and Identification:
   1. Pipe Markings:
      a. Clearly mark each piece of pipe or fitting with a designation conforming to that shown on the approved Shop Drawings.
      b. Manufacturer shall cast or paint on each length of pipe and each fitting the pipe material, diameter, and pressure or thickness class.
   2. Pipe Identification Markers and Arrows: Refer to Section 10 14 00, Signage.

C. Appurtenances: Provide products that comply with:
   1. Section 40 05 07, Pipe Hangers and Supports.
   2. Section 40 05 06, Couplings, Adapters, and Specials for Process Piping.
   3. Section 40 05 08, Wall Pipes, Floor Pipes and Pipe Sleeves.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine conditions under which the Work is to be installed and notify ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General:
   1. Install piping as shown, specified and as recommended by the pipe and fittings manufacturer.
   2. If there is a conflict between manufacturer's recommendations and the Contract Documents, request in writing instructions from ENGINEER before proceeding.

B. Temporary Blind Flanges, Plugs, Caps, and Bulkheads:
   1. Temporarily plug installed pipe at the end of each day of work or other interruption of pipe installation to prevent entry of animals, liquids, and persons into pipe, and entrance or insertion of deleterious materials into pipe.
   2. Install standard plugs in all bells at dead ends, tees, and crosses. Cap all spigot and plain ends.
   3. Fully secure and block blind flanges, plugs, caps, and bulkheads installed for testing, designed to withstand specified test pressure.

4. Where plugging is required for phasing of Work or subsequent connection of piping, install watertight, permanent type blind flanges, plugs, caps, or bulkhead acceptable to ENGINEER.

C. Piping Installation:
   1. Conform to manufacturer's instructions and requirements of standards and manuals listed in this Section, as applicable:
      a. Ductile Iron Pipe: ANSI/AWWA C600, AWWA M41.
      d. Thermoplastic Pipe: AWWA M23
   2. Install straight runs true to line and elevation.
   3. Install vertical pipe truly plumb in all directions.
   4. Install piping parallel or perpendicular to walls of structures. Piping at angles and 45 degree runs across corners of structures will not be accepted unless specifically shown on the Contract Documents or approved by the ENGINEER.
   5. Install small diameter piping generally as shown when specific locations and elevations are not indicated. Locate such piping as required to avoid ducts, equipment, beams, and other obstructions.
   6. Install piping to leave all corridors, walkways, work areas, and similar spaces unobstructed. Unless otherwise approved by ENGINEER provide a minimum headroom clearance under piping and pipe supports of 7.5 feet. Clearances beneath piping shall be measured from the outermost edge of piping, flanges or other type of joint that extends beyond the nominal outside diameter of piping.
   7. Protect and keep clean interiors, fittings, and valves of pipe that will convey potable water, chemicals, and other pipe designated by ENGINEER.
   8. Cutting: Cut pipe from measurements verified at Site. Field cut pipe, where required, with a machine specially designed for cutting type of pipe being installed. Make cuts carefully without damage to pipe, coating, or lining, and with a smooth end at right angles to axis of pipe. Cut ends of push-on joint type pipe shall be tapered and sharp edges filed off smooth. Do not flame-cut pipe.
   9. Additional General Requirements for Thermoplastic Piping:
      a. Utilize wide band supports as recommended by pipe manufacturer and approved by ENGINEER to minimize localized stresses.
      b. Provide piping passing through walls with a sleeve of wearing material to prevent abrasion damage to piping.
      c. Provide anchored supports at elbows, valves, bends in piping, and at connections to equipment and tanks.
      d. Spacing of supports shall be in accordance with the manufacturer's published recommendations at maximum design operating temperature of pipe.
      e. Provide U-clamps with wide band circumferential contact.
      f. Provide guides on long runs of piping to maintain alignment and reduce chance of elastic failure of pipe. Space guides as recommended by pipe manufacturer.

D. Jointing Pipe:
   1. General:
      a. Make joints in accordance with pipe manufacturer's recommendations and Contract Documents.
      b. Cut piping accurately and squarely and install without forcing or springing.
      c. Ream out pipes and tubing to full inside diameter after cutting. Remove all sharp edges on end cuts.
      d. Remove all cuttings and foreign matter from inside of pipe and tubing before installation. Thoroughly clean all pipe, fittings, valves, specials, and accessories before installing.
   2. Ductile Iron Flanged Joints:
      a. Assemble flanged joints using ring-type gaskets, with thickness as recommended by pipe manufacturer but not less than 1/8-inch thick, for raised-face flanges. Use full-face gaskets for flat-face flanges, unless otherwise approved by ENGINEER or recommended by pipe manufacturer. Gaskets shall be suitable for the service intended in accordance with the manufacturer's ratings and instructions. Gaskets shall be properly centered.
      b. Tighten bolts in a sequence that provides equal distribution of bolt loads.
      c. Length of bolts shall be uniform. Bolts shall not project beyond the nut more than 1/4-inch or fall short of the nut when fully taken up. Machine-cut ends of bolts to be neatly rounded. Do not use washers.
      d. Prior to assembly of flanged joints, lubricate bolt threads and gasket faces.
      e. Alternately tighten bolts 180 degrees apart to compress the gasket evenly.
      f. After assembly, coat all bolts and nuts, except stainless steel bolts and nuts, with same coating specified in Section 09 91 00, Painting, for material of pipe and fittings being joined.
   3. Thermoplastic Pipe Joints:
      a. Solvent Cement Welded Joints:
         1) Bevel pipe ends and remove all burrs before making joint. Clean pipe and fittings thoroughly. Do not make solvent cement joints if temperature is below 40 degrees F. Do not make solvent cement welded joints in wet conditions.
         2) Use solvent cement supplied or recommended by pipe manufacturer.
         3) Apply joint primer and solvent cement and assemble joints in accordance with recommendations and instructions of manufacturer of joint materials and pipe manufacturer.
         4) Implement appropriate safety precautions when using joint primers and solvent cements. Allow air to circulate freely through pipelines to allow solvent vapors to escape. Slowly admit fluid when flushing or filling pipelines to prevent compression of gases within pipes.
      b. Threaded Joints:
         1) Cut pipe square and smooth and remove burrs or raised edges with a knife or file.
         2) Hold pipe firmly in a pipe vise. Protect pipe at the point of grip by

inserting a rubber sheet or other material between pipe and vise.

3) Thread pipe in accordance with pipe manufacturer's recommendations. Brush threads clean of chips and ribbons.
4) After threading pipe, starting with second full thread, and continuing over thread length, wrap 100-percent virgin TFE (Teflon) thread tape in direction of threads. Overlap each wrap by one-half width of tape.
5) After application of the TFE thread tape, screw fitting or coupling onto the pipe end to be joined and tighten by hand. Using a strap wrench only, further tighten connection an additional one to two threads past hand tightness.

E. Installing Valves and Accessories:
   1. Provide supports for large valves, flow meters, and other heavy items as shown or required to prevent strain on adjoining piping.
   2. Position flow measuring devices in pipe lines so that they have the amount of straight upstream and downstream runs recommended by the flow measuring device manufacturer, unless specific location dimensions are shown.
   3. Position swing check valves and butterfly valves so that they do not conflict with upstream and downstream elements of the piping system.

F. Unions:
   1. Install dielectric unions as specified in Section 40 05 06, Couplings, Adapters, and Specials for Process Piping**,** where dissimilar metals are connected, except for bronze or brass valves in ferrous piping.
   2. Provide a union downstream of each valve with screwed connections.
   3. Provide screwed or flanged unions at each piece of equipment, where shown, and where necessary to install or dismantle piping.

G. Transitions from One Type of Pipe to Another:
   1. Provide all necessary adapters, specials, and connection pieces required when connecting different types and sizes of pipe or connecting pipe made by different manufacturers.

H. Closures:
   1. Provide closure pieces, such as blind flanges and caps, shown or required to complete the Work.

3.3 WORK AFFECTING EXISTING PIPING

A. Location of Existing Piping:
   1. Locations of existing piping shown on Drawings is approximate.
   2. Determine the true location of existing piping to which connections are to be made, crossed, and that could be disturbed, and determine location of other facilities that could be affected by the Work.

B. Taking Existing Pipelines Out of Service:
   1. Conform to Section 01 14 16, Coordination with Owner’s Operations.

C. Work on Existing Pipelines:
   1. Cut or tap pipes as shown or required with machines and tools specifically designed for cutting or tapping pipelines.
   2. Install temporary plugs to prevent entry of mud, dirt, water, and debris into pipe.
   3. Provide necessary adapters, sleeves, fittings, pipe, and appurtenances required to complete the Work.
   4. Conform to applicable requirements of Section 01 14 16, Coordination with Owner's Operations and Section 01 73 24, Connections to Existing Facilities.

3.4 PAINTING

A. Field painting shall conform to Section 09 91 00, Painting.

3.5 FIELD QUALITY CONTROL

A. Testing, General:
   1. Test all piping, except as exempted in the Exposed Piping Schedule.
   2. Notification:
      a. Notify ENGINEER at least 48 hours prior to testing.
      b. When authorities having jurisdiction are to witness tests, notify ENGINEER and authorities having jurisdiction in writing at least 48 hours in advance of testing.
   3. Conduct all tests in presence of ENGINEER.
   4. Remove or protect pipeline-mounted devices that could be damaged by testing.
   5. Provide all apparatus and services required for testing, including:
      a. Test pumps, compressors, hoses, calibrated gages, meters, test containers, valves, fittings, and temporary pumping systems required to maintain OWNER's operations.
      b. Temporary bulkheads, bracing, blocking, and thrust restraints.
   6. Provide air if an air test is required, power if pumping is required, and gases if gases are required.
   7. Unless otherwise specified, OWNER will provide fluid required for hydrostatic testing. CONTRACTOR shall provide means to convey fluid for hydrostatic testing into the pipe being tested. CONTRACTOR shall provide fluid for other types of testing required.
   8. Repair observed leaks and repair pipe that fails to meet acceptance criteria. Retest after repair.
   9. Unless otherwise specified, testing shall include existing piping systems that connect with new piping system. Test existing pipe to nearest valve. Piping not installed by CONTRACTOR and that fails the test shall be repaired upon authorization of ENGINEER or OWNER. Repair of existing piping will be paid as extra work unless otherwise specified.

B. Test Schedule:
   1. Refer to the Exposed Piping Schedule for type of test required and required test pressure.
   2. Unless otherwise specified, the required test pressures are at lowest elevation of pipeline segment being tested.
   3. For piping not listed in Exposed Piping Schedule:
      a. Hydrostatically test pipe that will convey liquid at a pressure greater than five psig. Provide process air pipe test for pipe that will convey air or gas under pressure or vacuum, except chlorine gas, which requires a separate test.
   4. Test Pressure:
      a. Use test pressures listed in Exposed Piping Schedule.
      b. If test pressure is not listed in Exposed Piping Schedule, or if a test is required for piping not listed in the Exposed Piping Schedule, test pressure will be determined by the ENGINEER based on the maximum anticipated sustained operating pressure and the methods described in the applicable ANSI/AWWA manual or standard that applies to the piping system.

C. Hydrostatic Testing:
   1. Preparation for Testing:
      a. For thermoplastic pipe and FRP pipe, follow procedures described in Section 7 of ANSI/AWWA Standard C605.
      b. For other piping follow procedures described in AWWA Manual M9. A wetting period is not required for pipe that is not cement mortar-lined.
      c. Prior to testing, ensure that adequate thrust protection is in place and all joints are properly installed.
      d. Piping for Hydraulic Fluid, Lube Oil, and Diesel Fuel: Hydrostatically test system using the fluid with which system will function permanently. Allowable leakage is zero. For fluid power systems, manufacturer shall supervise installation and testing of system components, including field piping.
   2. Test Procedure:
      a. Fill pipeline slowly to minimize air entrapment and surge pressures. Fill rate shall not exceed one foot of pipe length per second in the pipe being tested.
      b. Expel air from pipe as required. Obtain approval of ENGINEER prior to tapping pipe for expelling air.
      c. Examine joints and valves, and make repairs to eliminate visible leakage.
      d. After specified wetting period, add fluid as required to pressurize line to required test pressure. Maintain test pressure for a stabilization period of ten minutes before beginning test.
      e. Timed test period shall not begin until after the pipe has been filled, exposed to the required wetting period, air has been expelled, and pressure stabilized.
      f. Timed Test Period: After the stabilization period, maintain test pressure for at least two hours. During timed testing period, add fluid as required

to maintain pressure within five psig of required test pressure. The test pressure shall then remain steady for one hour, indicating no leakage.

g. Pump from a test container to maintain test pressure. Measure volume of fluid pumped from test container and record on test report. Record pressure at test pump at fifteen minute intervals for duration of test.

3. Allowable Leakage Rates: Leakage is defined as the quantity of fluid supplied to pipe segment being tested to maintain pressure within five psi of the test pressure during timed test period. Allowable leakage rates for piping are:

a. No Leakage: Pipe with flanged, welded, fused, threaded, soldered, or brazed joints.

3.6 CLEANING

A. Cleaning, General: Clean pipe systems as follows:

1. Thoroughly clean all piping, including flushing with water, dry air, or inert gas as required, in a manner approved by ENGINEER, prior to placing in service. Flush chlorine solution and sodium hypochlorite piping with water.
2. Plastic Pipe: Clean vacuum and liquid piping with a detergent and water and thoroughly rinse to remove all detergent, after which a cleaning ball or swab shall be drawn through the pipe.

B. Cleaning of Hydraulic and Fluid Power Oil Systems: Upon completion of field piping, but before connection to control components, hydraulic and fluid power oil systems shall be flushed and cleaned by circulating special flushing oil through the system. Flushing oil and procedures shall comply with ASTM D4174. System shall be cleaned such that internal contamination of system, when tested using procedures specified in SAE J1227, Section 2.3, shall not exceed the Allowable Cleanliness Level (ACL). Unless otherwise specified, ACL value shall be established by manufacturer of major hydraulic system components in accordance with SAE J1227, Section 9.1.

3.7 EXPOSED PIPING SCHEDULE

A. The schedules listed below, following the "End of Section" designation, are a part of this Specification section.

1. Table 40 05 05-A, Exposed Piping Schedule.

+ + END OF SECTION + +

TABLE
40 05 05-A, EXPOSED PIPING SCHEDULE

Service	Diameter (inch)	Material	Interior Lining	Exterior Coating	Pressure Class/ Thickness	Joint	Test	Remarks
SF	3, 4, 6	DI	CL	P	250 / 53	Flg	HYD (125)	
DR	14	DI	CL	P	250 / 53	Flg	-	-
PE	3, 4, 6	DI	CL	P	250 / 53	Flg	HYD (125)	
PE	<3	C		I		Sd	HYD (125)	Plant effluent piping above Elevation 71.75.
POLYS, PE	¾ - 2	PVC	--	P	SCH 80	SW	HYD (125)	
CEN, DR, V	2 - 12	PVC	--	P	SCH 80	SW/Flg	HYD (25)	Provide flanged connections above Elevation 71.75 and for process equipment connections.

A. Service Abbreviations

Service	Abbrev.		Service	Abbrev.
Sludge Feed	SF		Polymer Solution	POLYS
Centrate	CEN		Hydraulic Fluid	HF
Water	W		Fuel Oil	FO
Plant Effluent	PE		Lube Oil	LO
Drain, including slop	DR		Vent	V

B. Material Abbreviations

Material	Abbrev		Material	Abbrev.
Ductile Iron	DI		Polyvinyl Chloride	PVC
Cast Iron	CI		Stainless Steel	SS
Copper	C			

C. Lining/Coating Abbreviations

Lining	Abbrev		Coating	Abbrev.
Cement Mortar Lined	CL		Painted	P
			Insulated	I

D. Joint Abbreviations

Joint Type	Abbrev		Joint Type	Abbrev.
Flanged	Flg		Solvent Weld	SW
Threaded	Thd		Soldered	Sd

E. Test Abbreviations

Test	Abbrev		Test	Abbrev.
Hydrostatic Test (test pressure in psig)	HYD ( )		No Test Required	NR

SECTION 40 05 06

COUPLINGS, ADAPTERS, AND SPECIALS FOR PROCESS PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install all couplings, adapters, and specials for process piping.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate installation of items that must be installed with or before couplings, adapters, and specials for process piping Work.

C. Related Sections:
   1. Section 09 91 00, Painting.
   2. Section 40 05 05, Exposed Piping Installation.

1.2 REFERENCES

A . Standards referenced in this Section are:
   1. ANSI B16.1, Cast-Iron Pipe Flanges and Flanged Fittings.
   2. ANSI B16.39, Malleable Iron Threaded Pipe Unions.
   3. ASME B31, Standards of Pressure Piping.
   4. ASTM A53/A53M, Specification for Pipe, Steel, Black and Hot-dipped, Zinc-Coated, Welded and Seamless.
   5. ASTM A105/A105M, Specification for Carbon Steel Forgings and Piping Applications.
   6. ASTM B169/B169M Specification for Aluminum Bronze Sheet, Strip, and Rolled Bar.
   7. ASTM B650, Specification for Electro-Deposited Engineering Chromium Coatings of Ferrous Substrates.
   8. ASTM F593, Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer shall have at least five years experience producing substantial similar products to those specified and shall be able to provide documentation of at least five installations in satisfactory operation for at least five years each.

B. Component Supply and Compatibility:
   1. Obtain each type of coupling, adapter, and special for process piping product included in this Section, regardless of component manufacturer, from a single couplings, adapters, and specials manufacturer.
   2. Supplier shall prepare, or review, and approve all submittals for components furnished under this Section.
   3. Components shall be suitable for specified service conditions and be integrated into overall assembly by the Supplier.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Submit piping layout Shop Drawings in accordance with Section 40 05 05, Exposed Piping Installation.
   2. Product Data:
      a. Submit product data on each type of coupling, expansion joint, and other piping specialties and accessories, including gaskets, hardware, and appurtenances sufficient to demonstrate compliance with the Contract Documents.

B. Informational Submittals: Submit the following:
   1. Certificates:
      a. When requested by ENGINEER submit certificate attesting to compliance with standards referenced in this Section, signed by manufacturer.
   2. Manufacturer's Instructions:
      a. Provide instructions for handling, storing, installing, and adjusting of products.
   3. Source Quality Control:
      a. When requested by ENGINEER, submit results of source quality control tests.
   4. Qualifications Statements:
      a. Submit qualifications of manufacturer when requested by ENGINEER.

1.5 DELIVERY, STORAGE AND HANDLING

A. Refer to Section 40 05 05, Exposed Piping Installation.

PART 2 – PRODUCTS

2.1 COUPLINGS

A. Sleeve-type, Flexible Couplings:
   1. Pressure and Service: Same as connected piping.

2. Products and Manufacturers: Provide products of one of the following:
    a. Style 253, as manufactured by Dresser Piping Specialties, part of Dresser, Inc.
    b. Style 441, by Smith Blair, Inc.
    c. Or equal.
3. Material: Ductile Iron.
4. Gaskets: Suitable for specified service, as recommended by manufacturer.
5. Bolts and Nuts: Alloy steel, corrosion-resistant, primer-coated. For buried or submerged applications, provide stainless steel bolts complete with washers complying with ASTM F593, AISI Type 316 and with nitrided stainless nuts.
6. Harnessing:
    a. Harness couplings to restrain pressure piping. For pipelines that will be under pressure, test pressures are specified in piping schedules in Section 40 05 05, Exposed Piping Installation.
    b. Tie adjacent flanges with bolts of corrosion-resistant alloy steel. Provide flange-mounted stretcher bolt plates to be designed by manufacturer, unless otherwise approved. For buried or submerged applications, provide external bolting and other hardware of Type 316 stainless steel, including tie bolts, bolt plates, lugs, nuts, and washers.
    c. On plain-end piping, for harnessing couplings, provide anchor restraint system such as Dresser Piping Specialties STAR Anchor Style 443, or equal.
    d. Conform to dimensions, size, spacing, and materials for lugs, bolts, washers, and nuts as recommended by manufacturer and approved by ENGINEER for pipe size, wall thickness, and test pressure required. Provide minimum 5/8-inch diameter bolts.
7. Remove pipe stop(s) if used, unless otherwise shown or specified.

B. Flanged Coupling Adapters:
1. Description: One end of adapter shall be flanged and opposite end shall have sleeve-type flexible coupling.
2. Products and Manufacturers: Provide one of the following:
    a. Style 227, as manufactured by Dresser Piping Specialties, part of Dresser, Inc.
    b. Style 912, by Smith Blair, Inc.
    c. Or equal.
3. Pressure and Service: Same as connected piping.
4. Material: Ductile iron.
5. Gasket: Recommended by the manufacturer.
6. Bolts and Nuts: Alloy steel, corrosion-resistant, primer-coated. For buried or submerged applications, provide stainless steel bolts complete with washers complying with ASTM F593, AISI Type 316 and nitrided stainless nuts.
7. Harnessing:
    a. Harness adapters to restrain pressure piping. For pressure pipelines, test pressures are included in piping schedules in Section 40 05 05, Exposed Piping Installation.

b. For flanged adapters 12-inch diameter and smaller, provide 1/2-inch diameter (minimum) Type 316 stainless steel anchor studs installed in pressure-tight anchor boss. For buried or submerged applications, provide external bolting and other hardware of Type 316 stainless steel, including tie bolts, bolt plates, lugs, nuts, and washers. Provide number of studs required to restrain test pressure and service conditions. Harness shall be as designed and recommended by flanged adapter manufacturer. Provide the following minimum anchor studs unless otherwise approved by ENGINEER.
   1) Six-inch Diameter and Smaller: Two.
   2) Eight-inch Diameter and Smaller: Four.
   3) Ten-inch Diameter and Smaller: Six.
   4) Twelve-inch Diameter and Smaller: Eight.

c. For adapters larger than 12-inch diameter, provide split-ring harness clamps with minimum of four corrosion-resistant alloy steel bolts. For buried or submerged applications, provide external bolting and other hardware of Type 316 stainless steel, including tie bolts, bolt plates, lugs, nuts, and washers. Harness assembly shall be as designed and recommended by flanged adapter manufacturer. Dimensions, sizes, spacing and materials shall be suitable for service and conditions encountered and shall be approved by ENGINEER.

2.2 EXPANSION JOINTS

A. Rubber-type Expansion Joints:
   1. General:
      a. Use rubber-type expansion joints at all expansion joint locations, except where other types of expansion joints are shown or specified.
   2. Manufacturers: Provide products of one of the following:
      a. Mercer Rubber Company.
      b. U.S. Rubber Supply Company, USA.
      c. Or equal.
   3. Liquid Service:
      a. Construct expansion joints of neoprene or Buna-N suitable for temperatures up to 180 degrees F.
      b. Expansion joints shall be filled arch type. Provide backup or retaining rings as recommended by expansion joint manufacturer.
      c. Expansion joints shall be yoked in manner to provide transmission of tension loading to which expansion joint may be subjected during system operation. Compressive or lateral movement of expansion joint shall not be impaired by yoking system. Details of expansion joint yoking shall be submitted to ENGINEER for approval.
   5. Harnessing:
      a. Harness each expansion joint against thrust for test pressure in piping, as specified in piping schedules in Section 40 05 05, Exposed Piping Installation.

b. Harnessing shall be by control units consisting of two or more tie rods connected between flanges, set for maximum allowable elongation of expansion joint.
c. Provide epoxy-coated triangular plates to connect tie rods to flanges. Tie rods shall be Series 300 stainless steel. Rubber washers shall be used between triangular plates and tie rods.
d. Provide control units in accordance with recommendations of expansion joint manufacturer.

2.3 MISCELLANEOUS SPECIALTIES AND ACCESSORIES

A. Dielectric Connections:
1. General: Where copper pipe connects to steel pipe, cast-iron pipe, or ductile iron pipe, provide either dielectric union or an insulating section of rubber or plastic pipe. When used, insulating section shall have minimum length of 12 pipe diameters.
2. Manufacturers: Provide products of one of the following:
a. Epco Sales, Inc.
b. Watts Regulator Company.
c. Capitol Manufacturing Company.
d. Or equal.
3. Dielectcric Unions: Rated for 250 psi, ANSI B16.39.
4. Insulating Sections: Rated for same pressure as associated piping test pressure. Material shall be suitable for the application and service.

2.4 PAINTING

A. Shop Painting:
1. Clean and prime-coat ferrous metal surfaces of products in the manufacturer's shop in accordance with Section 09 91 00, Painting, unless otherwise specified in this Section
2. Coat machined, polished and non-ferrous surfaces bearing surfaces and similar unpainted surfaces with corrosion prevention compound that shall be maintained during storage and until products are placed into operation.

B. Field painting shall conform to Section 09 91 00, Painting.

PART 3 - EXECUTION

3.1 INSPECTION

A. Inspect materials for defects in material and workmanship. Verify compatibility of products with pipe, fittings, valves, and appurtenances.

3.2 INSTALLATION

A. Installation:
   1. Install piping specialties in accordance with the Contract Documents and manufacturer's instructions.
   2. For exposed installations, refer to Section 40 05 05, Exposed Piping Installation.

B. Adjust expansion joints as required to ensure that expansion joints will be fully extended when ambient temperature is at minimum operating temperature, and fully compressed at maximum operating temperature for the system in which expansion joints are installed.

+ + END OF SECTION + +

SECTION 40 05 07

PIPE HANGERS AND SUPPORTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified and required to design, furnish, and install all hangers, supports and appurtenances necessary to complete the Work.

B. Coordination:
   1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with the pipe hangers and supports Work.

C. Related Sections:
   1. Section 03 30 00, Cast-In-Place Concrete.
   2. Section 05 50 13, Miscellaneous Metal Fabrications.
   3. Section 09 91 00, Painting.
   4. Section 40 05 06, Couplers, Adapters, and Specials for Process Piping.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:
   1. American Society for Testing and Materials, (ASTM).
      a. ASTM A575, Specification for Steel Bars Carbon, Merchant Quality, M-Grades.
   2. Federal Specification, (FS).
      a. FS A-A-1192, Hangers, Pipe.
   3. Manufacturers Standardization Society of the Valve and Fittings Industry, (MSS).
      a. MSS SP 58, Pipe Hangers and Supports-Materials, Design and Manufacture.
      b. MSS SP 69, Pipe Hangers and Supports - Selection and Application.

1.3 QUALITY ASSURANCE

A. Each type of pipe hanger or support shall be the product of one manufacturer.

B. Component Supply and Compatibility:
   1. Obtain all equipment included in this Section regardless of the component manufacturer from a single pipe hangers and supports manufacturer.

2. The pipe hangers and supports equipment manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.
3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the pipe hangers and supports equipment manufacturer.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Detailed drawings showing all hangers and supports for each piping system specified. Shop Drawings shall show location, installation, material, loads or forces, and deflection of all hangers and supports.
      b. Submit and coordinate these with Shop Drawings required for all piping systems.

   2. Product Data:
      a. Submit manufacturers' catalogs, literature, and engineering data on all hangers and supports. Load ratings, materials and installation shall be consistent with the recommendations of the MSS SP 58, MSS SP 69 and Federal Specification A-A-1192.

1.5 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling and Unloading:
   1. Deliver materials to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices which are to be embedded in cast-in-place concrete in ample time to prevent delay of that Work.

B. Storage and Protection:
   1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
   2. Store materials in covered storage off the ground and prevent condensation.

C. Acceptance at Site:
   1. All boxes, crates and packages shall be inspected by CONTRACTOR upon delivery to the Site. CONTRACTOR shall notify ENGINEER, in writing, if any loss or damage exists to equipment or components. Replace loss and repair damage to new condition in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1 GENERAL

A. Hangers and supports shall meet with the following requirements:
   1. Standard and fabricated hangers and supports shall be furnished complete with necessary inserts, bolts, nuts, rods, washers, and other accessories.
   2. Generally, run piping in groups where practicable and parallel to building wall. Provide minimum clearance of 1-inch between pipe and other work.
   3. Install hangers or supports at all locations where pipe changes direction.
   4. All hangers and supports shall be capable of adjustment after placement of piping.
   5. Different types of hangers or supports shall be kept to a minimum.
   6. All suspended or supported ductile iron pipe shall have a hanger or support adjacent to each hub.
   7. Support vertical piping at each floor and between floors by stays or braces to prevent rattling and vibration.
   8. Hanger rods shall be straight and vertical. Chain, wire, strap or perforated bar hangers shall not be used. Hangers shall not be suspended from piping.
   9. Maximum support spacing unless otherwise shown or approved for standard weight steel pipe shall be as follows:

Pipe Size (inches)	Maximum Pipe Span [1] (feet)			
	Steel	Copper	Plastic [2]	Cast/Ductile Iron [4]
3/8 to 3/4	5	6	Cont. [3]	-
1	6	6	5	-
1-1/4	6	6	5	-
1-1/2	6	6	5	-
2	10	10	5	-
2-1/2	10	10	5	-
3	10	10	5	-
4	12	12	5	12 feet for pressure pipe
6	12	12	5	
8	12	12	5	
10	12	-	5	
12	12	-	10	
14	12	-	-	
16	12	-	-	
18	12	-	-	10 feet for soil pipe
20	12	-	-	
24	12	-	-	

[1]Pipe shall not have pockets formed in the span due to sagging of the pipe between supports caused by the weight of the pipe, medium in the pipe, insulation, valves and fittings.

[2]Span shown is for Schedule 80 CPVC pipe at 100°F. Spans for other plastics, other CPVC pipe Schedules and pipes at higher temperatures shall be shortened in accordance with the pipe manufacturer's recommendations.

[3]Continuous means pipe shall be in unistrut or similar channel.

[4] Pipe hanger and support selection shall be as shown and in this Section.

10. Plastic pipe at temperature greater than 130ºF shall be continuously supported in a metal cradle or tray.
11. Where proper hanger or support spacing does not correspond with joist or rib spacing, structural steel channels may be attached to joists or ribs and pipes suspended there from.
12. Prevent contact between dissimilar metals when supporting copper tubing, by use of copper plated, rubber or vinyl coated, or stainless steel hangers or supports.
13. Isolate thin walled stainless steel piping from carbon steel by use of plastic coated hangers or supports or by taping at points of contact with PVC or vinyl.
14. Supports and hangers shall be of a material that is compatible with the fluid being conveyed in such pipe being supported.
15. Anchors for pipe support systems shall be compatible or protected by a coating system which is compatible with the fluid being conveyed in such pipe being supported.

B. Expansion compensation shall be designed for individual exposed piping systems with the following Design Criteria:
   1. $\Delta L = L \times \Delta T \times \alpha$
      a. Where ΔL = pipe length change (inches).
      b. L = pipe length between anchors (inches).
      c. ΔT = 100 (F).
      d. α = coefficient of thermal expansion (inches/inches/F).
   2. Expansion compensation shall be designed as an integral part of the piping hanger, support and anchorage system.
   3. Expansion compensation shall be achieved via expansion joints specified in Section 40 05 06, Couplers, Adapters, and Specials for Process Piping.

2.2 HANGERS AND SUPPORTS

A. Hangers and supports where shown shall be in accordance with detail drawings. Hangers and supports not shown shall be in accordance with MSS SP 58.

B. Products and Manufacturers: Provide one of the following:
   1. Anvil International, Inc.
   2. B-Line.
   3. CADDY Mechanical Hangers.
   4. Globe Pipe Hanger Products, Inc.
   5. Grinnell Corporation.
   6. Unistrut Corporation.

C. Components:
   1. Conform to ANSI B31.1, ASTM F708, MSS SP58, and MSS SP69.
   2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inches: Malleable iron, adjustable swivel, split ring.
   3. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
   4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
   5. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
   6. Wall Support for Pipe Sizes 4 Inches and Over: Welded, steel bracket and wrought steel clamp.
   7. Vertical Support: Steel riser clamp.
   8. Floor Support: Cast iron, adjustable pipe saddle, lock nut, nipple, and floor flange.
   9. Copper Pipe Support: Copper-plated, carbon steel, adjustable ring.

D. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.3 ACCESSORIES

A. Hanger rods shall be made from ASTM A575, with square head nut on top and running thread on bottom end.

B. Hardware requirements:
   1. Hardware exposed to weather or high humidity, in contact with aluminum components, or in submerged conditions shall be Type 316 stainless steel.

2.4 PAINTING

A. Clean and prime ferrous metal surfaces in the shop in accordance with the requirements of Section 09 91 00, Painting.

B. Field painting shall conform to the requirements of Section 09 91 00, Painting.

PART 3 - EXECUTION

3.1 INSERTS

A. Provide inserts for placement in concrete formwork.

B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.

D. Where concrete slabs form finished ceiling, locate inserts flush with slab surfaces.

E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

3.2 INSTALLATION

A. Locate hangers, supports, and accessories to support piping, valves, and at all concentrated loads.

B. Locate hangers, supports, and accessories within maximum span lengths specified to support continuous pipeline runs unaffected by concentrated loadings.

C. Locate hanger, supports to prevent vibration or swaying and to provide for expansion and contraction.
   1. Temperature differential specified in this Section.
   2. Support piping independently so that equipment is not stressed by piping weight or expansion.
   3. For Uninsulated Copper Pipe or Tubing: Clamps and supports, electroplated copper finish. Instrumentation tubing shall be supported in steel or aluminum troughs with covers. All tubing layout and connections shall be as approved by the manufacturer of the equipment.
   4. Uncoated Hangers, Rods and Supports: Dip in zinc chromate primer before installation.
   5. Hanger types for horizontal piping, except as noted and shown:
      a. Forged steel adjustable clevis type, rod support for all services.
      b. Slide Bases:
         1) Pipe stand, brackets, trapeze or other equivalent structural support.
         2) For piping 2-inches or larger.
      c. For pipe and covering provide:
         1) Saddles for rollers or slide bases.
         2) Protective shields or saddles for all other types of supports.
      d. Threaded Steel Rods:
         1) Two inch vertical adjustment with two nuts each end for positioning and locking.

2) Size hanger rods according to the schedule below, unless otherwise noted:

Nominal Pipe (Inches)	Rod Diameter (Inches)
2 and less	3/8
2-1/2 to 3-1/2	1/2
4	5/8
6	3/4
8 through 12	7/8
14 through 18	1
20 through 30	1-1/4

3) For Double Rod Hangers: One size smaller than above.
4) Connection to Structure for Piping to 2-Inches: Concrete inserts, or expansion shields in shear into sides of beams.
5) Connection to Structure for Piping 2-1/2-Inch or Larger: Concrete inserts, beam clamps or suitable bridging.

7. Vertical Piping:
   a. Base Support: Base elbow or welded equivalent.
      1) Bearing plate on structural support.
   b. Guides not to exceed:
      1) 25 feet for piping to 2-inches.
      2) 36 feet for piping 2-1/2-inches or larger.
   c. Top Support:
      1) Special hanger or saddle in horizontal connection.
      2) Provisions for expansion.
   d. Intermediate Supports: Steel pipe clamp at floor.
      1) Bolted and welded to pipe.
      2) Extension ends bearing on structural steel or bearing plates.
   e. For Multiple Pipes: Coordinate guides, bearing plates and accessory steel.
8. Insulated Piping:
   a. Horizontal Pipe Shields at Supports:
      1) Minimum 120 degree arc.
      2) Length equal to diameter of insulation 12-inch minimum.
      3) To 6-Inch Pipe Size: No. 18 USSG galvanized steel.
   b. Vertical Pipe Shields at Guides:
      1) Full 360 degree arc, securely banded.
      2) Length equal to diameter of insulation, 12-inch minimum.
      3) To 6-Inch Pipe Size: No. 18 USSG galvanized steel.

D. Install items to be embedded before concrete placement.

E. Fasten embedded items securely to prevent movement during concrete placement.

F. Install hangers and support units on piping systems in accordance with manufacturer's recommendations.

G. Adjust hangers and supports and place grout for concrete supports to bring pipelines to specified elevations.

H. Bring all pipe systems up to operating pressures and temperatures. Cycle systems to duplicate operating conditions. Correct all support malfunctions.

+ + END OF SECTION + +

SECTION 40 05 08

WALL PIPES, FLOOR PIPES, AND PIPE SLEEVES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install all floor pipes, pipe sleeves, wall pipes, other wall pieces, and escutcheons to complete the Work.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate with the installation of floor pipes, pipe sleeves, wall pipes, other wall pieces and escutcheons that must be installed with or within formwork, walls, partitions, ceilings and panels.

C. Related Sections:
   1. Section 03 30 00, Cast-In-Place Concrete.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:
   1. American National Standards Institute, (ANSI).
      a. ANSI B16.1, Cast-Iron Pipe Flanges and Flanged Fittings.
      b. ANSI B16.4, Gray-Iron Threaded Fittings.
   2. American Water Works Association, (AWWA).
      a. AWWA C104 (ANSI A21.4), Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
      b. AWWA C110 (ANSI A21.10), Ductile-Iron and Gray-Iron Fittings, for Water.
      c. AWWA C111 (ANSI A21.11), Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
      d. AWWA C115 (ANSI A21.15), Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
      e. AWWA C151 (ANSI A21.51), Ductile-Iron Pipe, Centrifugally Cast, for Water.
      f. AWWA C200, Steel Water Pipe 6-Inches and Larger.

1.3 QUALITY ASSURANCE

A. Component Supply and Compatibility:
   1. Obtain all equipment included in this Section regardless of the component manufacturer from a single wall pipes, floor pipes and pipe sleeves manufacturer.
   2. The wall pipes, floor pipes and pipe sleeves manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.
   3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the wall pipes, floor pipes and pipe sleeves manufacturer.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Detailed drawings and data on all wall and floor pipe, and pipe sleeves. Submit and coordinate these with Shop Drawings required for all piping systems.

1.5 DELIVERY, STORAGE AND HANDLING

A. Comply with the requirements of Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Wall and Floor Pipes:
   1. Material: Same as specified for the piping connected to wall or floor pipe, unless otherwise approved by ENGINEER.
   2. End Connections: As shown.
   3. Thickness: Same as specified for the piping connected to wall or floor pipe.
   4. Collars: Provide collars at mid-point of wall for anchorage and watertightness.
   5. Pipes ends shall be flush with wall face, unless otherwise shown.
   6. Drill and tap flanged ends and mechanical joint bells for studs. Provide studs of same material as connected piping, except submerged and buried studs shall be of Type 316 stainless steel.

B. Pipe Sleeves:
   1. Ferrous and Plastic Pipe: Use standard weight galvanized steel pipe, unless otherwise shown.
   2. Copper Pipe: Use Type K hard drawn copper pipe, unless otherwise shown.

C. Link Seals: Provide link type mechanical seals suitable for 20 psi working pressure, corrosive service and accessible from one side, with glass-reinforced nylon pressure plate and stainless steel bolts and nuts.
   1. Products and Manufacturers: Provide one of the following:
      a. Link-Seal, as manufactured by Thunderline Corporation.
      b. Or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Wall and Floor Pipes: Install as shown and in accordance with approved Shop Drawings.

B. Pipe Sleeves:
   1. Use sleeves wherever pipes pass through walls, partitions, floors, and roofs, unless otherwise shown.
   2. Extend all sleeves through floor slabs a minimum of 2-inches above finished floor.
   3. Anchor sleeves to concrete and masonry walls as shown or otherwise approved.
   4. All sleeves through walls shall be flush with wall face.
   5. All pipe joints and annular spaces in exterior walls or walls subjected to hydrostatic pressure shall be completely watertight.
   6. Use link type seals to seal sleeve against hydrostatic pressure. Size sleeves to provide annular space required to suit the link type mechanical seals that are used.
   7. Do not install sleeves and pipes through structural members, unless specifically shown and approved by ENGINEER.
   8. Size sleeves to provide annular space as follows:

Pipe Size	Sleeve ID Minus Pipe Or Insulation OD
Less than 2-inches	1/2-inches to 3/4-inches
2-inches to 4-inches	3/4 inches to 1-1/4-inches.
6-inches to 12-inches	1-1/4 inches to 2-inches
Over 12-inches	2-inches to 3-inches

+ + END OF SECTION + +

SECTION 40 05 17

COPPER PROCESS PIPE

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish copper pipe and fittings.
   2. Extent of piping is shown and indicated in the piping schedules in Section 40 05 05, Exposed Piping Installation.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before copper pipe Work.

C. Related Sections:
   1. Section 40 05 05, Exposed Piping Installation.
   2. Section 22 07 19, Piping Insulation.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. ANSI/ASME B16.15, Cast Copper Alloy Threaded Fittings: Classes 125 and 150.
   2. ANSI/ASME B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.
   3. ANSI/ASME B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
   4. ANSI/ASME B16.23, Cast Copper Alloy Solder Joint Drainage Fittings: DWV.
   5. ANSI/ASME B16.24, Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 600, 900, 1500 and 2500.
   6. ANSI/ASME B16.29, Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings: DWV
   7. ANSI/ASME B16.39, Malleable Iron Threaded Pipe Unions: Classes 150, 250, and 300.
   8. ANSI/ASME B16.42, Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300.
   9. ANSI/ASME B18.2.1, Square and Hex Bolts and Screws, Inch Series.
   10. ANSI/ASME B18.2.2, Square and Hex Nuts.
   11. ASTM A194, Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
   12. ASTM A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

13. ASTM B68, Specification for Seamless Copper Tube, Bright Annealed.
14. ASTM B251, Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube.
15. ASTM B302, Specification for Threadless Copper Pipe, Standard Sizes.
16. ASTM D1330, Specification for Rubber Sheet Gaskets.
17. FS WW-U-516, Unions – Brass or Bronze.

1.3 QUALITY ASSURANCE

A. Component Supply and Compatibility:
   1. Unless otherwise approved, obtain all pipe, fittings, and appurtenances included in this Section from a single copper pipe manufacturer.
   2. Copper pipe Supplier shall review and approve or prepare all Shop Drawings and other submittals for pipe, fittings, and appurtenances furnished under this Section.

B. Regulatory Requirements:
   1. Pipe and fittings that will convey potable water or water that will be treated to become potable, shall be certified by an accredited organization in accordance with NSF/ANSI 61 as being suitable for contact with potable water, and shall comply with requirements of authorities having jurisdiction at the Site.
   2. Pipe and fittings materials and joint types shall comply with requirements of authorities having jurisdiction at Site.

1.4 SUBMITTALS

A. Action Submittals: Submit the following with Shop Drawings required under Section 40 05 05, Exposed Piping Installation:
   1. Shop Drawings:
      a. Detailed layout drawings for pipe, fittings, and appurtenances.
   2. Product Data:
      a. Detailed data on pipe, fittings, and appurtenances.

B. Informational Submittals: Submit the following:
   1. Certificates:
      a. Submit certificate signed by manufacturer of each material that material conforms to applicable referenced standards and the Contract Documents.

1.5 DELIVERY, STORAGE AND HANDLING

A. Refer to Section 40 05 05, Exposed Piping Installation.

B. Maintain ASTM B68 pipe, fittings, and appurtenances free of scale and dirt during transportation, delivery, storage, and handling.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Pipe for Plant Effluent Water: Pipe shall be seamless, bright annealed copper tubing, complying with ASTM B68. Pipe material shall be free from scale and dirt. Dimensions and tolerances shall comply with ASTM B251.

B. Brazed Copper Pipe: Assemble piping with braze joint pressure fittings. Pipe material shall comply with ASTM B302.

2.2 JOINTS

A. Refer to piping schedules at the end of Section 40 05 05, Exposed Piping Installation for the service and joint type specified for each piping system.

B. Provide type of fittings corresponding to the specified joint type in accordance with Table 40 05 17-A.

TABLE 40 05 17-A
COPPER PIPE JOINT TYPE AND FITTING SCHEDULE

Joint Type	Fitting Type, Applicable Reference Standards
Soldered	ANSI/ASME B16.22, ANSI/ASME B16.29 (DWV)
Threaded	ANSI/ASME B16.15
Flanged	ANSI/ASME B16.24 (bronze), ANSI/ASME B16.42 (ductile iron at dielectric connections)

C. When fully developed, the strength of the joint shall be greater than strength of adjoining pipe.

D. Flanged Joints for Plant Effluent Water Service: Comply with the following:
   1. Flanges: ANSI/ASME B16.24, Class 150.
   2. Gaskets: Red rubber, ASTM D1330, Grade 1, 1/8-inch thick.
   3. Bolts: ASTM A307, Grade B. Conform to ANSI/ASME B18.2.1.
   4. Nuts: ASTM A194, Grade 2H, Heavy hex. Comply with ANSI/ASME B18.2.2.

E. Unions for Plant Effluent Water Service: Shall be bronze, 250-pound class, conforming to FS WW-U-516.

F. Dielectric Connections for Plant Effluent Water Service:
   1. Manufacturers: Provide products of one of the following:
      a. Watts Regulator Company.
      b. Wilkins, a Zurn company.
      c. Or equal.
   2. Type: Union or flanged.

3. Ratings:
    a. Unions: Rated for 250 psi, complying with ANSI/ASME B16.39.
    b. Flanges: Rated for 175 psi, complying with ANSI/ASME B16.42 (Ductile Iron), or ANSI/ASME B16.24 (Bronze).
4. Bodies and flanges, and bolts and nuts shall be steel with galvanized coating. Insulator shall be nylon; tailpiece shall be brass. Provide EPDM gaskets for pipe temperature up to 200 degrees F, and Viton gaskets for temperatures over 200 degrees F.

2.3 MARKING

A. Mark or label all materials with the following:
    1. Metal or alloy designation.
    2. Temper.
    3. Size and schedule.
    4. ASTM reference standard number.
    5. Name and location of Supplier.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Refer to Section 40 05 05, Exposed Piping Installation, for exposed piping installation, disinfection, testing and cleaning.

B. Refer to Section 40 42 00, Insulation of Process Piping and Equipment, for requirements for piping specified as insulated in the piping schedules at the end of Section 40 05 05, Exposed Piping Installation.

+ + END OF SECTION + +

SECTION 40 05 19

DUCTILE IRON PROCESS PIPE

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish ductile iron pipe and fittings.
   2. Extent of piping is shown on the Drawings. Piping schedule in Section 40 05 05, Exposed Piping Installation, specify pipe service, diameter, material, lining, coating, pressure rating, joint type, and testing required.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before ductile iron pipe Work.

C. Related Sections:
   1. Section 09 91 00, Painting.
   2. Section 40 05 05, Exposed Piping Installation.
   3. Section 40 05 06, Couplers, Adapters, and Specials for Process Piping.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. ANSI B18.2.1, Square and Hex Bolts and Screws Inch Series.
   2. ANSI B18.2.2, Square and Hex Nuts. (Inch Series).
   3. ASTM A193, Alloy Steel and Stainless Steel Bolting Materials for High-Temperature Service.
   4. ASTM A194, Specification for Carbon Steel and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both.
   5. ASTM A307, Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
   6. ASTM A563, Specification for Carbon and Alloy Steel Nuts.
   7. ANSI/AWWA C104, Cement-Mortar Lining for Ductile Iron Pipe and Fittings for Water.
   8. ANSI/AWWA C110, Ductile Iron and Gray Iron Fittings for Water.
   9. ANSI/AWWA C111, Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings.
   10. ANSI/AWWA C115, Flanged Ductile Iron Pipe with Ductile Iron or Gray Iron 1Threaded Flanges.
   11. ANSI/AWWA C151, Ductile Iron Pipe, Centrifugally Cast, for Water.
   12. NAPF 500-03, Surface Preparation Standard for Ductile Iron Pipe and Fittings Receiving Special External Coatings and/or Special Internal Linings.

13. NSF/ANSI 61, Drinking Water System Components - Health Effects.

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer:
      a. Manufacturer shall have a minimum of five years successful experience producing ductile iron pipe and fittings and shall be able to show evidence of at least five installations in satisfactory operation in the United States that are similar applications to the specified service.
      b. Lining and coating products shall be manufactured by a firm with a minimum of five years successful experience in protecting pipelines exposed to the specified service conditions , and shall be able to show evidence of at least five installations in satisfactory operation in the United States that are similar applications to the specified service.
      c. When not applied by the manufacturer, lining and coating Subcontractor shall have a minimum of five years successful experience in the application of the specified linings and coatings for similar applications for the specified service, and shall be able to show evidence of at least five installations in satisfactory operation in the United States.

B. Supply and Compatibility:
   1. Unless otherwise approved, obtain all pipe, fittings, and appurtenances included in this Section from a single ductile iron pipe manufacturer.
   2. Ductile iron pipe manufacturer shall review and approve or prepare all Shop Drawings and other submittals for pipe, fittings, and appurtenances furnished under this Section.
   3. Pipe, fittings, and appurtenances shall be suitable for the specified service and shall be integrated into overall piping system by ductile iron pipe manufacturer.
   4. Ductile iron pipe manufacturer shall be responsible for all products and all factory-applied linings and coatings, whether installed at pipe manufacturer's facility or at manufacturer's Supplier's facility.

C. Regulatory Requirements:
   1. Pipe and fittings, including linings and coatings, that will convey potable water or water that will be treated to become potable, shall be certified by an accredited organization in accordance with NSF/ANSI 61 as being suitable for contact with potable water, and shall comply with requirements of authorities having jurisdiction at Site.

1.4 SUBMITTALS

A. Action Submittals: Submit the following with Shop Drawings required under Section 40 05 05, Exposed Piping Installation:
   1. Shop Drawings:
      a. Detailed drawings and data for pipe, fittings, gaskets, appurtenances, linings, and coatings.

B. Informational Submittals: Submit the following:
   1. Certificates:
      a. Submit certificate signed by manufacturer of each product that product conforms to applicable referenced standards and the Contract Documents.
      b. Submit certificate signed by applicator of the linings and coatings stating that product to be applied conforms to applicable referenced standards and that the applicator shall conform to the Contract Documents.
   2. Source Quality Control Submittals:
      a. Submit results of specified shop tests for pipe, fittings, linings, and coatings.
      b. Lining and coating test coupons.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 40 05 05, Exposed Piping Installation.

PART 2 – PRODUCTS

2.1 MATERIALS

A. General:
   1. Piping systems shall be suitable for their intended use.
   2. Joints shall be as specified in Section 40 05 05, Exposed Piping Installation. If not specified, provide flanged joints for exposed piping and push-on or mechanical joints for buried piping. Provide couplings on pipe with plain or grooved ends where shown or where approved by ENGINEER.

B. Ductile Iron Pipe, Joints, and Fittings:
   1. Flanged Pipe: Fabricate in accordance with ANSI/AWWA C115.
      a. Pressure Rating: As specified in piping schedule in Section 40 05 05, Exposed Piping Installation. If not otherwise specified, use Special Thickness Class 53 for three-inch to 54-inch diameter pipe and Pressure Class 350 for 60-inch and 64-inch diameter pipe.
   2. Non-Flanged Pipe: Conform to ANSI/AWWA C151 for material, pressure, dimensions, tolerances, tests, markings, and other requirements.
      a. Pressure Class: As specified in piping schedules in Section 40 05 05, Exposed Piping Installation. If not otherwise specified, use Pressure Class 53 for three-inch to 54-inch diameter pipe.
      b. Special Thickness Class: As specified in piping schedules in Section 40 05 05, Exposed Piping Installation.

3. Pipe Joints:
    a. Flanged Joints: Conform to ANSI/AWWA C110 and ANSI/AWWA C111 capable of meeting the pressure rating or special thickness class, and test pressure specified in piping schedule in Section 40 05 05, Exposed Piping Installation.
        1) Gaskets: Unless otherwise specified, gaskets shall be at least 1/8-inch thick, ring or full-face as required for the pipe, of synthetic rubber compound containing not less than 50 percent by volume nitrile or neoprene, and shall be free from factice, reclaimed rubber, and other deleterious substances. Gaskets shall be suitable for the service conditions specified, specifically designed for use with ductile iron pipe and fittings.
        2) Bolts: Comply with ANSI B18.2.1.
            a) Exposed: ASTM A307, Grade B.
            b) Buried or Submerged: ASTM A193, Grade B8M, Class 2, Heavy hex, Type 316 stainless steel.
        3) Nuts: Comply with ANSI B18.2.2.
            a) Exposed: ASTM A563, Grade A, Heavy hex.
            b) Buried or Submerged: ASTM A194, Grade B8M, Heavy hex, Type 316 stainless steel.
    b. Mechanical Joints: Comply with ANSI/AWWA C111 and ANSI/AWWA C151, capable of meeting pressure rating or special thickness class, and test pressure specified in piping schedule in Section 40 05 05, Exposed Piping Installation.
        1) Glands: Ductile iron.
        2) Gaskets: Plain tip.
        3) Bolts and Nuts: High strength, low alloy steel.
        4) Manufacturers: Provide products of one of the following:
            a) Clow Water Systems Company.
            b) Atlantic States Cast Iron Pipe Company.
            c) Canada Pipe Company, Ltd.
            d) McWane Cast Iron Pipe Company.
            e) Pacific States Cast Iron Pipe Company.
            f) Griffin Pipe Products Co.
            g) American Cast Iron Pipe Co.
            h) U.S. Pipe and Foundry Co.
            i) Or equal.
    c. Push-On Joints: Comply with ANSI/AWWA C111 and ANSI/AWWA C151, capable of meeting pressure class or special thickness class, and test pressure specified in piping schedule in Section 40 05 05, Exposed Piping Installation.
        1) Gaskets: Vulcanized SBR, unless otherwise specified.
        2) Stripes: Each plain end shall be painted with a circular stripe to provide a guide for visual check that joint is properly assembled.
        3) Products and Manufacturers: Provide one of the following:
            a) Tyton or Fastite Joint by Clow Water Systems, Atlantic States Cast Iron Pipe Company, Canada Pipe Company, Ltd., McWane

Cast Iron Pipe Company, Pacific States Cast Iron Pipe Company, and Griffin Pipe Products Company.
b) Fastite Joint by American Cast Iron Pipe Company.
c) Tyton Joint by U.S. Pipe and Foundry Company.
d) Or equal.

d. Restrained Joints: Restrained push-on joints shall be capable of being deflected after full assembly. Field cuts of restrained pipe are not allowed without approval of ENGINEER.
1) Products and Manufacturers: Provide restrained joints for mechanical joint piping by one of the following:
a) Megalug, Series 1100, by EBBA Iron Sales, Inc.
b) MJ Coupled Joint, by American Cast Iron Pipe Co.
c) MJ Field Lok, by U.S. Pipe and Foundry Co.
d) Or equal.
2) Products and Manufacturers: Provide restrained joints for push-on joint piping by one of the following:
a) Super-Lock Joint Pipe, by Clow Water Systems, a division of McWane, Inc.
b) Lok-Ring Joint, or Flex-Ring Joint, by American Cast-Iron Pipe Company.
c) TR Flex Joint, by U.S. Pipe and Foundry Company.
d) Snap-Lok, by Griffin Pipe Products Company.
e) Or equal.

4. Flanged and Push-On Joint Fittings: Comply with ANSI/AWWA C110 and ANSI/AWWA C111.
a. Material: Ductile iron.
b. Pressure rating, gaskets, bolts, and nuts shall be as specified for flanged joints. Pressure rating of fittings shall meet, but not exceed, specified pressure rating or special thickness class of the connected pipe.

5. Mechanical Joint Fittings: Comply with ANSI/AWWA C110 and ANSI/AWWA C111.
a. Material: Ductile iron.
b. Glands: Ductile iron.
c. Pressure rating, gaskets, bolts, and nuts shall be as specified for mechanical joints. Pressure rating of fittings shall meet, but not exceed, specified pressure rating or special thickness class of connected pipe.

C. Cement-mortar Lining:
1. Where specified in piping schedule included with Section 40 05 05, Exposed Piping Installation, pipe and fittings shall be lined with bituminous seal coated cement-mortar lining in accordance with ANSI/AWWA C104.

D. Couplings:
1. Refer to Section 40 05 06, Couplings, Adapters, and Specials for Process Piping.

I. Specials:
   1. Transition Pieces:
      a. Provide suitable transition pieces (adapters) for connecting to existing piping.
      b. Unless otherwise shown or indicated, expose existing piping to determine material, dimensions, and other data required for transition pieces.
   2. Taps:
      a. Provide taps where shown or required for small-diameter piping or instrumentation connections.
      b. Provide corporation stops where shown or required.

2.2 MARKING FOR IDENTIFICATION

A. In addition to identification markings specified in Section 40 05 05, Exposed Piping Installation, also stamp, mark, and identify push-on joint and mechanical joint pipe with:
   1. Name or trademark of manufacturer.
   2. Weight, class or nominal thickness, and casting period.
   3. Country where cast.
   4. Year the pipe was produced.
   5. Letters “DI” or “Ductile” shall be cast or metal stamped

B. In addition to identification markings specified in Section 40 05 05, Exposed Piping Installation, also stamp, mark, and identify flanged pipe with:
   1. Flange manufacturer’s mark, size, and letters “DI” cast or stamped on the flanges.
   2. Fabricator’s mark if other than flange manufacturer.
   3. Length and weight.

C. In addition to identification markings specified in Section 40 05 05, Exposed Piping Installation, also stamp, mark, and identify fittings with:
   1. Manufacturer’s identification.
   2. Pressure rating.
   3. Nominal diameters of openings.
   4. Country where cast.
   5. Number of degrees or fraction of the circle on bends.
   6. Letters “DI” or “Ductile” cast on them.

2.3 EXTERIOR SURFACE PREPARATION AND COATINGS

A. General Coating Requirements:
   1. Coating types are specified in piping schedule in Section 40 05 05, Exposed Piping Installation.

B. Exposed Pipe and Fittings:
   1. Surface Preparation:
      a. Initial Surface Inspection: Pipe and fitting manufacturer and coating

applicator shall inspect surface to be coated and mutually determine recommended NAPF 500-03 surface preparation method.

b. Surface Preparation: Prepare surface in accordance with recommended NAPF 500-03 method.

c. Finished Surface Inspection: Prepared surfaces shall be inspected by coating applicator prior to application to determine acceptability of finished surface. If surface is unacceptable, repeat surface preparation and re-application as necessary.

2. After recommended surface preparation, prime coat exterior ferrous metal surfaces of pipe and fittings in the shop in accordance with Section 09 91 00, Painting.

3. Field painting shall comply with Section 09 91 00, Painting.

PART 3 – EXECUTION

3.1 INSPECTION

A. Inspect piping to assure that piping is free from defects in material and workmanship. Verify compatibility of pipe, fittings, gaskets, linings, and coatings.

3.2 INSTALLATION AND FIELD QUALITY CONTROL

A. For exposed piping installation and testing, refer to Section 40 05 05, Exposed Piping Installation.

+ + END OF SECTION + +

SECTION 40 05 31

THERMOPLASTIC PROCESS PIPE

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install thermoplastic piping and fittings.
   2. Extent of piping is shown and shall be in accordance with piping schedules in Section 40 05 05, Exposed Piping Installation.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before thermoplastic piping Work.

C. Related Sections:
   1. Section 40 05 05, Exposed Piping Installation.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. ASTM D1784, Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
   2. ASTM D1785, Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120.
   3. ASTM D2464, Specification for Threaded Poly (Vinyl Chlorinated) (PVC) Plastic Pipe Fittings, Schedule 80.
   4. ASTM D2467, Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
   5. ASTM D2564, Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
   6. ASTM F656, Specification for Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
   7. NSF 14, Plastic Piping Systems Components and Related Material.
   8. ANSI/NSF 61, Drinking Water System Components - Health Effects.

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer: Shall have a minimum of five years experience producing thermoplastic pipe and fittings substantively similar to the materials specified,

and shall be able to submit documentation of satisfactory service in at least five completed installations in operation for at least five years each.

2. Installer:
    a. Engage a single pipe installer who shall be responsible for all thermoplastic pipe Work, and who shall employ only tradesmen with specific skills and experience in the type of Work required.
    b. Installer shall have a minimum of five-years experience installing thermoplastic pipe and fittings substantively similar to the materials specified and substantively similar to or larger than the scope of thermoplastic piping Work on the Project, and shall be able to submit documentation of satisfactory experience in at least five completed installations in operation for at least five years each.

B. Component Supply and Compatibility:
    1. Obtain all materials included in this Section, regardless of component Supplier, from a single thermoplastic pipe Supplier. All pipe of each material type shall be furnished by the same manufacturer.
    2. Thermoplastic pipe Supplier shall review and approve to prepare all Shop Drawings and other submittals for all materials furnished under this Section.
    3. Materials shall be suitable for specified service conditions and shall be integrated into overall assembly by thermoplastic pipe Supplier.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
    1. Shop Drawings:
        a. Submit piping layout Shop Drawings in accordance with Section 40 05 05, Exposed Piping Installation.
    2. Product Data:
        a. Submit product data on pipe, fittings, gaskets, hardware, and appurtenances sufficient to demonstrate compliance with the Contract Documents.

B. Informational Submittals: Submit the following:
    1. Certificates:
        a. Submit manufacturer's certificate of compliance standards referenced in this Section.
    2. Source Quality Control Submittals:
        a. When requested by ENGINEER, submit results of source quality control tests.
    3. Qualifications Statements:
        a. Submit qualifications of manufacturer when requested by ENGINEER.
        b. Submit qualifications of installer when requested by ENGINEER.

1.5 DELIVERY, STORAGE AND HANDLING

A. Section 40 05 05, Exposed Piping Installation.

PART 2 – PRODUCTS

2.1 SERVICE CONDITIONS

A. General:
   1. Pipe materials shall be suitable for services intended. Refer to piping schedule in Section 40 05 05, Exposed Piping Installation.
   2. Pipe shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, and other defects. Unless otherwise shown or indicated, pipe shall be uniform in color, opacity, density, and other physical properties.
   3. Comply with NSF 14.
   4. Buried pipe shall be capable of withstanding external live load, including impact, equal to AASHTO H-20 loading, with cover shown or indicated on the Drawings.
   5. Pipe, fittings, and appurtenances in contact with potable water or water that will be treated to become potable shall be listed in ANSI/NSF 61 as being suitable for contact with potable water, and shall comply with requirements of the authorities having jurisdiction at the Site.

2.2 POLYVINYL CHLORIDE (PVC) PIPING

A. PVC Pipe – General Applications: Unless otherwise shown or indicated, PVC pipe shall comply with the following:
   1. Manufacturers: Provide products of one of the following:
      a. Ipex, Inc.
      b. Spears Manufacturing Company.
      c. Or equal.
   2. Material: Unless otherwise specified, comply with the following:
      a. Type and Grade: Type 1, Grade 1.
      b. Wall Thickness: Schedule 80 complying with ASTM D1784 and ASTM D1785, and US Product Service PS 21-70 as having same outside diameter dimension as cast-iron pipe.
      c. Temperature Rating: Rated for temperature to 140 degrees F.
      d. Color: White or Gray.
   3. Fittings: Type, grade, schedule, and color of fitting shall match the associated pipe.
      a. Solvent Weld: Comply with ASTM D2467
      b. Threaded: Threaded fittings shall comply with ASTM D2464.
      c. Flanged: Provide flanged fittings with EPDM gaskets.
   4. Joints:
      a. Solvent Weld: Use primer and solvent cement recommended by PVC pipe manufacturer for the application. Primer shall be in accordance with ASTM F656, and solvent cement shall be in accordance with ASTM D2564.
      b. Threaded: Use 100 percent virgin polytetrafluoroethylene (Teflon or PTFE) tape for threaded fittings. Pipe shall not be threaded.

c. Flanged: Provide with backup flange minimum 1/8-inch thick. Backup flanges and connecting bolts shall be Type 304 stainless steel.

B. PVC Drain, Waste, and Vent (PVC-DWV) Pipe.
   1. Manufacturers: Provide products of one of the following:
      a. Chemtrol, manufactured by Nibco, Inc.
      b. Spears Manufacturing Company.
      c. Or equal.
   2. Material: In accordance with ASTM D1784. Unless otherwise shown or indicated, PVC-DWV pipe shall be:
      a. Type and Grade: Type 1, Grade 1.
      b. Wall Thickness: Schedule 40.
      c. Color: White.
   3. Fittings: Manufactured in accordance with ASTM D2665 and ASTM D3311.
      a. Solvent weld.
      b. Spigot.
   4. Joints:
      a. Solvent weld.
      b. Threaded.
      c. Flanged (all joints and connections above Elevation 71.75).

2.3 FLEXIBLE TUBING

A. Flexible Tubing: Unless otherwise shown or indicated, flexible tubing shall be as follows:
   1. Manufacturers: Provide products of one of the following:
      a. Nalgene 980
      b. Or equal.
   2. Material: Material shall comply with FDA CFR 21. Unless otherwise shown or indicated, PVC tubing shall be:
      a. Utility grade.
      b. Color: clear for visible flow.
      c. Rating: Minimum the same as the connecting piping.
   3. Fittings: Fitting shall be as recommended by tubing manufacturer.

2.7 IDENTIFICATION

A. Pipe material identification requirements are in Section 40 05 05, Exposed Piping Installation.

2.8 SOURCE QUALITY CONTROL

A. Shop Tests:
   1. Pipe manufacturer shall maintain continuous quality control program.
   2. Where applicable and when requested by ENGINEER, submit results of source quality control tests specified in reference standards.

PART 3 - EXECUTION

3.1 INSPECTION

A. Inspect pipe materials for defects in material and workmanship. Verify compatibility of pipe and fittings.

3.2 INSTALLATION

A. For exposed piping installation, refer to Section 40 05 05, Exposed Piping Installation.

+ + END OF SECTION + +

SECTION 40 05 53

PROCESS VALVES, FOUR-INCH DIAMETER AND LARGER

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install process valves, four-inch diameter and larger, and appurtenances, complete and operational.
   2. Valves for digester gas and air have been specifically identified. All other valves are for liquid service.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate installation of items that must be installed with or before process valves Work.

C. Related Sections:
   1. Section 05 05 33, Anchor Systems.
   2. Section 09 91 00, Painting.
   3. Section 40 05 05, Exposed Piping Installation.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:
   1. American Bearing Manufacturers Association (ABMA).
   2. ANSI B16.1, Cast-Iron Pipe Flanges and Flanged Fittings.
   3. ANSI/NSF 61 Drinking Water Components – Health Effects.
   5. ASTM A126, Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
   6. ASTM A380, Practice for Cleaning, Descaling and Passivation of Stainless Steel Parts, Equipment and Systems.
   7. ASTM A536, Specification for Ductile Iron Castings.
   8. ASTM B62, Specification for Composition Bronze or Ounce Metal Castings.
   9. ASTM D429, Test Methods for Rubber Property - Adhesion to Rigid Substrates.
   10. AWWA C508, Swing-Check Valves for Waterworks Service, 2-inch through 24-inch NPS.
   11. AWWA C509, Resilient-Seated Gate Valves for Water Supply Service.
   12. AWWA C550, Protective Interior Coatings for Valves and Hydrants.

13. AWWA Manual M49, Butterfly Valves: Torque, Head Loss, and Cavitation Analysis.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications:
   1. Manufacturer shall have minimum of five years of experience producing substantially similar materials and equipment to that required and be able to provide evidence of at least five installations in satisfactory operation for at least five years.

B. Component Supply and Compatibility:
   1. Obtain each type of equipment and appurtenances included in this Section, regardless of the component manufacturer, from a single manufacturer of the type of process valve. For each type of valve, do not furnish valves of more than one manufacturer.
   2. Supplier of each type of equipment specified shall review and approve or prepare all Shop Drawings and other submittals for all components associated with the type of process valve Supplier is furnishing.
   3. Components shall be suitable for use in the specified service conditions. Components shall be integrated into the overall assembly by the process valve manufacturer.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Installation drawings showing orientation of valve in both plan and elevation view. Drawings shall clearly identify valve and its appurtenances, including controls, actuators, valve stems, and other components. Show dimensions of valves and appurtenances in relation to piping and structural and architectural components, where applicable.
   2. Product Data:
      a. Product data sheets.
      b. Complete catalog information, including dimensions, weight, specifications, and identification of materials of construction of all parts.
      c. Corrosion resistance information to confirm suitability of valve materials for the application. Furnish information on chemical resistance of elastomers from elastomer manufacturer.
      d. Cv values and hydraulic headloss curves.

B. Informational Submittals: Submit the following:
   1. Certificates:
      a. Certificates of compliance with referenced standards, where applicable, including those of AWWA, NSF, and others required by ENGINEER.

C. Closeout Submittals: Submit the following:
   1. Operations and Maintenance Data:
      a. Furnish operation and maintenance manuals in accordance with Section 01 78 23, Operations and Maintenance Data.
      b. Furnish in operations and maintenance manuals complete nameplate data for each valve and electric actuator.

D. Maintenance Material Submittals: Submit the following:
   1. Spare Parts, Extra Stock Materials, and Tools:
      a. Spare Parts and Extra Stock Materials: Furnish as specified for each valve type.
      b. Tools: Furnish two sets of special tools (excluding metric tools, if applicable) for each size and type of valve furnished.

1.5 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling, and Unloading:
   1. Deliver materials and equipment to Site to ensure uninterrupted progress of the Work. Deliver anchorage products that are to be embedded in concrete in ample time to prevent delaying the Work.
   2. Inspect boxes, crates, and packages upon delivery to Site and notify ENGINEER in writing of loss or damage to materials and equipment. Promptly remedy loss and damage to new condition in accordance with manufacturer’s instructions.
   3. Conform to Section 01 65 00, Product Delivery Requirements.

B. Storage and Protection:
   1. Keep products off ground using pallets, platforms, or other supports. Store equipment in covered storage and prevent condensation and damage by extreme temperatures. Store in accordance with manufacturer's recommendations. Protect steel, packaged materials, and electronics from corrosion and deterioration.
   2. Conform to Section 01 66 00, Product Storage and Handling Requirements.

PART 2 - PRODUCTS

2.1 GENERAL

A. Valves, General:
   1. Provide each valve with manufacturer's name and rated pressure cast in raised letters on valve body.
   2. Provide valves with brass or Type 316 stainless steel nameplate attached with Type 316 stainless steel screws. Nameplates shall have engraved letters displaying the following minimum information:
      a. Valve size.
      b. Pressure and temperature ratings.
      c. Application (other than water and wastewater).
      d. Date of manufacture.
      e. Manufacturer's name.
   3. Provide valves to turn clockwise to close, unless otherwise specified.
   4. Provide valves with permanent markings for direction to open.
   5. Manually operated valves, with or without extension stems, shall require not more than 40-pound pull on manual operator to open or close valve against specified criteria. Gear actuator and valve components shall be able to withstand minimum pull of 200 pounds on manual operator and input torque of 300-foot pounds to actuator nut. Manual operators include handwheel, chainwheel, crank, lever, and T-handle wrench.

B. Valve Materials:
   1. Valve materials shall be suitable for the associated valve's service or application, as shown.
   2. Protect wetted parts from galvanic corrosion caused by contact of different metals.
   3. Wetted components and wetted surfaces of valves used with potable water or water that will be treated to become potable shall conform to ANSI/NSF 61.
   4. Clean and descale fabricated stainless steel items in accordance with ASTM A380 and the following:
      a. Passivate all stainless steel welded fabricated items after manufacture by immersing in pickling solution of six percent nitric acid and three percent hydrofluoric acid. Temperature and detention time shall be sufficient for removing oxidation and ferrous contamination without etching surface. Perform complete neutralizing operation by immersing in trisodium phosphate rinse followed by clean water wash.
      b. Scrub welds with same pickling solution or pickling paste and clean with stainless steel wire brushes or by grinding with non-metallic abrasive tools to remove weld discoloration, and then neutralize and wash clean.

C. Valve Joints:
   1. Exposed Valves: Unless otherwise specified, provide with flanged ends conforming to ANSI B16.1. Pressure class of flanges shall be equal to or greater than specified pressure rating of the associated valve.
   2. For stainless steel bolting, except where nitrided nuts are required, use graphite-free anti-seize compound to prevent galling. Strength of joint shall not be affected by using anti-seize compound.

2.2 RESILIENT-SEATED GATE VALVES

A. Manufacturers: Provide products of one of the following:
   1. M&H Valve Company
   2. US Pipe and Foundry.
   3. Or equal.

B. General:
   1. Provide valves conforming to AWWA C509 and as specified in this Section.
   2. Sizes: Four-inch through 12-inch diameter, 16-inch and 20-inch diameter.
   3. Type:
      a. Provide non-rising stem (NRS) valves for buried service.
      b. For interior and exposed service, provide outside screw and yoke (OS&Y) rising-stem valves, unless otherwise specified.
      c. Provide position indicators for NRS valves used in exposed service.
   4. Minimum Rated Working Pressure:
      a. Valves 12-inch Diameter and Smaller: 200 psig.
      b. Valves 16-inch and 20-inch Diameter: 150 psig.
   5. Maximum Fluid Temperature: 150 degrees F.
   6. Provide valves with fully encapsulated resilient wedges, unless otherwise specified.

C. Materials of Construction: Shall conform to AWWA C509 and be as follows:
   1. Valve Body, Bonnet, and Stuffing Box: Cast-iron.
   2. Wedge: Cast-iron, symmetrically and fully encapsulated with molded rubber having minimum 1/8-inch thickness.
   3. Stem: Manganese bronze.
   4. Rubber Items: Buna-N or other synthetic rubber suitable for the application.
   5. Internal and external bolting and other hardware including pins, set screws, plug, studs, bolts, nuts, and washers shall be Type 316 stainless steel.

D. Interior Coating:
   1. Valves shall be coated inside. Steel, cast-iron and ductile iron surfaces, except machined surfaces, shall be epoxy coated in accordance with AWWA C550.

E. Testing:
   1. Test valves in valve manufacturer's shop in accordance with AWWA C509.

F. Gear Actuators for Manually-operated Valves:
   1. Provide valves with gear actuators conforming to AWWA C500.
   2. Size gear actuators for the following maximum differential pressures:
      a. Valve Size and Location: 4-inch Plant Effluent.
      b. Maximum Differential Pressure Across Closed Valve: 100 psi.

2.3 ECCENTRIC PLUG VALVES

A. Manufacturers: Provide products of one of the following:
   1. DeZurik.
   2. Or equal.

B. General:
   1. Provide eccentric-type plug valves each with rectangular ports.
   2. Minimum Rated Working Pressure:
      a. Valves 12-inch Diameter and Smaller: 175 psig.
      b. Valves 14-inch through 72-inch Diameter: 150 psig.
   3. Maximum Fluid Temperature: 180 degrees F.
   4. Minimum Port Area: 100 percent of nominal pipe area.
   5. Packing and packing gland shall be externally adjustable and accessible without disassembling valve and without removing the actuator.
   6. Valves shall provide drip-tight, bi-directional shutoff at rated pressures.
   7. Plug shall have cylindrical seating surface eccentrically offset from center of plug shaft. Interface between plug face and body seat, with plug in closed position, shall be externally adjustable in the field with valve in the line while under pressure.
   8. Plug shall be supported to top bearing by using spring that is externally adjustable.
   9. For sludge service, plug valves shall allow pigging of the piping with line-size pigs.

C. Materials of Construction:
   1. Body: Cast Iron ASTM A126 Class B, or Ductile-iron ASTM A536 Grade 65-45-12.
   2. Plug:
      a. Core: Cast Iron ASTM A126 Class B, or Ductile-iron, ASTM A536 Grade 65-45-12.
      b. Plug Facing: Neoprene.
      c. For valves up to eight-inch diameter, plugs shall be fully encapsulated with rubber. For valves larger than eight-inch diameter, provide plugs with rubber facing. Minimum thickness of rubber lining shall be 1/8-inch. Rubber hardness shall be a minimum of 70 (Shore A) durometer. Rubber-to-metal bond shall withstand minimum 75-pound pull conforming to ASTM D429 Method B.
   3. Seats: Minimum 1/8-inch welded overlay of minimum 90 percent pure nickel on surfaces contacting plug face. Seats shall provide contact area of at least 1/2-inch width all around.

4. Stem Bearings: Sintered, oil impregnated, permanently lubricated of Type 316 stainless steel.
5. Stem Seal: Multiple neoprene V-ring type.
6. All internal and external bolting and other hardware including pins, set screws, plug, studs, bolts, nuts and washers shall be Type 316 stainless steel.

D. Interior Coating and Lining:
1. Valves shall be coated inside. Steel, cast-iron, and ductile iron surfaces, except machined surfaces, shall be epoxy-coated in accordance with AWWA C550.

E. Shop Testing:
1. Operational Tests:
a. To demonstrate that complete assembly is workable, successfully operate each valve (with actuator mounted directly on valve) three times from fully closed to fully open position and reverse under no-flow condition.
2. Leakage Tests:
a. Test each valve for leaks while valve is in closed position.
b. Test valves at rated pressures. During test, valves shall be drip-tight. Test duration shall be at least five minutes for valves up to 20-inch diameter and ten minutes for valves larger than 20-inch diameter. Tests shall be repeated successfully with pressure in the unseating direction.
3. Hydrostatic Test: Test valves to an internal hydrostatic pressure equivalent to twice rated pressure of valve. During hydrostatic test, there shall be no leakage through metal, end joints, and shaft seal, nor shall any part be permanently deformed. Duration of hydrostatic test shall be sufficient to allow visual examination for leakage. Test duration shall be at least one minute for valves eight-inch diameter and smaller, three minutes for valves 10-inch through 20-inch diameter, and ten minutes for valves 24-inch diameter and larger.

F. Gear Actuators for Manually-operated Valves:
1. Provide gear actuators on buried and exposed valves, except valves four-inch diameter and smaller located less than five feet above operating floor. Gas service valves shall be provided with worm gear actuators.
2. Size gear actuators for valves eight-inch diameter and smaller for 175 psig differential pressure.
3. Provide actuators capable of holding associated valves in any intermediate position without creeping or vibrating.
4. Provide valve position indicator on each actuator. Provide stop-limiting devices for open and closed position. For buried and submerged service actuators, provide position indicators in valve box.
5. Provide adjustable stop to adjust seating pressure.
6. Make packing accessible for adjustment without requiring removal of actuator from valve, except for valves in buried and submerged service.

7. Diameter ratio of handwheel or chainwheel and gear sector shall be less than two.
8. For buried and submerged valves, gear actuator shall be grease-packed and designed to withstand submersion, and shall be drip-tight in water 20 feet deep, with self-adjusting packing.
9. Provide each actuator with gearing totally enclosed.
10. Operator shaft and gear sector shall be supported on permanently lubricated bronze or stainless steel bearings.
11. Provide metal-encased spring loaded seals in top and bottom covers of gear housing.
12. Actuators shall be provided to produce indicated torque with maximum pull of 40 pounds on handwheel or chainwheel and maximum input of 150-foot pounds on operating nuts, for both seating and unseating heads equal to maximum differential pressure rating of valve.
13. Actuator components between input and stops shall be designed to withstand, without damage, a pull of 200 pounds for handwheel or chainwheel actuators and input torque of 300-foot pound for operating nuts when operating against stops.
14. Materials of Construction:
    a. Housing: Cast-iron, ASTM A126 Class B.
    b. Gear Sector: Cast-iron ASTM A126 Class B, or ductile iron ASTM A536.
    c. Worm Shaft: Steel, AISI 1144, hardened and tempered to an average Rc 40 and within range of Rc 35-45.
    d. Bearings: Bronze oil-impregnated, or stainless steel.
    e. Hardware, including bolts, nuts, washers, set screws, and pins, shall be Type 316 stainless steel.

2.4 BUTTERFLY VALVES

A. Manufacturers: Provide products of one of the following:
   1. DeZurik.
   2 Henry Pratt Company.
   3. Or equal.

B. General:
   1. Provide butterfly valves conforming to AWWA C504 and as specified herein.
   2. Sizes:
      a. Flanged: Four-inch through 72-inch diameter.
      b. Mechanical Joint: Four-inch through 48-inch diameter.
   3. Rated Working Pressure: 150 psig, Class 150B.
   4. Maximum Fluid Temperature: 150 degrees F.
   5. Valves shall provide drip-tight bi-directional shutoff at rated pressures.
   6. Mount valve seats in valve body. Rubber seats for 24-inch diameter and larger valves shall be replaceable in the field.

7. Valves shall be capable of being maintained in open or partially open position for manual operation, and for automatic operation. When valve disc is maintained, there shall be no chatter or vibration of disc or operating mechanism.
8. Valve packing shall be replaceable without dismantling valve.
9. Disc shall be offset from shaft to provide uninterrupted 360-degree seat seal.

C. Materials of Construction: Materials of construction shall conform to AWWA C504 and shall be as follows:
1. Body: Cast-iron, ductile iron, or alloy cast-iron.
2. Shaft: Type 316 stainless steel.
3. Discs:
   a. Valves Smaller than 30-inch Diameter: Cast-iron.
   b. Valves 30-inch Diameter and Larger: Ductile iron.
4. Seats: Buna-N or other synthetic rubber suitable for the application.
5. Seating Surfaces: Type 316 stainless steel.
6. Bearings:
   a. Valves Smaller than 24-inch Diameter: Nylon.
   b. Valves 24-inch Diameter and Larger: Fiberglass with Teflon lining.
7. Shaft Seals: Externally adjustable, material same as for seats. For services that are either buried or submerged, self-adjusting V-type chevron, material same as for seats.
8. Tapered Pins for Attachment of Shaft to Disc: Type 316 stainless steel.
9. Internal and external bolting and other hardware; including pins, set screws, studs, bolts, nuts, and washers shall be Type 316 stainless steel.

D. Interior Coating:
1. Valves shall be coated inside. Steel, cast-iron, and ductile iron surfaces, except machined surfaces, shall be epoxy-coated in accordance with AWWA C550.

E. Testing:
1. Test each valve in the manufacturer's shop in accordance with AWWA C504.

F. Gear Actuators for Manual Valves:
1. Provide gear actuators conforming to AWWA C540.
2. Gear actuators for valves 20-inch diameter and smaller shall be constructed for 150 psi differential pressure and 4 feet per second port velocity.
3. Gear actuators for valves 24-inch diameter and larger shall be constructed for maximum differential pressures and velocities as specified below:
   a. Maximum Differential Pressure Across Closed Valve: 100 psi.
   b. Maximum Port Velocity through Full Open Valve: 4 fps.

2.5 AUTOMATIC PRESSURE REDUCING VALVES

A. Manufacturers: Provide products of one of the following:
   1. G.A. Industries, Inc.
   2. Or equal.

B. General:
   1. Application: Reduce higher, fluctuating upstream pressure to a lower, steady, downstream pressure within specified range of flow variations.
   2. Rated Working Pressure:
      a. Smaller than 12-inch Diameter: 250 psig.
      b. 14-inch through 36-inch Diameter: 250 psig.
   3. Sizing Data:
      a. Maximum Flow Rate: 150 gpm.
      b. Minimum Flow Rate: 15 gpm.
      c. Maximum Upstream Pressure: 75 psig.
      d. Minimum Upstream Pressure: 30 psig.
      e. Setpoint Downstream Pressure: 90 psig.
      f. Setpoint downstream pressure shall be field-adjustable over range of near-zero to 110 percent.
   4. Valves shall not suffer cavitation damage within five-year period from date of Substantial Completion when exposed to specified operating conditions.

C. Valve Construction:
   1. Type: Pilot-operated globe or angle-style valves as shown.
   2. Valves shall include one-piece piston and full-stroke length liner. Seating shall include replaceable resilient seat ring mounted on underside of piston and metal seat integral with liner or attached to valve body.
   3. Provide V-ports for pressure control at low flows.
   4. Flow area shall be equal to nominal pipe area when valve is fully open.
   5. Valves shall provide drip-tight shut-off at rated pressure when closed.
   6. Provide removable flanged cover to access valve's internals.
   7. Provide indicator rod attached to piston for visual position indication of piston.
   8. Pilot control piping shall include the following minimum items:
      a. Needle valve for field adjustment of closing speed.
      b. Pilot valve to adjust required setpoint downstream pressure.
      c. Wye strainer with valved blow-off connection.
      d. Isolation valves.

D. Materials of Construction:
   1. Body: Cast-iron, ASTM A126 Class B, or ductile iron, ASTM A536.
   2. Piston, Liner, Seat Crown, Indicator Rod and Hardware, Vent Tube and Glands: Bronze, ASTM B62.
   3. Flexible Items: Nylon reinforced Buna-N, leather or other synthetic rubber suitable for the application.

4. Internal and external bolting and other hardware; including pins, set screws, studs, bolts, nuts, and washers: Type 316 stainless steel.
5. Packing: Teflon.
6. Control Piping Components (including piping, tubing, fittings, valves, and wye strainer): Brass or bronze with stainless steel wetted trim. Small valves shall conform to Section 40 05 56.

E. Interior Coating:
1. Valves shall be coated inside. Steel, cast-iron and ductile iron surfaces shall be epoxy coated in accordance with AWWA C550.

F. Testing:
1. Test each assembled valve, except control piping, hydrostatically at 1.5 times rated working pressure of valve for minimum of five minutes per valve.
2. Test each valve for leakage at rated working pressure against closed valve. Test duration shall be minimum 15 minutes and allowable leakage shall be zero.
3. Perform functional test on each valve to verify proper operation at specified performance.

2.6 APPURTENANCES FOR EXPOSED METALLIC VALVES

A. General:
1. For valves located less than five feet above operating floor, provide levers on four-inch diameter quarter-turn valves, and provide handwheels on all other valves, unless otherwise shown or specified.
2. For valves located five feet or more above operating floor, provide chain operators.
3. Where indicated, provide extension stems and floorstands.

B. Handwheels:
1. Conform to applicable AWWA standards.
2. Material of Construction: Ductile iron, or cast aluminum.
3. Arrow indicating direction of opening and word “OPEN” shall be cast on trim of handwheel.
4. Maximum Handwheel Diameter: 2.5 feet.

C. Chain Operators:
1. Chains shall extend to three feet above operating floor.
2. Provide 1/2-inch stainless steel hook bolt to keep chain out of walking area.
3. Materials of Construction:
   a. Chain: Type 316L stainless steel.
   b. Chainwheel: Recessed groove type made out of Type 316 stainless steel.
   c. Guards and Guides: Type 316L stainless steel.

4. Chain Construction:
    a. Chain shall be of welded link type with smooth finish. Chain that is crimped or has links with exposed ends is unacceptable.
5. Provide geared operators where required to position chainwheels in vertical position.

2.7 ANCHORAGES AND MOUNTING HARDWARE

A. General:
1. Comply with Section 05 05 33, Anchor Systems, except as modified in this Section.
2. Obtain bolts, nuts, and washers for connection of valve and appurtenances to concrete structure or other structural members from valve Supplier.
3. Bolts, nuts, and washers shall be of ample size and strength for purpose intended. Anchorages in concrete shall be at least 5/8-inch diameter.
4. Provide stem guide anchorages of required strength to prevent twisting and sagging of guides under load.
5. Materials: Provide bolts and washers of Type 316 stainless steel and nitrided nuts. Bolts shall have rolled threads. Bolts and nuts shall be electropolished to remove burrs.

2.8 TOOLS, LUBRICANTS, AND SPARE PARTS

A. Lubricants: For valves, actuators, and appurtenances requiring lubricants, provide suitable lubricants for initial operation and for first year of use following Substantial Completion. Lubricants for equipment associated with conveying potable water or water that will be treated to become potable shall be food-grade and ANSI/NSF 61-listed.

B. Tools, spare parts, and maintenance materials shall conform with Section 01 78 43, Spare Parts and Extra Materials.

2.9 PAINTING OF EXPOSED VALVES, HYDRANTS, AND APPURTENANCES

A. Exterior steel, cast-iron, and ductile iron surfaces, except machined surfaces of exposed valves and appurtenances, shall be finish painted in manufacturer's shop. Surface preparation, priming, finish painting, and field touch-up painting shall conform to Section 09 91 00, Painting.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine conditions under which materials and equipment are to be installed and notify ENGINEER in writing of conditions detrimental to proper and timely

completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General:
   1. Install valves and appurtenances in accordance with:
      a. Supplier's instructions and the Contract Documents.
      b. Requirements of applicable AWWA standards.
      c. Applicable requirements of Section 40 05 05, Exposed Piping Installation.
   2. Install valves plumb and level. Install all valves to be free from distortion and strain caused by misaligned piping, equipment, and other causes.
   3. Position swing check valves and butterfly valves so that, when valve is fully open, valve disc does not conflict with piping system elements upstream and downstream of valve.

B. Exposed Valves:
   1. Provide supports for large or heavy valves and appurtenances as shown or required to prevent strain on adjoining piping.
   2. Operators:
      a. Install valves so that operating handwheels or levers can be conveniently turned from operating floor without interfering with access to other valves, piping, structure, and equipment, and as approved by ENGINEER.
      b. Avoid placing operators at angles to floors or walls.
      c. Orient chain operators out of way of walking areas.
      d. Install valves so that indicator arrows are visible from floor level.
      e. For motor-operated valves located lower than five feet above operating floor, orient motor actuator to allow convenient access to pushbuttons and handwheel.
   3. Floor Stands and Stems:
      a. Install floor stands as shown and as recommended by manufacturer.
      b. Provide lateral restraints for extension bonnets and extension stems as shown and as recommended by manufacturer.
      c. Provide sleeves where operating stems pass through floor. Extend sleeves two inches above floor.

C. Plug Valves:
   1. Install plug valves that are in horizontal liquid piping with stem horizontal and plugs on top when valve is open. Plug shall be on upstream end when valve is closed.
   2. Install plug valves that are in vertical liquid piping with plug at top when closed or as recommended by valve Supplier.
   3. Supplier shall tag or mark plug valves to indicate proper mounting position.

3.3 FIELD QUALITY CONTROL

A. Field Tests:
   1. Adjust all parts and components as required to provide correct operation of valves.
   2. Conduct functional field test on each valve in presence of ENGINEER to demonstrate that each valve operates correctly.
   3. Verify satisfactory operation and controls of motor operated valves.
   4. Demonstrate satisfactory opening and closing of valves at specified criteria requiring not more than 40 pounds effort on manual actuators.
   5. Test ten percent of valves of each type by applying 200 pounds effort on manual operators. There shall be no damage to gear actuator or valve.

3.4 SUPPLEMENTS

A. The supplements listed below, following "End of Section" designation, are a part of this Specification Section:
   1. Table 40 05 53-A, Schedule of Valves Greater Than 4-Inches.

+ + END OF SECTION + +

SECTION 40 05 56

PROCESS VALVES, SMALLER THAN FOUR-INCH DIAMETER

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install process valves, smaller than four-inch diameter, and appurtenances, complete and operational.
   2. This Section does not include valves used for:
      a. Heating and ventilating.
      b. Instrumentation.
      c. Gases.
   3. This Section does not include:
      a. Valves specified in other Sections.
      b. Valves furnished with equipment.
      c. Air and vacuum valves.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate installation of items that must be installed with or before process valves Work.
   2. Notify other contractors in advance of the installation of process valves and appurtenances to provide them with sufficient time for installing items included in their contracts that must be installed with or before process valves Work.

C. Related Sections:
   1. Section 40 05 05, Exposed Piping Installation.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:
   1. ASTM D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.

1.3 QUALITY ASSURANCE

A. Manufacturer’s Qualifications:
   1. Manufacturer shall be able to provide evidence of at least five installations of substantially similar valves in satisfactory operation for at least five years.

B. Component Supply and Compatibility:
   1. Valves of the same type shall be the products of a single manufacturer.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Product Data:
      a. Product data sheets.
      b. Complete catalog information, including dimensions, weight, specifications, and identification of materials of construction of all parts.

B. Informational Submittals: Submit the following:
   1. Certifications:
      a. Submit a certificate signed by the manufacturer of each product stating that the product conforms to the applicable referenced standards.

1.5 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling, and Unloading:
   1. Deliver materials and equipment to Site to ensure uninterrupted progress of the Work. Deliver anchorage products that are to be embedded in concrete in ample time to prevent delaying the Work.
   2. Inspect boxes, crates, and packages upon delivery to Site and notify ENGINEER in writing of loss or damage to materials and equipment. Promptly remedy loss and damage to new condition in accordance with manufacturer's instructions.
   3. Conform to Section 01 65 00, Product Delivery Requirements.

B. Storage and Protection:
   1. Keep products off ground using pallets, platforms, or other supports. Store equipment in covered storage and prevent condensation and damage by extreme temperatures. Store in accordance with manufacturer's recommendations. Protect steel, packaged materials, and electronics from corrosion and deterioration.
   2. Conform to Section 01 66 00, Product Storage and Handling Requirements.

PART 2 – PRODUCTS

2.1 GENERAL

A. Valves, General:
   1. Provide each valve with manufacturer's name and rated pressure cast in raised letters on valve body.
   2. Provide valves to turn clockwise to close, unless otherwise specified.
   3. Provide valves with permanent markings for direction to open.

B. Valve Materials:
   1. Valve materials shall be suitable for the associated valve's service or application, as shown.
   2. Protect wetted parts from galvanic corrosion caused by contact of different metals.

C. Actuators for Exposed Valves:
   1. Manual actuators:
      a. Unless otherwise shown or specified provide lever actuators for quarter turn valves not equipped with gear drives and hand wheels for all other valves.
      b. Provide accessories (special features) which may include locking devices and limit switches where shown or specified.

2.2 VALVES

A. Ball Valves for Plant Effluent Water Service:
   1. Size: 1/2- to 3-inch diameter (nominal)
   2. Manufacturers:
      a. Apollo of Conbraco Industries, Inc.
      b. Stockham Valves and Fitting Company.
      c. Spirax Sarco, Inc.
      d. Or equal.
   3. Type: Two-piece body with standard port opening.
   4. Construction:
      a. Body: Brass.
      b. Ball: Brass with hard chrome-plated finish.
      c. Stem: Brass.
      d. Stem Packing: PTFE.
      e. O-Rings: Viton.
      f. Seats: PTFE.
   5. Ball valves shall be non-blowout stem design.
   6. Minimum Working Pressure: 150 psig.
   7. End Connections: Refer to Section 40 05 05, Exposed Piping Installation.
   8. Electric actuators: See Paragraph 2.2F of this Section.

B. Ball Valves for Sludge Blow-Off, Sample and Drain Service:
   1. Size: 3/4- to 2-inch diameter (nominal)
   2. Manufacturers:
      a. Apollo of Conbraco Industries, Inc.
      b. Stockham Valves and Fitting Company.
      c. Spirax Sarco, Inc.
      d. Or equal.
   3. Type: Two-piece body with full port opening.
   4. Construction:
      a. Body: Type 316 stainless steel.

b. Ball: Type 316 stainless steel.
c. Stem: Type 316 stainless steel.
d. Seat and Stem Seals: PTFE or Reinforced PTFE.

5. Ball valves shall be non-blowout stem design.
6. Minimum Working Pressure: 200 psig.
7. End Connections: Refer to Section 40 05 05, Exposed Piping Installation.

C. Ball Valves for Polymer Service:
1. Size: 1/2- to 2-inch diameter (nominal)
2. Manufacturers:
a. Hayward Manufacturing Company.
b. Chemtrol/Nibco Incorporated.
c. Or equal.
3. Ball valves shall be manufactured of polyvinyl chloride (PVC) material with Teflon seats and Viton seals.
4. PVC shall be Type 1, Grade 1 in accordance with ASTM D1784, and shall be dark gray in color.
5. Valve shall be either flanged or furnished with socket ends with either rated for 150 psi service.

D. Check Valves Polymer Service:
1. Size: 1- to 2-inch diameter (nominal).
2. Manufacturers:
a. TC Series, by Hayward Manufacturing Company.
b. Chemtrol/Nibco Incorporated.
c. Or equal.
3. Check valves shall be manufactured of polyvinyl chloride (PVC) material with EPDM seats.
4. PVC shall be Type 1, Grade 1 in accordance with ASTM D1784, and shall be dark gray in color.
5. Valve shall be either flanged or furnished with socket ends with either rated for 150 psi service.

E. Solenoid Valves:
1. Size: 1/2- to 3/4-inch diameter (nominal).
2. Manufacturers:
a. Automatic Switch Company.
b. Or equal.
3. Solenoid valves where shown or required shall be of packless construction with screwed ends and a threaded conduit connection.
4. Parts in contact with the fluid being handled shall be stainless steel.
5. Enclosure shall be NEMA 4X.
6. Coils shall be rated for continuous duty, and shall be completed encapsulated in epoxy resin.
7. Solids valves shall be suitable for operation on 120 volt, 60 Hz., single phase power.
8. Solenoid valves shall not be piloted.

F. Electric-Actuators (Open/Close Service):
   1. Size: 1-inch and 3-inch diameter (nominal).
   2. Quantity: 6 (3 for each valve size).
   3. General Features:
      a. Self contained unit with drive motor, gear train, limit switches and declutchable manual override.
      b. Torque Rating: 1.25 times the maximum required torque suggested by the manufacturer based on valve size, shaft size, bearing friction, type of seat and seat material, shut-off pressure, velocity, and valve operation in 32-degrees Fahrenheit water.
      c. Gearing capable of opening or closing valve from one extreme to the other in not less than 10 seconds nor more than 30 seconds.
      d. Internal limit switches to prevent overtravel. Limit switches shall also be capable of providing remote position indication.
      e. 90 degree turn reversible motor with thermal overload protection
      f. Visual position indicator.
      g. Auxiliary Limit Switches for Remote Position Indication: 2 SPDT required; 1 for open and 1 for closed.
      h. Declutchable manual override to disengage motor and gearing mechanically.
      i. Enclosure shall be suitable for installation in the specified area classification as specified in Section 26 05 05, General Provisions for Electrical Systems.
   4. Electrical Features:
      a. Coordinate interfacing of the motor operators with instrumentation and control Work specified in Division 40, Process Integration, in Division 26, Electrical, and as shown on the Drawings.
      b. Electrical Characteristics:
         1) Power Supply: 120 volt, single phase, 60 Hz.
         2) Control Power: 120 volt, single phase, 60 Hz.
      c. Motor Duty Rating: 75% duty cycle at 10 seconds.
      d. Integral reversing capacitor-run motor.
      e. 115 volt space heater in control enclosure to maintain control devices at 40-degrees Fahrenheit. Connect space heater to control circuitry.
      f. Local Controls:
         1) Refer to the Instrumentation Drawings and the Electrical Drawings for specific control and electrical requirements for each motor operated valve.
   5. Supports:
      a. If the valve is mounted in such a position that the actuator is not directly above the valve, the Contractor shall provide stainless steel floor stands or knee braces to support the actuator as recommended by the manufacturer.
   6. Suppliers:
      a. Asahi/America, Series 92 Quarter Master Model A-92.
      b. George Fischer, Model EA-120.

c. Or equal.

PART 3 – EXECUTION

3.1 INSPECTION

A. Examine conditions under which materials and equipment are to be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General:
   1. Install valves and appurtenances in accordance with:
      a. Supplier's instructions and the Contract Documents.
      b. Requirements of applicable AWWA standards.
      c. Applicable requirements of Section 40 05 05, Exposed Piping Installation.
   2. Install valves plumb and level. Install all valves to be free from distortion and strain caused by misaligned piping, equipment, and other causes.

B. Exposed Valves:
   1. Provide supports for large or heavy valves and appurtenances as shown or required to prevent strain on adjoining piping.
   2. Operators:
      a. Install valves so that operating levers can be conveniently turned from operating floor without interfering with access to other valves, piping, structure, and equipment, and as approved by ENGINEER.
      b. Avoid placing operators at angles to floors or walls.
      c. Install valves so that indicator arrows are visible from floor level.

3.3 FIELD QUALITY CONTROL

A. Field Tests:
   1. Adjust all parts and components as required to provide correct operation of valves.
   2. Conduct functional field test on each valve in presence of ENGINEER to demonstrate that each valve operates correctly.
   3. Verify satisfactory operation and controls of motor operated valves.
   4. Demonstrate satisfactory opening and closing of valves.

+ + END OF SECTION + +

SECTION 40 05 93

COMMON MOTOR REQUIREMENTS FOR PROCESS EQUIPMENT

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Electric motors and accessories to be furnished under other equipment Sections shall comply with this Section, unless specified otherwise in the Section for the associated driven equipment.
   2. Motor horsepower and voltage ratings, speed, enclosure type, and unusual service conditions (such as ambient temperatures above 40 degrees C, corrosive areas requiring severe duty motors, and variable frequency drive applications requiring inverter duty motors), and requirements for witnessing shop tests shall be as specified in the Sections for the associated driven equipment. Specific accessories and construction features may also be required by the Sections on the associated driven equipment.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. ASTM A48/A48M, Specification for Gray Iron Castings.
   2. IEEE 112, Test Procedure for Polyphase Induction Motors and Generators.
   3. IEEE 522, Guide for Testing Turn-to-Turn Insulation on Form-Wound Stator Coils for Alternating Current Electric Machines.
   4. IEEE 841, Petroleum and Chemical Industry - Premium-Efficiency, Severe-Duty, Totally Enclosed Fan-Cooled (TEFC) Squirrel Cage Induction Motors – Up to and Including 370 KW (500 HP).
   5. IEEE 1043, Recommended Practice for Voltage Endurance Testing of Form-Wound Bars and Coils.
   6. NEMA MG 1, Motors and Generators. (This Section's references to NEMA MG 1 followed by a hyphen and number, such as "NEMA MG 1-20.14", indicate the associated NEMA MG 1 paragraph reference.)
   7. ANSI/NETA ATS, Acceptance Testing Specifications for Electrical Power Equipment and Systems.
   8. UL 674, Electric Motors and Generators, for Use in Division 1 Hazardous (Classified) Locations.
   9. UL 1004, Electric Motors.

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer:
      a. Manufacturer shall have not less than five years experience producing equipment substantially similar to that required and shall be able to submit documentation of at least five installations in satisfactory operation for at least five years each.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Data sheets indicating nameplate data for fractional-horsepower motors.
      b. Outline drawing or data sheet indicating complete motor dimensions for motors rated greater than 1/3-hp. Several motors of the same type and rating for the same application may be covered by an appropriate single drawing or data sheet. Drawings and data sheets shall have complete identifying data including frame size, speed, horsepower ratings, and application for each particular motor.
      c. Details of motor heaters, winding thermal protection, and other accessories.
      d. Copies of motor characteristic curves and data inputs when required for programming motor protection and management relays.
   2. Product Data:
      a. Submit motor test data sheets for each motor rated one horsepower or greater. Values indicated on test data sheets shall be from tests of a previously manufactured, electrically duplicate motor or calculated data. Mark each test data sheet to indicate the Project motor application location, manufacturer, type, frame size, horsepower, voltage, speed, bearing type, lubrication medium and enclosure type. Test data sheet shall also include:
         1) Winding resistances.
         2) Torques.
         3) Efficiencies.
         4) Power factors.
         5) Slip.
         6) Full load amperes.
         7) Locked rotor and no load amperes.
         8) Nameplate temperature and results of dielectric tests.
   3. Testing Plans and Procedures:
      a. When witnessed source quality control testing is required in the Section for associated driven equipment, submit description of proposed shop testing methods, procedures, and testing apparatus with calibration dates, together with proposed testing schedule and proposed travel and logistical plans for testing.

B. Informational Submittals: Submit the following:
   1. Manufacturer's Instructions:
      a. Instructions and recommendations for handling, storing, protecting the motors.
      b. Installation data for motors, including setting drawings, templates, and directions and tolerances for installing anchorage devices.
   2. Source Quality Control Submittals:
      a. Written reports presenting results of required shop testing. Shop test reports shall be dated and signed by motor manufacturer.
      b. When witnessed shop tests are required, shop test results shall be signed by and shall bear the seal of registered professional engineer. Name on seal, registration or license number, and jurisdiction or registration of license shall be legible.
   3. Field Quality Control Submittals:
      a. Written reports presenting results of required field testing and inspections. Field testing reports shall be dated and signed by CONTRACTOR.
   4. Supplier Reports:
      a. Submit written report of results of each visit to Site by Supplier's service personnel, including purpose and time of visit, persons contacted, problems encountered and resolved, tasks performed, results obtained, and other pertinent information. Submit within two days of completion of visit to the Site.
   5. Qualifications Statements:
      a. Submit manufacturer's qualifications data when requested by ENGINEER.

C. Closeout Submittals: Submit the following:
   1. Operation and Maintenance Data:
      a. Furnish operation and maintenance data for motors as part of the operations and maintenance data for the associated driven equipment.
      b. Comply with Section 01 78 23, Operations and Maintenance Data.

D. Maintenance Material Submittals: Submit the following:
   1. Spare Parts and Extra Stock Materials: For each motor size and type, furnish spare parts in accordance with motor manufacturer's recommendations, including the following for three-phase motors:
      a. One set of fans and guards for each set of three or fewer motors, for each size of totally-enclosed fan-cooled motor.
      b. One set of bearing liners, or renewable ball or roller bearings, for each set of three or fewer motors, for each type and size of motor.
      c. One set of oil rings, for each sleeve bearing motor.
      d. One set of bearing temperature detectors, for each set of three or fewer motors, of each type of motor.

1.5 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling, and Unloading:
   1. Ship motors with openings sealed.

B. Storage and Protection:
   1. Protect materials and equipment from corrosion and deterioration.

PART 2 – PRODUCTS

2.1 EQUIPMENT PERFORMANCE

A. Equipment Description:
   1. Comply with motor requirements specified in the Sections for the associated driven equipment.
   2. Motors shall be suitable for continuous operation at an elevation of up to 3,300 feet above mean sea level, at ambient temperatures ranging from -25 degrees C to 40 degrees C, unless specified otherwise in the Section for the associated driven equipment.

2.2 CONSTRUCTION – GENERAL

A. Unless specified otherwise in Sections on the associated driven equipment, motors shall have the following features of construction and operation:
   1. Successfully operate under power supply variations in accordance with NEMA MG 1-14.30 and NEMA MG 1-20.14.
   2. NEMA Design B with torque and starting currents in accordance with NEMA MG 1, except in special high-torque applications, as specified in the Section for the associated driven equipment, which may require NEMA Design C.
   3. Motors shall operate within their full load rating without applying the service factor, unless specified otherwise in Section for the associated driven equipment.
   4. Speed and horsepower specified or required to properly operate the associated driven equipment and torque characteristics required by the drive load and suitable for direct coupling or V-belt drive, as specified in the Section for the associated driven equipment.
   5. Constructed for full-voltage starting.
   6. Fabricated steel or cast-iron frames with integrally cast feet or bases, cast-iron end bells, cast iron or steel conduit boxes and covers and bases with precision machined bearing fits, ASTM A48/A48M, Class 25 or better. For each TEFC motor, provide UL-approved automatic stainless steel breather drains in lowest part of front and back brackets to allow drainage of condensation.
   7. Stator core assembly shall consist of stacked lamination made from specially selected electrical sheet silicon steel.

8. Rotor cages shall be die-cast or fabricated aluminum or fabricated copper or copper alloy. Shafts shall be carbon steel unless specified otherwise in this Section or in the Section on the associated driven equipment.
9. Rotors on frames 213T and larger shall be keyed shrunk or welded to shaft and rotating assembly, dynamically balanced to NEMA limits. Use rivets to secure balance weights, if required, to rotor resistance ring or fan blades. Machine screws and nuts are unacceptable. Coat entire rotating assembly between bearing inner caps with corrosion-resistant epoxy.
10. Bolt and cap screws shall be high-strength, SAE Grade 5 zinc-plated and chromatic steel. Screwdriver slot fasteners are unacceptable.
11. Motors shall be shop-painted at the motor fabrication facility. Finish coat shall be the same color as the associated driven equipment. Final paint finish shall be corrosive resistant and capable of passing ASTM B117 250-hour salt spray test. Motors that will be located outdoors shall have coating resistant to degradation or chalking in sunlight.

2.3 SINGLE-PHASE AC MOTORS

A. Motors shall be rated 115-, 200-, or 230-volt, 60 Hertz.

B. Bearings shall be grease-lubricated ball type with grease fittings or with lubrication for 10 years of normal operation.

C. Motors shall be totally enclosed except fractional-horsepower motors may be open type if motor is suitably protected from moisture, dripping water, and airborne particulates accumulation. Motor features shall be in accordance with the following:
   1. Open motors shall be split-phase or capacitor start in accordance with torque requirements, with service factor of not less than 1.25, 40 degrees C ambient rating, and Class B insulation.
   2. Enclosed motors shall be capacitor start, with service factor of not less than 1.15, 40 degrees C ambient rating, and Class F insulation. Motors shall be fan-cooled or non-ventilated.
   3. Severe duty type motors shall be designed to withstand chemical corrosion and equipped with cast iron end shields, neoprene gaskets, stainless steel shaft, heavy pressed steel fan cover and provision for threaded conduit connection.
   4. Provide direct drive fan motors with conduit fittings and leads to allow external connection.
   5. Explosion-proof motors shall comply with UL 674.

2.4 THREE-PHASE AC MOTORS

A. General: Unless specified otherwise in the Sections for the associated driven equipment, provide three-phase motors with the following features:
   1. Premium, energy-efficient construction complying with NEMA MG 1.
   2. Motor efficiency determined in accordance with NEMA MG 1-12.58.

3. Minimum and nominal full-load efficiencies not less than those listed in: NEMA MG 1 Table 12-12 for motors rated 600 volts and smaller, and NEMA MG 1 Table 12-13 for motors rated larger than 600 volts and equal to or less than 5,000 volts.
4. Motors shall be constructed for operation on three-phase, 60 Hertz, alternating current system. Motor voltage and variable frequency operation, where required, shall be as specified in the Sections for the associated driven equipment. Voltage ratings shall be 200 volts for operation on 208-volt systems, 230 volts for 240-volt systems, 460 volts for 480-volt systems, 2300 volts for 2400-volt systems, and 4000 volts for 4160-volt systems.
5. Unless otherwise required by the load, motors shall be NEMA Design B, normal starting torque. Locked rotor KVA/HP shall not exceed NEMA Code Letter G for motors 20 hp and larger.
6. Motor frame shall be a rigid structure, constructed to maintain the lamination in correct alignment, and shall not depend on lamination or bolts for rigidity.
7. Severe-duty totally-enclosed motors shall comply with IEEE 841.

B. Bearings:
1. Provide horizontal motors with rolling element (anti-friction) or sliding element (sleeve) type bearings. Use anti-friction type bearings for NEMA frame motors. Use sleeve type bearings when specified in the Section for the associated driven equipment.
2. Insulate the bearings for motors larger than 200 hp and for inverter-duty motors 100 hp and larger, to prevent shaft currents and related bearing damage.
3. Bearings for open drip-proof, TEFC, and explosion-proof motors shall be grease lubricated, ball type, unless specified otherwise in the Section for the associated driven equipment. Bearings shall have inlet fittings and outlet plugs. Protect bearings and grease reservoirs from entry of contaminants. Provide suitable fittings to allow convenient positive purging of old grease during re-greasing.
4. For horizontal motors with ratings up to and including 500 hp, or for motors with speeds up to and including 3600 rpm, and where both conditions apply, anti-friction bearings furnished shall have a minimum L-10 bearing life of 100,000 hours, as defined by the ABMA, for direct-connected motors, and L-10 bearing life of 50,000 hours for belted motors.
5. Sleeve bearings shall be ring-oiled with adequate, integral self-cooled oil reservoir. Bearing sleeves shall be lined with high tin content babbitt to minimize oil contamination. Close running shaft seals shall prevent oil leakage as well as prevent entrance of foreign material such as water and dirt into the bearing area. Provide oil level sight gauges with permanently-marked easily-discernible oil level. Provide inspection openings to observe the oil rings.
6. When specified in Section for the associated driven equipment or required by motor speed and bearing size, provision shall be made for forced lubrication. Provide oil rings and an adequate oil reservoir in bearing housings to allow orderly shutdown of motor in the event of failure of forced feed lubrication system.

7. Provide vertical motors with thrust bearings adequate for all thrusts to which motor can be subjected. Rated minimum L-10 life of the thrust bearings shall be at least 15,000 hours when operated at rated speed and full load thrust. Manufacturers of the associated driven equipment shall furnish motor manufacturer with speed and thrust conditions required by the associated driven equipment.

C. Insulation:
   1. Insulation systems shall be rated Class F, with a service factor of 1.15 times motor's nameplate horsepower rating when operated on a sine wave power supply, and a service factor of 1.00 on an adjustable frequency power supply. Temperature rise shall be limited to Class B insulation system when motor is operated continuously at rated horsepower with ambient temperature not exceeding 40 degrees C, unless specified otherwise in the Section for the associated driven equipment.
   2. Windings shall be epoxy-coated. Treat windings with insulating compound suitable for protecting against moisture, salt air, and slightly acidic and alkaline conditions. Insulation system for enclosed motors shall be upgraded to increase moisture resistance.
   3. Motors for outdoor service and all motors larger than 200 hp shall have vacuum/pressure-impregnated epoxy insulation (VPI) for moisture resistance. Motors shall be preheated before VPI and baked in temperature-controlled oven.
   4. Stator windings and end turn connections shall be fully brazed to withstand full voltage starting, regardless of the starting method indicated in the Section for the associated driven equipment. Bracing system shall essentially eliminate coil vibration under the high-current conditions of starting as well as during normal operation. When a tied system is used, system shall be such that no tie depends on the integrity of another tie within the system.
   5. Motors larger than 200 hp shall be form wound. Form wound coils with micaceous ground wall insulation shall have additional insulation and hot-pressed to provide sealed system. Complete stator shall be vacuum/ pressure-impregnated.

D. Enclosures:
   1. Motor enclosure type shall be as specified in the Section for the associated driven equipment. Enclosure types shall comply with the following:
      a. Open Drip Proof: Motors shall have a steel or cast-iron frame, cast-iron end brackets, and steel conduit box. Provide vertical motors of the open type with drip hoods. When the drip hood is too heavy to be easily removed, provide access for testing. Provide stainless steel corrosion-resistant screens over air openings in accordance with NEMA requirements for guarded machines.
      b. Weather Protected Type I and Type II: Weather-protected motor shall be an open drip proof guarded machine with ventilating passages constructed to minimize entrance of rain, snow, and airborne particles to motor's

electric parts complying with NEMA MG 1-1.25.8

c. Totally enclosed fan cooled and non-ventilated motors shall have cast-iron frame, cast-iron end brackets, and cast-iron conduit box. Provide drain holes on each end of motor.

d. Explosion-proof motors shall comply with NEMA MG 1-1.26.10 and UL 674.

2. Motor conduit box shall be split from top to bottom, shall be capable of being rotated to four positions 90 degrees apart, and shall comply with the following:

a. Box shall be gasketed with rubber-like gaskets between frame and conduit box and between conduit box and conduit box cover.

b. Provide box or opening in motor housing with conduit hub type fitting to allow threaded conduit connections.

c. Box sizes shall be in accordance with code requirements and shall accommodate medium-voltage terminations or stress cones, when required.

d. Protective and auxiliary devices shall terminate in auxiliary conduit boxes.

e. Terminal leads shall be flexible and of sufficient length to extend for distance of not less than ten inches beyond face of terminal box. Terminal leads shall be fitted with solderless lugs suitable for attachment to lugs installed on external wiring. Leads shall be sealed with non-wicking, non-hygroscopic insulating material, or insulating "wrap-cap" as manufactured by Ideal Industries, or equal.

f. Provisions for terminal box size, length of leads, size of conduit openings, and type of terminal lugs shall be complied with irrespective of other standards or practice.

g. Provide motor frame grounding stud inside conduit box. Stud shall include a drilled and tapped hole.

E. Motors for Use with Variable Frequency Drives:

1. Motors shall be compatible with characteristics of the intended variable frequency inverters.

2. Motors shall comply with the performance standards of NEMA MG 1-31.

F. Vertical Motors:

1. Vertical motors shall have Type P base specifically constructed for vertical installation. Universal position motors are unacceptable.

2. Vertical motors shall have solid shafts, unless otherwise specified in Section for the associated driven equipment.

G. Lifting Eyes: Motors weighing more than 50 pounds shall include at least one lifting eye or lifting lug. Construct motor and lifting eyes or lifting lugs to bear motor's full weight.

2.5 ACCESSORIES

A. General:
   1. Provide motor accessories in accordance with this Section unless specified otherwise in the Section for the associated driven equipment.
   2. Provide space heaters in motors five horsepower and larger installed outdoors, and in enclosed motors five horsepower and larger installed indoors in unheated spaces.
   3. Provide thermostat type winding thermal protection for motors in accordance with the following:
      a. Variable speed motors up to and including 25 hp.
      b. Constant speed motors when specified in Section for the associated driven equipment.
   4. Provide thermistor type winding thermal protection for motors in accordance with the following:
      a. Constant speed motors 50 hp and larger up to and including 200 hp.
      b. Variable speed motors 30 hp and larger up to and including 200 hp.
   5. Provide resistance temperature detector (RTD) type winding thermal protection for all motors larger than 200 hp.
   6. Provide stator and bearing temperature detectors for each motor 250 hp and larger.

B. Space Heaters:
   1. Space heaters for condensation prevention shall operate at 120 volts and shall be sized to provide approximately 10 degrees C temperature rise above ambient.
   2. Heaters shall be low-density type for low surface temperature and long life.

C. Winding Thermal Protection:
   1. Thermostats shall be bi-metal disk or rod type embedded in the stator windings. Thermostat contacts shall be normally-closed, automatic-reset type, rated 120 vac, five amps minimum, opening on excessive temperature. Provide three thermostats, one in each phase, wired to motor junction box.
   2. Thermistors embedded in each stator phase winding shall be in direct contact with the winding conductors. Each thermistor circuit shall be factory-wired to 120-volt solid-state control module mounted at the motor in box rated NEMA 4X. Control module contacts shall be automatic-reset type, rated 120 vac, five amps minimum, opening on excessive temperature. Provide normally-closed isolated contact for motor shutdown.
   3. Resistance temperature detectors (RTD) shall be 100-ohm platinum three-lead type with calibrated resistance-temperature characteristics. Position detectors, two per phase for non-explosion proof motors and one per phase for explosion proof motors, to detect highest winding temperature and located between coil sides in stator slots. Detector leads shall be wired to a separate terminal box.

D. Bearing Temperature Protection: When specified in Section for the associated driven equipment, provide motor bearing temperature detectors, RTD type similar to the winding detectors specified in this Article, on each bearing for horizontal motors and on the thrust bearing for vertical motors.

E. Vibration Protection: When specified in Section for associated driven equipment, provide accommodations for mounting sensors for monitoring bearing or casing vibration.

F. Single-Phase Motors: Single-phase motors requiring auxiliary starting resistors, capacitors or reactors and switching devices shall be provided as combination units with such auxiliaries either incorporated within motor housings or housed in suitable enclosures mounted on motor frames. Each combination unit shall be mounted on a single base and be provided with a single conduit box.

2.6 IDENTIFICATION

A. Nameplates:
   1. Nameplates shall be Type 316 stainless steel with embossed or pre-printed lettering and fastened to the motor frame with Type 316 stainless steel pins.
   2. Nameplates shall have stamped on them the motor manufacturer's name, voltage, number of Hertz and phases, horsepower rating, amperes and temperature rise at rated load, full load speed, locked rotor amperes or code letter, service factor, NEMA nominal efficiency, model number, insulation class, bearing number, serial number and maintenance manual number.
   3. Name plates for explosion proof motors shall indicate the Division, Class and Group of the hazardous location in which the motor is intended for use.
   4. Dual-voltage motor nameplates shall include connection diagrams.
   5. Nameplate markings shall be in accordance with NEMA MG 1-10.

2.7 SOURCE QUALITY CONTROL

A. Shop Tests:
   1. Perform shop testing on the motors at the manufacturer's facility. Shop test shall be in accordance with NEMA MG 1, UL 674, and UL 1004 and shall demonstrate that the motors tested comply with the Contract Documents.
   2. Submit shop test reports identifying tests performed and results obtained.
   3. Motors shall be given Routine Test in accordance with NEMA MG 1-12.55 and IEEE 112. Test shall include the following:
      a. Measurement of winding resistance.
      b. No-load readings of current and speed at normal voltage and frequency.
      c. Current input at rated frequency with rotor at standstill for squirrel-cage motors (locked rotor amperes).
      d. High-potential test.
      e. Bearing inspection.

4. Motors rated 200 hp and larger shall be given a "Complete Test" in accordance with IEEE 112 consisting of a "Routine Test" and a full-load heat run. When "Complete Tests" are required for a group of the same type, rating and horsepower for the same application, each motor of the group shall be given a "Complete Test", unless specified otherwise in the Section for the associated driven equipment. Testing shall document the following:
    a. Percent slip.
    b. No-load speed, voltage, current, and losses at rated frequency.
    c. Full-load current.
    d. Locked-rotor torque.
    e. Locked-rotor current.
    f. Breakdown torque (calculated).
    g. Starting torque (squirrel-cage).
    h. Winding resistance.
    i. Sound pressure level at no-load.
    j. Vibration levels.
    k. Efficiency current, and power factor at 100, 75, and 50 percent of full load and at service factor load.
    l. Stabilized full load temperature rise.
5. Motors with stator windings rated greater than six kV shall have the following additional tests:
    a. Voltage endurance test of the ground-wall insulation system in accordance with IEEE 1043.
    b. Partial discharge testing of the stator coils to insure proper impregnation and clearances. Acceptance criteria shall be based on manufacturer's quality assurance data base.
    c. Voltage surge test on multi-turn stator coils in accordance with IEEE 522.

PART 3 – EXECUTION

3.1 INSTALLATION

A. General:
1. Install motors in accordance with the Contract Documents and manufacturer's instructions and recommendations. Obtain written interpretation from ENGINEER in the event of conflict between manufacturer's instructions and recommendations and the Contract Documents.
2. Install in accordance with Laws and Regulations.
3. Do not modify structures to facilitate installation of motors, unless approved in writing by ENGINEER.
4. Carefully and properly align motors with the driven equipment.
5. Secure motors to mounting surfaces with anchorage devices complying with manufacturer's recommendations that are of sufficient size and quantity to secure motor to equipment.

6. Until start-up and operation, tightly cover and protect motors from dirt, water, and chemical and mechanical damage.

3.2 FIELD QUALITY CONTROL

A. Site Tests:
   1. Inspect motors prior to supplying electricity to (energizing) equipment. Do not energize equipment without ENGINEER's permission. Inspections shall include the following:
      a. Inspect motor and equipment for physical damage.
      b. Inspect motor for proper anchorage, mounting, grounding, connection, and lubrication.
      c. Check for unusual noise and indications of overheating during initial or test operation.
   2. Perform testing at the Site for motors larger than 200 hp, as follows:
      a. Testing shall be witnessed by ENGINEER.
      b. Initial inspections and testing shall include the following:
         1) Electrical and grounding connections.
         2) Shaft alignment, proper mounting and lubrication.
         3) Check ventilating air passageways for blockage.
         4) Excessive noise.
         5) Overheating.
         6) Correct rotation.
         7) Protective detectors operation.
         8) Excessive vibration.
         9) Space heater operation.
      c. Electrical testing shall include the following:
         1) Insulation resistance test.
         2) Surge comparison test.
         3) Vibration test.
         4) Bearing insulation resistance test on insulated bearings.
         5) Running current and voltage measurements and evaluations relative to load conditions over full range of operations and nameplate full-load amperes.
         6) High-potential test.
         7) For wound rotor motors, additional testing at minimum and normal operating load points and at ring short.
         8) Motor operation with the driven equipment for not less than 48 continuous hours per motor, with checks for overheating and vibration during operation.
      d. Tests and values shall be in accordance with motor manufacturer’s recommendations and ANSI/NETA ATS.
      e. Prepare and submit field testing report in accordance with ANSI/NETA ATS.

+ + END OF SECTION + +

SECTION 40 61 13

PROCESS CONTROL SYSTEM GENERAL PROVISIONS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish, install, calibrate, test, start-up and place in satisfactory operation a complete process control system (PCS).
   2. The process instrumentation and control Work includes, but is not limited to, the following:
      a. Panels and panel-mounted instruments and devices.
      b. Field-mounted instruments and devices.
      c. Programmable logic controllers (PLC) and software.
      d. Personal computers and human-machine interface (HMI) software.
      e. Local area network hardware and software.
      f. Uninterruptible power supply.
      g. Field instruments, Ethernet network communication hardware and software required for interfacing various systems to provide a fully-integrated system.

B. PCS shall be modified to monitor, store, display, and log process and equipment operating information; perform various process control functions; and generate various reports.

C. The Contract Documents describe the required PCS and PCS functions and operational requirements.

D. Coordination:
   1. Process Controls:
      a. Modifications of the central computer system, instruments, and controls are part of the Work by instrumentation and controls (I&C) Subcontractor. Programming of control logic and configuration of human machine interface (HMI) software is part of the Work. CONTRACTOR's I&C Subcontractor shall program and configure the Owner's existing software. Functional description of process system and associated equipment is included in Section 40 61 96, Process Control Descriptions.
      b. I&C Subcontractor:
         1) Status Control & Integration
         2) Address: 8555 McCann RD, Kensington, OH.
         3) Phone: 330-223-7022.

c. Some panels and equipment are furnished under other Specification Sections under this Contract. Coordinate with Suppliers of these panels and equipment to provide fully functional system in accordance with the Contract Documents and that interfaces with central computer system.

d. Computer system input/output list identifies inputs and outputs required and is part of this Section. Input/output list is for coordinating signals between equipment provided by other Suppliers and computer system Supplier, and identifying signals to be programmed by CONTRACTOR's configuration Subcontractor. Provide Work for CONTRACTOR-furnished control options not on the input/output list at no additional cost to OWNER.

2. To centralize responsibility, I&C materials and equipment provided under this Contract shall be furnished by a single Supplier.

3. With CONTRACTOR, Supplier shall assume the responsibility for adequacy and performance of materials and equipment provided under this Section.

4. To the greatest extent possible, provide I&C materials and equipment from a single manufacturer.

5. Supplier's Responsibilities:
   a. Preparing all process control equipment submittals in accordance with the Contract Documents.
   b. Proper interfacing of instrumentation and control equipment with field equipment, instruments, devices, and panels, including required interfacing with packaged control systems furnished by other equipment Suppliers, and required interfacing with the Site's electrical system.
   c. Review and coordination with manufacturers, other Suppliers, and other contracts of Shop Drawings and other CONTRACTOR submittals for equipment, valves, piping, and appurtenances for ensuring proper interfacing of hardware, and locations and installation requirements of inline devices and instrument taps.
   d. Direct, detailed oversight of installation of instruments, panels, consoles, cabinets, wiring and other components, and related wiring and piping connections.
   e. Calibrating, source quality control, field quality control, and start-up of the system.
   f. Responsibility for correction period obligations for the PCS.
   g. Training operations and maintenance personnel in operation and maintenance (including calibration and troubleshooting) of the PCS.

6. The Contract Price includes an allowance amount specified in Section 01 21 00, Allowances, to be used for payment to I&C Subcontractor for construction costs incurred for the I&C equipment, programming and configuration of the HMIs and Programable Logic Controllers (PLC) described in this Specification Section and other Division 40 Sections and invoiced to CONTRACTOR relative to work for the Site.
   a. Comply with Section 01 21 00, Allowances, regarding submittal of costs proposed to be paid under the allowance. Do not include in

proposed payment under the allowance CONTRACTOR's cost other than cost invoiced to CONTRACTOR by I&C Subcontractor and CONTRACTOR fee (overhead and profit). Include other costs, if any, under other non-allowance pay items.

b. Include in an Application for Payment costs invoiced to CONTRACTOR by I&C Subcontractor.

c. If costs payable under the allowance exceeds the listed allowance value, OWNER will issue a Change Order to pay CONTRACTOR the extra amount, or will pay CONTRACTOR the extra amount by other means available under the contract.

d. If actual invoiced costs are less than the allowance amount, the Contract Price will be reduced by the difference between cost eligible and recommended by ENGINEER for payment, and the allowance amount via a Change Order.

E. Related Sections:
   1. Section 40 61 96, Process Control Descriptions.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. ANSI/ASQ Z1.4, Sampling Procedures and Tables For Inspection By Attributes.
   2. ISA 5.4, Instrument Loop Diagrams.
   3. ISA 20, Specification Forms for Process Measurement & Control Instruments, Primary Elements & Control Valves.
   4. NFPA 79, Electrical Standard for Industrial Machinery.

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Supplier:
      a. Shall be financially sound with at least five years of continuous experience in designing, implementing, supplying, and supporting process control systems for municipal wastewater treatment facilities comparable to PCS required for the Project, relative to hardware, software, cost, and complexity.
      b. Shall have record of successful process control system equipment installations. Upon ENGINEER's request, submit record of experience for at least five projects, each with the following information: project name, owner name and contact information, name and contact information for contractor, name and contact information for engineer or architect, approximate and contract value of process control systems Work for which Supplier was responsible,
      c. Shall have at time of Bid experienced engineering and technical staff capable of designing, supplying, implementing, and supporting the instrument and control system and complying with submittal and training requirements of the Contract Documents.

d. Shall be capable of training operations and maintenance personnel in PCS applications, and in operating, programming, and maintaining the control system and equipment.
e. Shall have UL-approved panel shop.
f. Supply and support system hardware components and software packages of fully developed and field-proven standardized designs that are not a highly unique, custom, or one-of-a-kind systems.
g. Offer standard courses in general process control applications, programming, and maintenance of the PCS and equipment at a facility specifically utilized for training. Training facility shall have been in operation continuously for the previous two years, minimum.
h. Possess a thorough, working knowledge of wastewater treatment processes and control philosophy in accordance with standard practices of the wastewater treatment industry.
i. Possess and maintain a documented program of failure analysis.

2. Manufacturers:
   a. Manufacturers of instrumentation and control equipment furnished for the PCS shall be experienced producing similar equipment and shall have the following qualifications:
      1) Shall manufacture instrumentation and control system components that are fully-developed, field-proven, and of standardized designs.
      2) Shall have system of traceability of manufactured unit through production and testing in accordance with ANSI/ASQ Z1.4.
      3) Shall have guaranteed availability clause (99.99 percent, minimum for one year) for microprocessor-based components and appurtenances.
      4) Shall have documented product safety policy relevant to materials and equipment proposed for the Work.

B. Component Supply and Compatibility:
   1. PCS components shall be furnished by a single Supplier who shall have responsibility for furnishing a complete and integrated system.
   2. Supplier who shall have responsibility for adequacy and performance of all items furnished.
   3. Supplier shall prepare, or shall review and approve, all Shop Drawings and other submittals for the PCS.

C. Pre-submittal Conference:
   1. Schedule and conduct a pre-submittal conference for the PCS within 60 days after the Contract Times commence running.
   2. Required Attendance for Pre-submittal Conference: CONTRACTOR, I&C Subcontractor, I&C Supplier, and OWNER. Pre-submittal conference will be 2 hours. Conference will be held at Canton WRF unless otherwise acceptable to the entities attending.
   3. Purpose of pre-submittal conference is to review manner in which I&C Subcontractor and I&C Supplier intend to comply with requirements of the Contract Documents relative to PCS submittals before submittals are prepared.

4. Bring to pre-submittal conference list of proposed personnel committed to assignment to the Project. List shall include I&C Subcontractor project manager, project engineer, field representative, local service representative, and sales representative(s); and similar personnel for I&C Supplier. Indicate addresses of personnel not based at Subcontractor's and Supplier's office nearest to the Site.
5. Prepare items listed below for presentation at pre-submittal conference. Submit information to ENGINEER two weeks prior to pre-submittal conference.
    a. List of materials and equipment required for PCS, and manufacturer and model proposed for each item.
    b. List of currently-known requests for interpretations of which CONTRACTOR, I&C Subcontractor, and I&C Supplier are currently aware.
    c. List of proposed exceptions to the Contract Documents along with brief explanation of each.
    d. Proposed PCS network architecture diagram.
    e. Sample of each type of process control submittal required by the Contract Documents. These may be submittals prepared for other projects.
    f. Flow chart showing steps to be taken in preparing and coordinating PCS submittals.
    g. General outline of types of tests to be performed to verify that all sensors and transducers, instruments, and digital processing equipment are functioning properly.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
    1. Shop Drawings:
        a. Field Instruments:
            1) Manufacturer’s product name and complete model number of devices proposed for use, including manufacturer’s name and address.
            2) Instrument tag number in accordance with the Contract Documents.
            3) Data sheets and manufacturer’s catalog literature. Provide data sheets in accordance with ISA 20 and annotated for features proposed for use. For instruments not included in ISA 20, submit data sheets using a format similar to ISA 20.
            4) Description of construction features.
            5) Performance and operation data.
            6) Installation, mounting, and calibration details; instructions and recommendations.
            7) Service requirements.
            8) Dimensions of instruments and details of mating flanges and locations of closed tanks, pipe sizes for insertion instruments, and upstream/downstream straight run pipe lengths required.
            9) Range of each device and calibration information.

10) Descriptions of materials of construction and listing of NEMA ratings for equipment.

b. Panels, Consoles, and Cabinets:
   1) Layout drawings that include:
      a) Front, rear, and internal panel views to scale.
      b) Tag number and functional name of components mounted in and on panel, console, or cabinet, as applicable.
      c) Product information on panel components.
      d) Nameplate location and legend including text, letter size and colors to be used.
      e) Location of anchorage connections.
      f) Location of external wiring and piping connections.
      g) Mounting and installation details, coordinated with actual application.
      h) Proposed layouts and sizes of operator interface graphic display panels and alarm annunciator panels.
      i) Calculations substantiating panel heating and cooling provisions proposed.
      j) Subpanel layouts and mounting details for items located inside control panels.
   2) Product information on panel components including:
      a) Manufacturer's product name and complete model number of devices being provided, including manufacturer's name and address.
      b) Instrument tag number in accordance with the Contract Documents.
      c) Data sheets and catalog literature. Submit data sheets as shown in ISA 20 and annotated for features proposed for use. For instruments not included in ISA 20, submit data sheets with format similar to ISA 20.
      d) Description of construction features.
      e) Performance and operation data.
      f) Installation, mounting, and calibration details; instructions and recommendations.
      g) Service requirements
   3) Wiring and piping diagrams, including the following:
      a) Name of each panel, console, or cabinet.
      b) Wire sizes and types.
      c) Pipe sizes and types.
      d) Terminal strip and terminal numbers.
      e) Wire color coding.
      f) Functional name and manufacturer's designation for components to which wiring and piping are connected.
      g) Lightning and surge protection grounding.
   4) Electrical control schematics in accordance with NFPA 79. Control schematics shall be in accordance with convention indicated in Annex D of NFPA 79. Standardized wiring diagrams that do not

accurately reflect actual wiring to be furnished are unacceptable. Tables or charts for describing wire numbers are unacceptable.

5) Stock list or bill of materials for each panel including tag number, functional name, manufacturer's name, model number and quantity for components mounted in or on the panel or enclosure.
6) Detail showing anchorage plan of wire bundles between subpanels and front panel mounted devices.

c. Field wiring and piping diagrams, include the following:
   1) Wire and pipe sizes and types.
   2) Terminal numbers at field devices and in panels.
   3) Fiber optic termination designations in the field and in panels.
   4) Color coding.
   5) Conduit numbers in which wiring will be located.
   6) Locations, functional names, and manufacturer's designations of items to which wiring or piping are connected.

d. Proposed operator interface graphics layouts. Each graphic display and process report layout will be subject to modification from CONTRACTOR's submitted format within limits of software package used for development. Implement such modifications in accordance with ENGINEER's written comments on the submittal.

e. Supervisory Control and Data Acquisition (SCADA) System:
   1) Submit the following general information:
      a) Detailed block diagram showing system hardware configuration and identifying model numbers of system components.
      b) Software listings for operating system, applications, and HMI.
      c) Software language and organization.
      d) Format, protocol and procedures for data transmission and communications with input/output modules and peripheral devices.
      e) HMI interfacing details, licensing structure, and included functions.
      f) Control and failure modes.
      g) Online and offline capabilities for programming, system utilities, and diagnostics.
      h) Input/Output Information:
         i. Input/output (I/O) point listing with I/O module cross-reference identification.
         ii. I/O module cross-reference identification based on I/O address list developed by I&C Subcontractor.
      i) Database listing, including all I/O points.
      j) Suggested detailed format and configuration of log reports, alarm summaries, printer outputs, displays, and graphics.
   2) Hardware:
      a) Layout drawings showing front, rear, end, and plan views to scale of equipment, I/O components, power supplies, and peripheral devices.
      b) Equipment ventilation and cooling requirements.

c) Interconnection diagrams, including termination details, cable identification list, and cable length.
d) Drawings showing equipment layout.
e) Installation requirements, instructions, and recommendations.

3) Software:
a) Licensing agreement with name of licensee, renewal requirements, release and versions, expiration dates (if any) and upcoming releases scheduled before Project completion. When upcoming releases are expected, provide descriptions, when available, of features that differ from the proposed release.
b) Provide information of number of run, client, and development licenses as well as I/O point count limit per license.
c) Standard technical and instructional documentation covering software for utility, system support, system documentation, display, communications, data logging and storage and diagnostic functions. Submit this information as electronic files.
d) Standard technical documentation covering all aspects of the computer system software functions and capabilities, including instruction set description and programming procedures related to monitoring, display, logging, reporting and alarming functions.
e) Detailed functional descriptions of application programs explaining control, display, logging and alarming features to be provided and functions to be performed.

4) Documentation describing memory type, size and structure and listing size of system memory, I/O and data table memory and size of memory available for control programs.

5) System I/O Loop Wiring Diagrams: Prepare Shop Drawings on module-by-module basis and include the following information:
a) Rack numbers, module type and slot number, and module terminal point numbers. Include location and identification of intermediate panel and field terminal blocks and terminal numbers to which I/O wiring and power supply wiring is connected. Identify power supply circuits with designation numbers and ratings.
b) Wiring types, wire numbers, and color coding.
c) Designation of conduits in which field I/O wiring will be installed.
d) Location, functional name, tag numbers and manufacturer's module numbers of panel and field devices and instruments to which I/O wiring will be connected.
e) Prepare loop wiring diagrams in accordance with ISA 5.4.

f. Complete point-to-point interconnection wiring diagrams of field wiring associated with the system. Diagrams shall include the following:

1) Field wiring between each equipment item, panel, instruments, and other devices, and wiring to control stations, panelboards, and

motor starters. Some of this equipment may be specified in other Divisions. CONTRACTOR is responsible for providing complete point-to-point interconnection wiring diagrams for control and monitoring of that equipment.

2) Numbered terminal block and terminal identification for each wire termination.
3) Identification of assigned wire numbers for interconnections. Assign each wire a unique number.
4) Schedule showing the wiring numbers and the conduit number in which the numbered wire is installed.
5) Junction and pull boxes through which wiring will be routed.
6) Identification of equipment in accordance with the Contract Documents.

2. Product Data:
   a. Product data for field instruments in accordance with requirements for Shop Drawings in this Section.
   b. Product data for panels, consoles, and cabinets in accordance with requirements for Shop Drawings in this Section.
   c. Product data for field wiring and piping provided for instrumentation and control service and not included under other Sections or contracts.
   d. Product data for SCADA system, including software and hardware. Requirements for software product data are included in requirements for Shop Drawings under this Section.
3. Samples:
   a. Color charts for finish paint for metallic panels. Provide full range of paint manufacturer's standard and custom colors. Color selection will be by ENGINEER.
   b. Color charts for fiberglass-reinforced panels. Provide full range of panel manufacturer's standard and custom colors. Color selection will be by ENGINEER.
4. Factory Acceptance Test Procedure: Submit proposed procedures for factory testing required to comply with the Contract Documents. Test procedure shall include the following:
   a. Visual inspection of components and assembly.
   b. Description of hardware operational testing.
   c. Description of software demonstration.
   d. Description of testing equipment to be used.
   e. Sign-off sheets to be used at time of testing.

B. Informational Submittals: Submit the following:
   1. Documents to be submitted prior to pre-submittal conference, in accordance with Article 1.3 of this Section.
   2. System Software Documentation: Submit preliminary software documentation not later than 28 days prior to scheduled start of factory testing. Software documentation shall include the following:
      a. Complete printed copies of all programming.
      b. Complete listing of external and internal I/O address assignments, register assignments and preset constant values with function point

descriptions. List unused/undefined I/O and data table registers available.

c. Copies of all configured HMI screens.

3. Manufacturer's Instructions:
   a. Shipping, handling, storage, installation, and start-up instructions.
   b. Templates for anchorage devices for materials and equipment that will be anchored to concrete or masonry.
4. Source Quality Control Submittals:
   a. Results of factory testing.
5. Special Procedure Submittals:
   a. Notification to OWNER and ENGINEER at least 14 days before readiness to begin system checkout at the Site. Schedule system checkout on dates acceptable to OWNER and ENGINEER.
   b. Written procedure for system checkout. Submit not less than 90 days prior to starting system checkout.
   c. Ninety days prior to starting system checkout submit written procedure for start-up.
6. Field Quality Control Submittals:
   a. Submit the following prior to commencing system checkout and start-up.
      1) Completed calibration sheets for each installed instrument showing five-point calibration (zero, 25, 50, 75, 100 percent of span), signed by factory-authorized serviceman.
   b. Field calibration reports
   c. Field testing reports.
7. Supplier's Reports:
   a. Installation inspection and check-out report.
   b. Submit written report of results of each visit to Site by Supplier's service technician, including purpose and time of visit, tasks performed, and results obtained. Submit within two days of completion of visit to the Site.
8. Qualifications Statements:
   a. I&C Subcontractor.
   b. I&C Supplier.
   c. Manufacturers, when required by ENGINEER.

C. Closeout Submittals: Submit the following:
   1. Operations and Maintenance Data:
      a. Submit in accordance with Section 01 78 23, Operation and Maintenance Data.
      b. Include complete up-to-date system software documentation. Provide hardcopy and electronic copies.
   2. Record Documentation:
      a. Prepare and submit record documents in accordance with Section 01 78 39, Project Record Documents.

b. Revise all PCS Shop Drawings to reflect as-built conditions in accordance with the following.
   1) Use "as-built" updates of approved Shop Drawings and submittals in operation and maintenance manuals.
   2) Half-size black line prints of wiring diagrams applicable to each control panel shall be placed in clear plastic envelopes inside a suitable print pocket or container inside each control panel.
   3) Submit drawings of the point-to-point interconnection wiring diagrams updated to reflect final as-built equipment information and as-installed field installation information.

D. Maintenance Materials Submittals: Submit the following:
   1. Spare Parts and Test Equipment:
      a. General:
         1) Furnish the spare parts and test equipment in accordance with the Contract Documents, identical to and interchangeable with similar materials and equipment provided for the PCS under the Contract.
         2) Provide source quality control for spare parts as part of factory testing prior to shipment of process control system equipment.
         3) For process sensors and other analog instruments, Supplier shall submit a separate quotation for recommended list of spare parts and test equipment. Separately list and price each item recommended. Spare parts quotation shall include a statement that prices quoted are valid for a period of one year from date of equipment installation and that Supplier understands that OWNER reserves the right to purchase none, any, or all parts quoted. Upon request, Supplier shall submit documentation that stock of spare parts and test equipment is obtainable within 48 hours of receipt of OWNER's order.
      b. Furnish the following spare parts:
         1) Five of each type of input/output relay for each quantity of forty or fraction thereof provided under the Contract.
         2) Two of each type of PLC input/output module or card used.
         3) One replacement power supply for each type and size provided under the Contract.
         4) One-year supply of all expendable or consumable materials.
         5) One per quantity of five or fraction thereof of gauges, indicators, and switches provided, complete with diaphragm seals, filled and ready to use.
         6) One per quantity of ten of fraction thereof provided, per range of field instruments including insertion type instruments. No spares are required for inline instruments such as magnetic flow meters and flumes or venturis that include flow tubes through which flow is conveyed.
         7) Twelve of each type and size of fuse used in instruments.

2. Software:
    a. Submit copies of programming and configuration files developed specifically for the Project in accordance with Section 01 78 23, Operations and Maintenance Data.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prior to packaging, each manufacturer or Supplier shall securely attach tag number and instructions for proper field handling and installation to each instrument.

PART 2 – PRODUCTS

2.1 PCS – GENERAL PROVISIONS FOR PRODUCTS

A. General:
    1. All electrically-powered equipment and devices shall be suitable for operation on 115-volt plus-or-minus 10 percent, 60 Hertz plus-or-minus two Hertz power. If different voltage or closer regulation is required, provide suitable regulator or transformer.
    2. Provide appropriate power supplies for all two-wire transmitters, loops for monitoring discrete inputs and necessary outputs. Install power supplies mounted in enclosures, and install in appropriate control room or field panel.
    3. Power supplies shall be suitable for minimum of 130 percent of the maximum simultaneous current draw.
    4. Provide power on-off switch or air circuit breaker for each item requiring electrical power.
    5. Provide isolation transformers, line voltage regulators and power distribution panels for the distributed digital portions of the PCS to eliminate electrical noise and/or transients entering on the primary power line.
    6. Unless otherwise shown or indicated in the Contract Documents, control system shall be furnished to use 4 to 20 mADC analog signals.
    7. Provide signal converters and repeaters where required. Analog inputs to distributed control system shall be through appropriate repeaters to provide signal isolation where series-looped with other devices and to allow loop to maintain integrity even when distributed control system is out of service. Power supplies shall adequate for signal converter and repeater loads.
    8. Signals shall be isolated from ground.
    9. Signals shall not have a transient DC voltage exceeding 300 volts over one millisecond nor a DC component over 300 volts.
    10. PCS and associated input/output wiring will be used in a facility environment where there can be high-energy AC fields, DC control pulses, and varying ground potentials between the sensors/transducers or input contact locations and PCS components. PCS shall be adequate to provide proper protection against interferences from all such possible situations.

11. Instrumentation and PCS components shall be heavy-duty types, suitable for continuous service in a municipal wastewater treatment plant environment. Furnish products that are currently in production at the time products are shipped from the factory. All equipment furnished shall be of modular construction and be capable of field expansion through installation of plug-in circuit cards and additional cabinets as necessary. Logic and control loops shall be fail-safe.
12. Instrumentation and other PCS components shall return automatically to accurate measurement within 15 seconds upon restoration of power after a power failure, and when transferred to standby power supply.
13. Provide surge protection for instruments and all other PCS components that could be damaged by electrical surges.
14. Field-mounted instruments and PCS components shall be suitable for installation in humid and corrosive service conditions. Field-mounted instrument enclosures, junction boxes, and appurtenances shall comply with NEMA 4X requirements, unless otherwise shown or specified.
15. Relays with interconnections to field devices shall be wired through terminal blocks. Terminals as part of the relay base are unacceptable.
16. Panel mounted instruments, switches, and other devices shall be selected and arranged to present a pleasing coordinated appearance. Front-of-panel-mounted devices shall be of the same manufacturer and model line.
17. All components furnished, including field-mounted and rear-of-panel instruments, shall be tagged with the item number and nomenclature as shown and the instrument index in the Contract Documents or, as applicable, the "data sheets" that are part of the Contract Documents.
18. Ranges and scales specified in the Contract Documents shall be coordinated to suit equipment actually furnished. Range, scale, and set point values specified in other Sections of Division 40 are for initial setting and configuration. Coordinate specified values with actual equipment furnished to implement proper and stable process action as systems are placed in operation.
19. Field-mounted devices shall be treated with an anti-fungus spray.
20. Field-mounted devices shall be protected from exposure to freezing temperatures.

B. Environmental Conditions:
    1. PCS and its components shall be designed and constructed for continuous operation under the following temperature and humidity conditions:
        a. Equipment and Devices Installed in Control Rooms:
            1) Ambient Temperature: 60 degrees F to 80 degrees F normal range; and 40 degrees F to 105 degrees F occasional maximum extremes.
            2) Relative Humidity: 80 percent, normal; 95 percent maximum.
        b. Equipment and devices installed at indoor locations (other than control rooms) for digital processing equipment hardware, control panels, and instruments:
            1) Ambient Temperature: 40 degrees F to 120 degrees F.
            2) Relative Humidity: 98 percent maximum.
        c. Equipment and Devices Installed Outdoors:

1) Ambient Temperature: -10 degrees F to 120 degrees F.
2) Relative Humidity: 100 percent maximum.

C. Refer to Sections 40 60 01 through 40 79 99.99 for product requirements for materials and equipment that are part of the PCS.

PART 3 – EXECUTION

3.1 PCS – GENERAL PROVISIONS FOR EXECUTION

A. Refer to Sections 40 60 01 through 40 79 99.99 for execution requirements for the PCS.

+ + END OF SECTION + +

SECTION 40 61 21

PROCESS CONTROL SYSTEM FACTORY TESTING

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as specified and required for factory testing at the process control system manufacturer's facility to verify that system components function properly and comply with the functional and performance requirements of the Contract Documents.
   2. Perform factory testing on the following types of equipment:
      a. New PLC and Remote I/O Control Panels.
      b. Configured HMI Software (new equipment).
   3. Perform factory testing on the process control systems for the following process equipment:
      a. Dewatering centrifuges.
   4. CONTRACTOR shall advise ENGINEER in writing of the scheduled dates for process control systems factory testing; submit such notice not less than 28 days prior to the scheduled start of factory testing. OWNER and ENGINEER will not be present at factory testing facility during operational testing of the process control systems at the factory, either for individual units or for the integrated system. In lieu of OWNER and ENGINEER witnessing the process control system factory testing, CONTRACTOR shall submit a letter, sealed and signed by a professional engineer, certifying that the required factory testing was successfully completed in accordance with testing procedure approved by ENGINEER and the Contract Documents.

B. Related Sections:
   1. 40 61 13, Process Control System General Provisions.

1.2 QUALITY ASSURANCE

A. Qualifications:
   1. Professional Engineer:
      a. Engage a registered professional engineer legally qualified to practice and experienced in providing the engineering services of the kind indicated. Professional engineer may be an employee of manufacturer.
      b. Submit qualifications data.
      c. Responsibilities include but are not necessarily limited to:
         1) Preparing or supervising the preparation of factory test set-ups.
         2) Performing or supervising performance of factory testing, interpretation and engineering analysis of factory testing data, and preparation of test reports.

3) Certifying that factory tests performed and results achieved comply with the Contract Documents.

1.3 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Testing Plans:
      a. Submit factory test procedures in accordance with Section 40 61 13, Process Control System General Provisions, for all equipment listed in Paragraph 1.1A of this Section. Obtain ENGINEER's acceptance of testing plan not less than 28 days prior to scheduled start of factory test.

B. Informational Submittals: Submit the following:
   1. Source Quality Control Submittals:
      a. Written results of factory testing for process control systems. Submit the complete factory test report within two weeks after completion of the factory test.
      b. Certification of factory testing results by professional engineer.
   2. Qualifications Statements:
      a. Professional engineer.

PART 2 – PRODUCTS

2.1 SOURCE QUALITY CONTROL

A. Inspections Prior to Factory Testing:
   1. Inspect each panel, console, and cabinet to verify compliance with the Contract documents, and approved Shop Drawings and approved other CONTRACTOR submittals.
   2. Inspection shall include, but not be limited to, the following:
      a. Nameplates and tags.
      b. Wire sizes and color coding.
      c. Terminal block contact ratings and numbers.
      d. Panel-mounted equipment and identification.
      e. External and internal panel layout.
      f. Proper wiring practices and grounding.
      g. Enclosure flatness, finish and color.
      h. NEMA rating and environmental control equipment.
   3. Correct materials and equipment that do not comply with the Contract Documents and submittals approved by ENGINEER, and re-inspect until compliance is verified.

B. Factory Tests:

1. System Hardware Operational Testing:
    a. Test each input/output device and component to verify operability. If panel or device being tested contains pneumatic systems, test the instruments associated with such systems to verify that calibration.
    b. Test all system hardware components to verify proper operation of the equipment as stand-alone units and as a system. Tests shall include, but are not necessarily limited to, the following:
        1) AC/DC power checks.
        2) Power fail/restart tests.
        3) Verify that network switches and fiber-optic converters are powered by separate circuits.
        4) Verify that quantity of circuits assigned to power field instruments corresponds to approved Shop Drawings and approved other CONTRACTOR submittals.
    c. Criteria for Acceptance: System hardware operational testing shall acceptably demonstrate that specified and required equipment operations capabilities function properly.
    d. Test remote I/O, operator interface terminals, Ehternet linking devices and control panels, and similar devices, to verify that communication between units functions properly.
    e. Perform an integrated system test, with all control system equipment connected (excluding field sensors and instruments), to verify that equipment performs and functions properly as an integrated system. During the factory test, simulate field sensors and instruments using appropriate signal generators, switches, and jumper cables.
    f. Separately test each panel furnished under this Contract to verify that panel instruments and processors are perform and function properly in accordance with the Contract Documents. For the factory test required in this Section, simulate field sensors and field instruments using appropriate signal generators, switches, and jumper cables.
2. System Hardware Demonstration (Programming by CONTRACTOR):
    a. CONTRACTOR shall perform and be solely responsible for system hardware demonstration factory test.
    b. Preparation:
        1) System performance shall be tested using fully-integrated system, including all software and hardware. Entire control system, including one of each type of field device with interconnecting cables, shall be assembled at the factory test location and simulated inputs applied. Signal generators shall be appropriately sized and calibrated for full range of use and shall have a power source to accommodate not less than a full day of testing. Prior to the factory test, provide process I/O simulation panel that includes the following:
            a) Toggle switches to simulate field or other input contacts.
            b) Indicating lights to simulate outputs from tested panels.
            c) Control relays to simulate motor control center coil inputs.
            d) Time relays to simulate position switches.

e) Indications (in milliamps) to indicate every 4 to 20 ma-dc output from tested panel.
f) Potentiometers to simulate 4 to 20 ma-dc inputs to tested panel.
g) Each device shall have nameplate with description and device's process and instrumentation Drawings (P&ID) tag number. Nameplates shall be removable and interchangeable for multiple use of the panel during the test.

2) Operator Interfaces: Prior to factory testing of the system, configure the display environments in accordance with the display structure agreed upon by CONTRACTOR, ENGINEER, and OWNER, and load and link database parameters to the specified fields.

c. Factory Test:

1) CONTRACTOR shall demonstrate system software utility programs and system software security programs incorporated into the control system, to demonstrate proper functioning of the various functions and capabilities specified.
2) Perform complete system test, during which entire system shall operate continuously without failure in accordance with the Contract Documents.
3) Demonstrate the monitoring and control information displayed on each HMI screen, based on simulation of each associated point for each screen, in accordance with test procedure approved by ENGINEER. Simulation through forced values in the PLC programming is acceptable. In addition, OWNER or ENGINEER will randomly select, at the time of the factory test, additional inputs and outputs to be simulated in quantity not less than five percent of total I/O quantity. Demonstrate that monitoring and control application software associated with I/O points performs and functions as intended.
4) Demonstrate communications between integrated system elements; include such demonstration in the testing procedure submittal, where applicable.
5) Operator Interfaces:
a) During factory test, demonstrate overall display structure, including environment configurations, passwords, security, and other parameters and functions.
b) Review menu display contents to demonstrate how an operations person will navigate within the overall display structure.
c) Demonstrate assignment of displays to annunciator keys.
d) Review each graphic display for correctness relative to layout, symbols, color scheme, and other requirements.
e) Demonstrate operation of standard alarm management displays (current alarm display, alarm history, and similar alarm displays).
f) Perform demonstration of each type of report specified. Printing shall be an integral part of the report demonstration.

3. Factory Test Acceptance Criteria:
    a. In addition to complying with Paragraph 2.1B.1 of this Section, failure or non-functioning of one or more communication links, failure of more than five percent of the total control functions, more than ten internal panel wiring discrepancies including I/O point cross-wirings, or more than ten I/O point- or database-addressing errors will be unacceptable and constitutes factory test failure.
    b. Do not ship the equipment from the factory until ENGINEER accepts the factory test results submittal.
    c. Modifications, if any, to documentation as a result of the factory tests shall be completed before shipping the control system.
    d. Should a factory test run fail to comply with the Contract Documents, necessary changes and corrections shall be made and the entire system retested until acceptable results are achieved.

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 40 61 23

PROCESS CONTROL SYSTEM START-UP AND FIELD TESTING

PART 1 – GENERAL

1.1 SYSTEM CHECK-OUT AND START-UP RESPONSIBILITIES

A. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install all equipment and coordinate all activities necessary to perform check-out and start-up of the equipment.

B. CONTRACTOR shall retain the services of the Supplier to supervise and/or perform check-out and start-up of all system components. As part of these services, the system Supplier shall include for those equipment items not manufactured by him the services of an authorized manufacturers' representative to check the equipment installation and place the equipment in operation. The manufacturers' representative shall be thoroughly knowledgeable about the installation, operation and maintenance of the equipment.

1.2 SYSTEM CHECKOUT AND START-UP

A. CONTRACTOR, under the supervision of the PMCS Supplier, and other instrument suppliers as applicable, shall perform the following:
   1. Check and approve the installation of all PMCS components and all cable and wiring connections between the various system components prior to placing the various processes and equipment into operation.
   2. Conduct a complete system checkout and adjustment, including calibration of all instruments, tuning of control loops, checking operation functions, and testing of final control actions. When there are future operational functions included in this work, they should be included in the system checkout. All problems encountered shall be promptly corrected to prevent any delays in start-up of the various unit processes.

B. CONTRACTOR shall provide all test equipment necessary to perform the testing during system checkout and start-up.

C. CONTRACTOR and Supplier shall be responsible for initial operation of monitoring and control system and shall make any required changes, adjustment or replacements for operation, monitoring and control of the various processes and equipment necessary to perform the functions intended.

D. CONTRACTOR shall furnish to the ENGINEER certified calibration reports for field instruments and devices specified in Section 40 70 05, Primary Sensors and Field Instruments, and panel mounted devices specified in Section 40 78 00, Panel-Mounted Instruments and Devices, as soon as calibration is completed.

E. CONTRACTOR shall furnish ENGINEER an installation inspection report certifying that all equipment has been installed correctly and is operating properly. The report shall be signed by authorized representatives of both CONTRACTOR and the Supplier.

1.3 INTEGRATED SYSTEM FIELD TEST

A. Following the PMCS checkout and initial operation, CONTRACTOR, under the supervision of the Supplier, shall perform a complete system test to verify that all equipment and programmed software is operating properly as a fully integrated system, and that the intended monitoring and control functions are fully implemented and operational. Any defects or problems found during the test shall be corrected by CONTRACTOR and then retested to demonstrate proper operation.

B. Following demonstration of all system functions, the PMCS including field sensors/transducers and instruments shall be running and fully operational for a continuous 48 hour period. The Operational Availability Demonstration specified below shall not begin until the continuous 48 hour integrated system test has been successfully completed and OWNER and ENGINEER agree that the Operation Availability Demonstration can begin.

1.4 OPERATIONAL AVAILABILITY DEMONSTRATION

A. Operational Availability Demonstration (OAD) shall begin following completion of the integrated system field test as specified above and shall continue until a time frame has been achieved wherein the system (both hardware and software) availability meets or exceeds 99.7 percent for 60 consecutive days and no system failures have occurred which result in starting the OAD over again. During the OAD the system shall be available to plant operating personnel for use in normal operation of the plant.

B. For the purpose of the OAD, the system will be defined as consisting of the following systems and components:
   1. Remote I/O Panel.
   2. Interface and configuration of (3) new centrifuge panels and plant RTU-SH PLC.
   3. Modification to plant Operator Interface Software (iFix).

C. The conditions listed below shall constitute system failures which are considered critical to the operability and maintainability of the system. The OAD shall be terminated if one or more of these conditions occur. Following correction of the problem, a new 60 consecutive day OAD shall begin.
   1. Failure to repair a hardware or software problem within 120 consecutive hours from the time of notification of a system failure.
   2. Recurrent Hardware or Software Problems: If the same type of problem occurs three times or more.

3. Software problem causing a processor to halt execution.

D. The following conditions shall constitute a system failure in determining the system availability based on the equation specified in Paragraph 1.4E., below:
   1. Failure of Remote I/O panel or loss of communications between Centrifuge Panels, Remote I/O panel, and existing PLC-based control panel RTU-SH.
   2. Loss of communications between devices on the communications network.
   3. Failure of one or more input/output components.
   4. Failures of any type affecting ten or more input/output points simultaneously.
   5. Failure of any type affecting one or more regulatory control loops or sequential control strategies thereby causing a loss of the automatic control of the process variable or process sequence operation.
   6. Failure of power supply. Where redundant power supplies are provided, failure of one power supply shall not constitute a system failure provided the backup power supply operates properly and maintains supply power. Failure of the backup supply to operate properly and maintain supply power shall constitute a system failure.
   7. Failure of three or more primary sensors/transducers or field instruments simultaneously.

E. The system availability shall be calculated based on the following equation:

$$A = \frac{TTO}{TTO + TTR} \times 100 \text{ percent}$$

where, A = system availability in percent
TTO = total time in operation
TTR = total time to repair

F. Time to repair shall be the period between the time that CONTRACTOR is notified of a system failure and the time that the system has been restored to proper operation in terms of hours with an allowance for the following dead times which shall not be counted as part of the time to repair period.
   1. Actual travel time for service personnel to get to the Site up to six hours per incident from the time CONTRACTOR is notified of a system failure.
   2. Time for receipt of spare parts to the plant site once requested up to 24 hours per incident. No work shall be done on the system while waiting for delivery of spare parts.
   3. Dead time shall not be counted as part of the system available period. The dead time shall be logged and the duration of the OAD extended for an amount of time equal to the total dead time.

G. Completion of a 60 consecutive day period without any restarts of the OAD and with a system availability in excess of 99.7 percent will constitute acceptance of the PMCS by OWNER.

H. All parts and maintenance materials required to repair the system prior to completion of the OAD shall be supplied by CONTRACTOR at no additional cost to OWNER. If parts are obtained from the required plant spare parts inventory, they shall be replaced to provide a full complement of parts as specified.

I. A Plant Monitoring and Control System Malfunction/Repair Reporting Form shall be completed by the plant personnel and ENGINEER to document system failures, to record CONTRACTOR notification, arrival and repair times and CONTRACTOR repair actions. Format of the form shall be developed and agreed upon prior to the start of the OAD.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 40 61 26

PROCESS CONTROL SYSTEM TRAINING

PART 1 – GENERAL

1.1 REQUIREMENTS AND RESPONSIBILITIES

A. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to perform and coordinate all required training at times acceptable to OWNER and ENGINEER.

B. CONTRACTOR shall retain the services of the Supplier to provide operation and maintenance training for all PMCS equipment as specified herein.

C. For equipment items not manufactured by the Supplier, the Supplier shall provide for on-site training by an authorized representative of the equipment manufacturer as part of the Supplier's services. The manufacturer's representative shall be fully knowledgeable in the operation and maintenance of the equipment.

D. CONTRACTOR shall be responsible for all costs, including cost of travel, meals and lodging, if required, associated with training on-site, and shall provide all required materials, texts and required supplies.

E. All training shall be conducted in the normal eight-hour working days until conclusion of the training course. For training at the Supplier's facility, the course instructor shall be assigned full time and shall not perform other duties throughout the period of the course.

1.2 SUBMITTALS

A. Within 90 days of the effective date of the Notice to Proceed, CONTRACTOR shall submit his plan for training conforming to the requirements of Section 01 79 23, Instruction of Operations and Maintenance Personnel. Included in the plan shall be course outlines and schedules for training to be provided at the Supplier's facilities.

1.3 ON-SITE TRAINING

A. Primary Sensors/Transducers and Field Instruments:
   1. Provide on-site operation and maintenance training by Supplier and the equipment manufacturer representatives prior to placing the equipment in continuous operation, conforming to the requirements of Section 01 79 23, Instruction of Operations and Maintenance Personnel. The services of equipment manufacturer's representatives shall be provided for a minimum of eight hours for each type of instrument provided.

2. Training shall accomplish the following:
    a. Provide instruction covering use and operation of the equipment to perform the intended functions.
    b. Provide instruction covering procedures for routine, preventive and troubleshooting maintenance including equipment calibration.
    c. Explain procedures for placing the equipment in and out of operation and explain necessary actions and precautions to be taken regarding the overall plant monitoring and control system.

B. Training covering the control equipment:
    1. The Supplier shall provide 8 hours of operations training covering all system components.
    2. Training course shall accomplish the following:
        a. Provide all instructions necessary to operate and utilize all system components.
        b. Provide all instruction necessary to monitor and control the system processes from the designated control panel.
        c. Explain procedures for control of the system during scheduled or rescheduled shutdown and the subsequent start-up.
        d. Provide instructions for regular caretaking operations.

C. PLC Training:
    1. The PMCS Supplier shall provide training that covers PLC as follows:
        a. Provide an overview of system hardware and software modifications, as well as new equipment provided.
        b. It shall train people in configuration, operation and programming modifications.
        c. The emphasis shall be placed on how to perform set point changes, minor programming changes, range changes, diagnostics and upkeep of documentation.
        d. Instruction for hardware and software maintenance, trouble shooting and maintenance planning.
        e. Provide one 8-hour training session.

D. Training following two months of regular system operations:
    1. The Supplier shall provide operation and maintenance covering all system equipment provided.
    2. The training shall be of the same format, content and duration as the training described in Paragraph 1.4A. and Paragraph 1.4B., above.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 40 61 93

PROCESS CONTROL SYSTEM INPUT/OUTPUT SCHEDULES

PART 1 – GENERAL

1.1 SUMMARY

A. CONTRACTOR shall provide PLC I/O modules and the field wiring for the input/output capacity as listed herein and as shown on the Drawings.

B. An input/output schedule for the Process Control System is included at the end of this Section.

1.2 SUBMITTALS

A. Comply with the requirements of Section 40 61 13, Process Control Systems General Provisions.

PART 2 – PRODUCTS

2.1 INPUT/OUTPUT SCHEDULE

A. Column Headings: The following column headings identify individual I/O point characteristics:
   1. CP: Name of the panel or enclosure containing the I/O module.
   2. DESCRIPTION 1/DESCRIPTION 2: Functional description of the I/O point.
   3. I/O Type: I/O module type.
      a. DI, isolated discrete input.
      b. DO, isolated discrete solid state or relay output.
      c. AI, analog input.
      d. AO, analog output.
   4. Range: Range of analog signal in engineering units.
   5. EQUIP TAG: Equipment Tag Number
   6. TAG: Signal Tag Number.
   7. DWG NO.: Corresponding P&ID.

PART 3 – EXECUTION

3.1 GENERAL

A. System Integrator is responsible for all necessary I/O communication to/from RTU-SH PLC and RIO-RTU-SH PLC and all Centrifuge PLC I/O. See Section 46 76 33, Dewatering Centrifuges, and associated I/O Schedule.

3.2 INPUT/OUTPUT SCHEDULES

A. The schedule listed below, following the "End of Section" designation, are a part of this Specification Section.
   1. Process Control System Input/Output Schedule.

+ + END OF SECTION + +

PROCESS CONTROL SYSTEM INPUT/OUTPUT SCHEDULE

Index	Dwg #	Equip Tag	Tag	DESCRIPTION 1	DESCRIPTION 2	I/O Type	Range	Monitor/ CNTRL/ Monitor w/ Action	CP
1	I-04		HS-614A	POLYMER PUMP #1	START/STOP	DO	N/A	CNTRL	RIO-RTU-SH
2	I-04		YI-614A	POLYMER PUMP #1	RUNNING	DI	N/A	MONITOR	RIO-RTU-SH
3	I-04		GAI-614A	POLYMER PUMP #1	LOW FLOW ALARM	DI	N/A	MONITOR	RIO-RTU-SH
4	I-04		FI-630A	POLYMER PUMP #1	FLOW PACE	AO	0 - # GPM	CNTRL	RIO-RTU-SH
5	I-04		FI-631A	POLYMER PUMP #1	FLOW RATE	AI	0 - # GPM	MONITOR	RIO-RTU-SH
6	I-04		PAH-632A	POLYMER PUMP #1	HIGH PRESSURE	DI	N/A	MONITOR	RIO-RTU-SH
7	I-04		HS-614B	POLYMER PUMP #2	START/STOP	DO	N/A	CNTRL	RIO-RTU-SH
8	I-04		YI-614B	POLYMER PUMP #2	RUNNING	DI	N/A	MONITOR	RIO-RTU-SH
9	I-04		GAI-614B	POLYMER PUMP #2	LOW FLOW ALARM	DI	N/A	MONITOR	RIO-RTU-SH
10	I-04		FI-630B	POLYMER PUMP #2	FLOW PACE	AO	0 - # GPM	CNTRL	RIO-RTU-SH
11	I-04		FI-631B	POLYMER PUMP #2	FLOW RATE	AI	0 - # GPM	MONITOR	RIO-RTU-SH
12	I-04		PAH-632B	POLYMER PUMP #2	HIGH PRESSURE	DI	N/A	MONITOR	RIO-RTU-SH
13	I-04		HS-614C	POLYMER PUMP #3	START/STOP	DO	N/A	CNTRL	RIO-RTU-SH
14	I-04		YI-614C	POLYMER PUMP #3	RUNNING	DI	N/A	MONITOR	RIO-RTU-SH
15	I-04		GAI-614C	POLYMER PUMP #3	LOW FLOW ALARM	DI	N/A	MONITOR	RIO-RTU-SH
16	I-04		FI-630C	POLYMER PUMP #3	FLOW PACE	AO	0 - # GPM	CNTRL	RIO-RTU-SH
17	I-04		FI-631C	POLYMER PUMP #3	FLOW RATE	AI	0 - # GPM	MONITOR	RIO-RTU-SH
18	I-04		PAH-632C	POLYMER PUMP #3	HIGH PRESSURE	DI	N/A	MONITOR	RIO-RTU-SH

Index	Dwg #	Equip Tag	Tag	DESCRIPTION 1	DESCRIPTION 2	I/O Type	Range	Monitor/ CNTRL/ Monitor w/ Action	CP
19	I-05		HS-609A	WATER BOOSTER PUMP #1	START/STOP	DO	N/A	CNTRL	RIO-RTU-SH
20	I-05		YI-609A	WATER BOOSTER PUMP #1	RUNNING	DI	N/A	MONITOR	RIO-RTU-SH
21	I-05		GAI-609A	WATER BOOSTER PUMP #1	ALARM	DI	N/A	MONITOR	RIO-RTU-SH
22	I-05		HS-609B	WATER BOOSTER PUMP #2	START/STOP	DO	N/A	CNTRL	RIO-RTU-SH
23	I-05		YI-609B	WATER BOOSTER PUMP #2	RUNNING	DI	N/A	MONITOR	RIO-RTU-SH
24	I-05		GAI-609B	WATER BOOSTER PUMP #2	ALARM	DI	N/A	MONITOR	RIO-RTU-SH
25	I-05		HS-609C	WATER BOOSTER PUMP #3	START/STOP	DO	N/A	CNTRL	RIO-RTU-SH
26	I-05		YI-609C	WATER BOOSTER PUMP #3	RUNNING	DI	N/A	MONITOR	RIO-RTU-SH
27	I-05		GAI-609C	WATER BOOSTER PUMP #3	ALARM	DI	N/A	MONITOR	RIO-RTU-SH
28	I-05		YIA-640	VENTILATION MONITORING STATION	ALARM	DI	N/A	CNTRL	RIO-RTU-SH
29									
30									

SECTION 40 61 96

PROCESS CONTROL DESCRIPTIONS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Definition:
   1. The purpose of this document is to describe the proposed control philosophy and control system approach for the project. This document describes the proposed control system, including monitoring requirements, control capabilities and general control system and operator interface computer station (otherwise referred to as a Human Machine Interface, or HMI) layout.

B. Scope:
   1. CONTRACTOR's I&C Subcontractor shall furnish control strategy diagrams, configuration sheets and control strategy descriptions as shown, specified and required to configure the system complete and operational.
   2. CONTRACTOR's I&C Subcontractor shall perform all programming, configuration and tuning of the control system.
   3. The Process Control System (PCS) shall monitor and control the systems contained within the facility in accordance with this specification section and the manufacturer recommendations. The control descriptions and instrumentation drawings describe the required monitoring and control, which may include multiple locations of control including at the equipment, at PLC panels, and at HMI. The I&C Subcontractor will be responsible for the programming and configuration of the PLC, HMI, and network hardware. The I&C Subcontractor HMI programming is to provide graphical control of equipment from the locations shown in accordance with OWNER preferences.

C. Related Sections:
   1. Section 40 61 13, Process Control System General Provisions.
   2. Section 40 61 21, Process Control System Factory Testing.
   3. Section 40 61 23, Process Control System Start-up and Field Testing.
   4. Section 40 61 26, Process Control System Training.
   5. Section 40 61 93, Process Control System Input/Output Schedule.
   6. Section 40 64 00, Programmable Logic Controllers.
   7. Section 40 67 17, Process Control Panels and Enclosures.
   8. Section 40 70 05, Primary Sensors and Field Instruments.
   9. Section 40 78 00, Panel Mounted Instruments and Devices.

D. This Section describes the anticipated control programming. The control strategies are generally divided by process area.

E. The Contract Price includes an allowance amount specified in Section 01 21 00, Allowances, to be used for payment to I&C Subcontractor for construction costs incurred for the programming and configuration of the HMIs and Programable Logic Controllers (PLC) described in this Specification Section and invoiced to CONTRACTOR relative to work for the Site:
   1. Comply with Section 01 21 00, Allowances, regarding submittal of costs proposed to be paid under the allowance. Do not include in proposed payment under the allowance CONTRACTOR's cost other than cost invoiced to CONTRACTOR by I&C Subcontractor and CONTRACTOR fee (overhead and profit). Include other costs, if any, under other non-allowance pay items.
   2. Include in an Application for Payment costs invoiced to CONTRACTOR by I&C Subcontractor.
   3. If costs payable under the allowance exceeds the listed allowance value, OWNER will issue a Change Order to pay CONTRACTOR the extra amount, or will pay CONTRACTOR the extra amount by other means available under the contract.
   4. If actual invoiced costs are less than the allowance amount, the Contract Price will be reduced by the difference between cost eligible and recommended by ENGINEER for payment, and the allowance amount via a Change Order.

1.2 GENERAL CONTROL PHILOSOPHY

A. Control System Description:
   1. The control system will consist of HMIs and Programmable Logic Controllers (PLC). The Controllers will be configured and programmed to control all systems either manually or automatically, based on monitored data, commands and set points entered by operators at the existing plant HMI. For maintenance mode only, control of equipment will be possible from local control stations or control panels located at or near the equipment.
   2. The control strategies are written descriptions of process control for the unit processes and mechanical or electrical equipment controls required for safe operation. Control strategies shall reside in the memory of the designated processor.

B. Local Control Mode:
   1. All equipment will have local manual control capability at or near the equipment. Equipment that can also be controlled remotely by the PLC will have a LOCAL-OFF-REMOTE selector switch at that equipment to select control location. If the selector switch is in the LOCAL position, the local manual control will be enabled and the remote control and PLC control will be disabled.

C. Remote Control Mode:
   1. When the LOCAL-OFF-REMOTE selector switch for the equipment that can be controlled remotely is in the REMOTE position, the remote control and

PLC control will be enabled and the local manual control (except for stop push buttons) will be disabled. Where multiple remote control locations are available such as OIT and HMI, both controls are available simultaneously with no priority given to one or the other.

2. In some cases, there is more than one level of remote control. In the case of a VFD driven pump or blower, for example, local control is provided by a Local Control Station (LCS) at or near the piece of equipment as the VFD is usually remote from the equipment. The remotely located VFD then acts as a first layer of remote control. The OITs and HMIs, together, form the second layer of remote control.
    a. When the LOCAL-OFF-REMOTE switch on the LCS is in LOCAL, the equipment shall be controlled via START and STOP pushbuttons on the LCS.
    b. When the LOCAL-OFF-REMOTE switch on the LCS is in the REMOTE mode, the PLC will be allowed to control the equipment based on control values entered by the operator. The PLC will control the equipment in either a PLC MANUAL or a PLC AUTO mode of operation, as selected by the operator at the HMI.
        1) PLC MANUAL Control: The PLC MANUAL mode of control requires operator action at the HMI to change the operating status of the piece of equipment.
        2) PLC AUTO Control: PLC AUTO control allows the PLC to control the equipment based on operator-entered set points and measured values.
3. Control Modes:
    a. Remote Manual control: It shall be possible for the Operator to interrupt any sequence, loop, or automatic operation and operate the same manually through the operator workstation.
    b. Output Verification: This control function shall verify that the equipment has responded to the digital commands before proceeding to the next step during automatic operation. If any discrepancy is detected, an alarm shall be annunciated.
    c. System Initialization Routine: Each processor shall have an initialization routine to initialize all system variables.

D. Protective Interlocks:
1. Equipment protective, hardwired interlocks shall remain in effect in all control modes.

E. Control System Configuration:
1. The PLC and HMIs will be located as shown on the configuration diagram and building layout drawings.
2. At each HMI, graphic displays will provide detailed, user-friendly information on all equipment, and will allow the operator to initiate process changes or respond to alarm conditions as shown on the drawings with this description.

3. The information contained within each PLC connected to the network shall be fully available on the control system network for viewing on the HMIs within the control room. The monitoring and control functions shown on the drawings represent the minimum required information to be programmed into the HMI screens.
4. Each PLC shall be programmed to be a standalone unit that will control the equipment connected to it, even if the communication between the PLC and the HMI is severed. In this case, the PLC shall use the previously entered set points to control the equipment.
5. All set points, tuning parameters and engineering scales shall be documented for each control point and each control strategy on configuration sheets or similar documentation. These configuration sheets with initial data shall be submitted for review, shall be updated before the factory test and available at the factory test, and shall be updated during startup and commissioning. The record documents shall be submitted showing the final version of the configuration sheets.

F. Process Control Functions:
1. Process control function shall be structured to permit the realization of all control strategy requirements. In addition, each control function shall be designed so that non-disruptive (bumpless and balance free) transfers are obtained during operating mode changeover and initialization. Where applicable, user changeable parameters shall be automatically defaulted to a preset value if a specific value is not given during system operation.
2. The P&IDs represent the required process monitoring and control. The required control for the system is a combination of the representation on the P&IDs and the requirements specified herein. The P&IDs do not show all the required internal diagnostic indications for the systems. In addition to the indications shown on the P&IDs, the following, at a minimum shall be provided, including internal diagnostic functions, indications, analog signal conversions and discrete signal verifications:
    a. Indication of bad quality on any hard wired input/output point (such as zero milliamps on a 4 to 20 mADC circuit). Bad quality points shall be excluded from average calculations.
    b. Individual PLC fault indications. (controller fault).
    c. Indication of a communications failure.
    d. For all motor start and stop commands check for run feedback after adjustable time delay (0 to 30 seconds). Provide a “FAIL TO START” and “FAIL TO STOP” alarm if unit fails to run or stop. Provide validation of equipment running using process monitoring conditions such as PSH, FSH, or PSL instead of starter contact. Use the bad start or stop bit to remove the run command from the control logic.
    e. For all motorized valve and gate open and close commands check for open or close limit switch feedback after an adjustable time delay (0 to 360 seconds). Provide a “FAIL TO OPEN” and “FAIL TO CLOSE” alarm if valve or gate fails to open or close. Each timer shall be adjusted during startup based on valve and gate performance.

f. For all modulating valve and gate position control commands check for a deviation between command and feedback after an adjustable time delay (0 to 360 seconds). Provide a "FAIL TO MOVE" alarm if valve or gate fails to move to ± 5% of the commanded position. Each timer shall be adjusted during startup based on valve and gate performance.
g. Cumulative runtime indicators shall be provided for all equipment.
h. Adjustable startup and shutdown delay timers shall be provided to allow normal startup and shutdown of equipment without alarms or bypassing of hardware safety interlocks.
i. Controller fault- individual controller fault indication.
j. PCS Network Communication Failure: Indication of communication failure at each process network node or processor.
k. Track and hold- for analog control loops, when control of field equipment is not in "remote mode" the associated PID controller output shall track the position feedback.
l. Analog Alarms: for all analog signals, provide the following alarm indications. These settings shall be adjustable based on security login.
    1) High-high
    2) High
    3) Low
    4) Low-low
    5) High rate of change, low rate of change.

3. If any equipment faults or shuts down through an interlock, the cause of the alarm/shutdown must be corrected and the alarm must be acknowledged in the HMI prior to restart.
4. All equipment shall be controlled independently of each other when operated in manual unless otherwise indicated.
5. Each control function shall be implemented using the programmable hardware in the designated processor. No functions shall be developed using hardwired relay logic.
6. The following shall be provided in addition to the indications above.
    a. ANALOG DATA SCALING: This control function shall scale all analog inputs to a common span and shall normalize the digital representation of each analog input to a percent of the operating span. The processed value shall be expressed as a binary number that specifies the analog input's position on a straight line lying between zero and full scale as defined for a given input by the zero and span values in the data base.
    b. AMPLITUDE LIMIT CHECK: This control function shall perform dual level, high/low amplitude limit checking and shall identify a limit violation every time a measured or virtual variable goes out-of-limits and returns back into limits. The control function shall determine the time at which each limit excursion occurred. A deadband shall be provided on each limit and shall be expressed as a percentage of span or in engineering units. Low and high limiting default values shall be set-up for each measured or calculated variables used in the process control loops.

c. ENGINEERING UNIT CONVERSION: This control function shall convert scaled analog data to engineering units by means of the following equation:

$Y = (H - L) (D/DH) + L$

where:

Y = value in engineering units

H = high value of span, expressed in engineering units

L = low value of span, expressed in engineering units

D = digitized scaled input value in counts

DH = full scale digitized value in counts

7. All equipment shall be controlled independently of each other when operated in manual unless otherwise indicated.

G. Hardware: CONTRACTOR shall provide all the hardware, as shown, specified, or required to implement the control strategies as described.

H. Configuration: All set points, tuning parameters, and engineering scales shall be documented for each control point and each control strategy on configuration sheets or similar documents. These documents shall be updated during Factory Testing and finally during start-up.

I. Control Strategy Displays: Control strategy displays shall be submitted for review. Displays shall clearly show initial conditions, start, and progression of the control strategies. Each control strategy shall be displayed in a minimum number of displays for ease of monitoring by the Operator.

J. Plant Power Failure: Plant equipment controlled by the control system shall be programmed to automatically reset upon failure. The reset and restart sequence shall be enabled through the PCS. When power is restored select process equipment as approved by the ENGINEER shall be permitted to restart.

K. Restart: Equipment and motors that can safely be restarted shall be automatically restarted after power failure by the control system in an orderly time delayed sequence approved by the ENGINEER. Equipment that requires Operator intervention shall be prompted for restart following power restoration.

L. All relays, tuning parameters, scales, configuration values, mathematical constants, equations, and set points given in the control strategies are adjustable over a wide range. The values given are initial and may change during Shop Drawing review and may have to be readjusted during start-up.

1.3 COORDINATION WORKSHOPS

A. I&C Subcontractor shall attend programming workshops with OWNER. The content of these workshops shall include PLC and HMI programming, including documentation and security. Prior to the development of the control strategies these workshops shall be scheduled and completed. (2) workshops shall be held, each 4 hours in length.

1.4 SUBMITTALS

A. The control strategies are written descriptions of the basic configuration and/or programming required to implement regulatory and sequential control of the unit processes as shown on the P&IDs. They do not in all cases describe the process characteristics fully. Finalizing and tuning of strategies, as required, by process characteristics shall be accomplished during start-up. Control strategies shall fully reside in the memory of the designated PLC. The process inputs/outputs referred to in the Control Strategies are shown on the P&IDs.

B. I&C Subcontractor shall furnish control strategy diagrams, configuration sheets and control strategy descriptions as shown, specified and required to configure a complete and operational system. They shall incorporate revisions to the Contract P&IDs, these control descriptions, the I/O listing, interlocks, alarms, reporting requirements and manufacturer equipment requirements.
   1. Shop drawing review.
   2. Factory test.
   3. Following system startup and commissioning.

PART 2 – PRODUCTS

2.1 PERFORMANCE

A. Purpose of the Control Descriptions:
   1. The following descriptions explain the proposed monitoring and control scheme for each piece of equipment in each process area, with additional control operations listed in Specification Division 46.
   2. Equipment that is just monitored will be indicated as “Just monitoring, no control.”

B. Update digital inputs and analog inputs in the processor controller within 1 second of a change of state for digital inputs or exceeding the exception deadband for analog inputs.
   1. Display response time is the elapsed time from the instant the display request is made by the operator, to the instant the display is completely shown on the operator workstation. Meet the following display response times:
      a. For graphic displays average 1 second with a maximum of 2 seconds for static and dynamic data fields. Update dynamic fields every 2 seconds.

b. For real-time trend displays average 2 seconds with a maximum of 3 seconds.
c. Average 1.5 seconds with a maximum of 3 seconds for other displays which do not require access to historical data.
d. For historical data displays, do not exceed 10 seconds to retrieve and display data.

2. The operator workstation response time is the elapsed time from the instant an operator request has been made and the instant the request is executed at the processor. Average 1 second with a maximum of 2 seconds for control related requests including, but not limited to, start/stop, open/close, setpoint changes, and control strategy auto/manual status changes.
3. The report request time is the elapsed time from the instant a report request is made to the instant the printing of the report begins. Do not exceed 30 seconds.
4. Accept data entry at 60 words per minute typing speed.
5. Reload the system software for entire system within 1 hour.
6. Demonstrate performance at Factory Testing and Field Testing.
7. Meet a system availability of 99.7 percent over 90 consecutive days.

PART 3 – EXECUTION

3.1 CENTRIFUGE OPERATIONS

A. General:
1. Plant sludge flow is pumped from the sludge feed pumps in the Sludge Holding Building to the Solids Handling Building. (2) sets of 3 sludge feed pumps can be used, with a maximum of 3 total pumps running simultaneously. The sludge feed pumps have VFD control, with the Centrifuge Control Panels providing speed control via the Ethernet network. The polymer feed system will be flow paced based on the amount of sludge flow that enters the building. The Centrifuge Control Panel will provide the flow pacing control of the polymer feed systems. The existing washwater pumps will provide wash water to the Centrifuge system. The Centrifuge Control Panel will provide control of the Water Booster System pumps.

B. Local Control:
1. Provided by vendor. See Section 46 76 33, Dewatering Centrifuges, for Centrifuge operations.

C. Interlocks:
1. See Section 46 76 33, Dewatering Centrifuges.

D. Operation:
1. All logic for Centrifuge operations shall be performed by the vendor PLC in each Centrifuge Control Panel, located in the Solids Handling Building.

E. SCADA Monitoring:
   1. All available signals from the Centrifuge Control Panels shall be available via the plant Ethernet network system.
   2. All available signals from the existing Sludge Feed Pumps shall be provided via the plant Ethernet network system.
   3. All available signals from the Water Booster System pumps shall be provided via the plant Ethernet network system.

3.2 SOLIDS HANDLING CENTRIFUGE POLYMER FEED

A. General:
   1. The Solids Handling Polymer Feed System consists of a skid located inside the Solids Handling Building, with 3 Polymer Blending Units.

B. Local Control (each unit):
   1. When the HAND-OFF-REMOTE selector switch on the local control panel (LCP) is in the HAND position:
      a. The polymer system shall run.
      b. Speed control of the metering pump and mixer shall be from their respective speed potentiometers.
   2. When the HAND-OFF-REMOTE selector switch is in the OFF position, the polymer system shall not operate.

C. Remote Control (each unit):
   1. When the HAND-OFF-REMOTE selector switch on the LCP is in the REMOTE position, the polymer system shall be controlled from the Centrifuge Control Panel PLC in either a manual or automatic mode, as selected at the OIT:
      a. Manual Mode: Polymer system shall be controlled from a start/stop selector switch on the OIT. Metering pump speed shall be controlled from the OIT.
      b. Automatic Mode: Polymer system shall be started automatically by the PLC when the sludge pumps at the WRF are called to run. Polymer system shall remain running until the sludge pumps are stopped. Metering pump speed shall be automatically adjusted by the PLC to maintain a speed setpoint as selected by the operator.

D. Interlocks:
   1. None.

3.3 CONVEYOR OPERATIONS

A. General:
   1. Conveyor Operations shall remain unchanged, with safety interlocks being provided from the Centrifuge Control Panels to replace interlocks with the removed Belt Filter Press System.

+ + END OF SECTION + +

SECTION 40 64 00

PROGRAMMABLE LOGIC CONTROLLERS

PART 1 – GENERAL

1.1 DESCRIPTION

A. CONTRACTOR shall furnish all labor, materials, and components, and shall provide all design, assembly, testing, and start-up services required to provide a complete and operational programmable controller (PLC) system as specified and shown on the Drawings. The existing plant PLC is an Allen-Bradley 1756 ControlLogix based rack, CPU, and Ethernet network module system. The system includes, but is not necessarily limited to the following:
   1. PLC processors.
   2. PLC I/O modules, chassis, and power supplies.
   3. Operator Interface Terminals (OIT) for interfacing with PLCs.
   4. PLC communications systems to distributed I/O racks and to HMI computers.
   5. Industrial Ethernet Switch for network communications.
   6. PLC system detailed design, assembly, installation, testing, and start-up services.

B. The plant PLC system configuration shall be as shown on the Drawings and specified herein. The PLC system configuration was developed using Allen Bradley ControlLogix processors and 1756 input/output modules as the basis of design. Some variations in the configuration will be considered provided the physical and functional constraints as intended for the various system components are met.

C. The Process and Instrumentation Diagrams (P&ID's) and the specifications of this Section and the other Division 40 Sections generally illustrate and describe the overall PLC System requirements.

D. All equipment shall be constructed specifically for the demanding requirements of real-time process management and control on a continuous basis for use in a municipal wastewater treatment plant.

1.2 SUBMITTALS

A. Comply with the requirements of Section 40 61 13, Process Control System General Provisions.

1.3 QUALITY ASSURANCE

A. Comply with the requirements of Section 40 61 13, Process Control System General Provisions.

1.4 EQUIPMENT DELIVERY, HANDLING, AND STORAGE.

A. Comply with the requirements of 40 61 13, Process Control System General Provisions.

PART 2 – PRODUCTS

2.1 PLC SYSTEM GENERAL REQUIREMENTS

A. All materials and equipment furnished shall be new, free from defects, and of first quality, produced by manufacturers who have been regularly engaged in the manufacture of these products.

B. All materials furnished under this Contract shall be determined safe by either Underwriters Laboratories, Inc., or Factory Mutual and all material shall be labeled, certified, or listed by the testing agency.

C. Provide PLC processors, communication modules, local and remote I/O components, and other hardware and system components required for a complete functioning PLC System to meet the intent of the configuration drawing and as listed in the PLC System I/O Schedule at the end of this section. The PLC shall be configured to perform the functions shown on the Contract Drawings and specified herein.

D. The PLC shall be designed, constructed and tested in conformance to NEMA Standard ICS 3-304 for programmable controllers, and shall be suitable for use under the following environmental conditions:
   1. Operating Temperature: 32° to 140°F.
   2. Relative Humidity: 5% to 95% non-condensing.
   3. Shock: 30 G peak acceleration for 11ms duration.
   4. Vibration: 10 to 500 Hz, 2.0g maximum peak acceleration.

E. The PLC shall be capable of being programmed in both an off-line (program) mode and an on-line (run) mode by means of a portable personal computer based laptop programming unit connected to the PLC processor installed in the system I/O chassis and/or connected to the processor via the PLC System Ethernet Communication Link at a remote location. On-line data and program logic changes shall not necessitate halting the processor.

F. The PLC shall be a complete system of modular design consisting of the following major components:
   1. PLC (CPU) processor modules.
   2. Discrete and Analog I/O modules of the types and quantities described in the Input/Output list at the end of this Section.
   3. Chassis for housing, distributing power to, and providing digital interfacing of the CPU and I/O modules.

4. 120 VAC system power supply for providing DC operating power to the chassis, processor, and I/O modules.
5. Communications to distributed I/O racks and to the HMI.
6. Miscellaneous communications hardware and wiring components necessary for a complete functioning PLC system.

G. All system modules shall be designed for easy removal from and replacement in the chassis. The PLC shall be designed to allow removal and insertion of any module under power without disruption to the system. All discrete and analog I/O modules shall be designed to permit module removal and re-installation without disturbing or disconnecting any field wiring terminations.

H. Electronic keying shall be used to prevent insertion of an I/O module into the wrong chassis slot, once the slot assignments and module layouts are finalized.

I. The PLC editor shall be IEC-1131 compliant.

2.2 APPLICATION PROCESSOR (CPU)

A. Type: Microprocessor based, industrial, CPU with high quantities of I/O available.

B. Non-Volatile Memory: 1 gigabyte Secure Digital non-volatile memory.

C. Processor Memory: 2 megabyte Static RAM. Energy storage module shall maintain memory for a minimum of one (1) year with no power applied to the processor.

D. Program Scan Rate: less than 1ms typical.

E. Diagnostics:
   1. Standard, self-diagnostic routines shall be provided to determine proper hardware and software operation.
   2. Diagnostic LED's shall be provided on the processor front panel to indicate the following:
      a. Processor running.
      b. Processor fault.
      c. Battery low.
      d. Forced I/O.
      e. Communications active.
      f. Communications error.

F. System Communications: The PLC shall be equipped with a USB port for connection to the PLC system and programming unit.

G. Instruction Set:
   1. The PLC shall be equipped with the following instructions as a minimum:
      a. Ladder and Function Block programming.

b. Ladder-logic or relay-type logic Functions: Normally open contacts, normally closed contacts, and output coils.
c. Timers: On delay, off delay, and retentive.
d. Counters: Up, down.
e. Math Functions Including Integer and Floating Point: Add, subtract, multiply, divide, and square root.
f. Data Transfer Instructions: Bit, word, and file.
g. Logical Instructions: AND, NOT, OR, XOR.
h. Compare Instructions: Equal to, greater than, less than.
i. Control: Proportional - Integral - Derivative control instruction.
j. Advanced instruction set including file handling, sequencer, diagnostic, shift register, immediate I/O, and program control instructions.

2. The PLC shall support branching functions to allow any combination of series or parallel instructions.
3. The PLC shall support the use of subroutines where appropriate.

H. Clock: Battery-backed clock with a typical variation of ± 20 seconds per month.

I. Manufacturer and Model:
1. Allen Bradley 1756-L71 ControlLogix 5571 processor.
2. Or equal.

2.3 PLC POWER SUPPLY

A. Each PLC processor or remote rack with I/O shall include a separate power supply. The power supply shall be mounted alongside the I/O.

B. Input Voltage: 120 VAC, 60 Hz.

C. Output Current: Coordinate Power Supply output with equipment provided. As a minimum, provide 10 amp at 5 VDC.

D. Provide all cabling as required.

E. Manufacturer and Model:
1. Allen Bradley 1756-PA75.
2. Or equal.

2.4 PLC CHASSIS

A. Each PLC processor or remote rack with I/O shall be mounted within a chassis, which serves as a backplane to the PLC circuitry.

B. Chassis shall be mountable within PLC control panel on subpanel.

C. Provide slot fillers for unused slots.

D. Manufacturer and Model:
   1. Allen Bradley 1756-A13.
   2. Or equal.

2.5 PLC I/O MODULES

A. Available Types: The types of I/O modules available for use with the PLC system shall be as specified and as identified in the input/output list.
   1. Sixteen point discrete input modules which accept an input of 115 VAC, 60 Hz. The discrete input modules shall be Allen Bradley Model 1756-IA16, or equal.
   2. Sixteen point individually isolated relay output modules. The output modules shall be Allen Bradley Model 1756-OW16I, or equal.
   3. Six point isolated analog input modules (16 bit resolution) which accept an input of 4-20 mA DC. The analog input modules shall be Allen Bradley Model 1756-IF6I, or equal.
   4. Six point isolated analog current output modules (16 bit resolution) which produce an output of 4-20 mA DC. Analog output modules shall allow selectable output response to faults of minimum, maximum, or last output value. The analog output modules shall be Allen Bradley Model 1756-OF6CI, or equal.

B. Required Features: The I/O modules and system hardware supplied shall incorporate the following design and construction features and comply with the following requirements:
   1. Noise immunity and filtering.
   2. IEEE surge-withstand rating to IEEE 472.
   3. Optical isolation for all inputs and outputs to provide controller logic protection.
   4. Any card, plug-in packaging, with locking bars and/or screws to hold I/O modules in place.
   5. 300 volt, screw type, I/O wiring terminal arms sized to accommodate a minimum of two #14 AWG wires per terminal. Wiring design shall allow I/O module removal and replacement without disturbing I/O wiring connections.
   6. Front-of-module LED Status indicators for each individual input and output point to indicate when power is applied at I/O terminals.
   7. Fused output circuits for all output modules. Front panel indication shall be provided for blown fuse status.
   8. Where required and recommended by the manufacturer, external transient suppressors shall be provided for installation across the output loads.
   9. Scaling to engineering units for analog modules.
   10. Provide required connectors with each I/O module.

C. For each PLC, provide installed I/O capacity of the types and quantities as identified in the Input/Output Schedule, plus an additional 25% spare capacity for each type of I/O. All I/O, including future and spare, shall be wired to terminal blocks prior to interconnection with other devices.

D. Provide blank cover plates for unused chassis slots.

2.6 PLC COMMUNICATION INTERFACE MODULES

A. The PLC system shall include communication bridge modules as required for system communications. Modules shall enable the PLC processor to communicate with the remote input/output stations and HMI at a minimum of 10Mb/sec.

B. Manufacturers and Models:
   1. Allen Bradley ControlLogix Compatible Modules:
      a. Ethernet Communication Interface: Allen Bradley 1756-EN2T Ethernet/IP Bridge Module.

2.7 WIRING ACCESSORIES

A. Provide wiring accessories including but not limited to connectors, taps, terminator lugs, and screw clamp blocks as recommended by the manufacturer for a complete PLC system installation.

2.8 BACKUP POWER UNIT

A. A backup power unit shall be provided for each panel housing a PLC or remote rack.

B. Backup power unit shall be self-contained, and shall fit inside the PLC enclosure.

C. Backup power unit shall be as specified in Section 40 78 00, Panel Mounted Instruments and Devices.

2.9 OPERATOR INTERFACE TERMINALS (CENTRIFUGE PANELS)

A. General: The OIT shall provide a means of communicating with the local PLC. The OIT shall continue to function in the event of a failure of the Fiber Optic/Ethernet Backbone for the PLC network. Provide an OIT where indicated on the Drawings and connect to the local PLC.

B. The OIT shall meet the following requirements:
   1. Display Screen Resolution: 1024 X 768 pixels, 256k colors minimum.
   2. Display type: Color Active Matrix Thin Film Transistor.
   3. Touch Screen.
   4. Memory: 512 MB nonvolatile memory and 512 MB of random-access memory minimum.
   5. Storage Memory: 1 Secure Digital high-capacity (SDHC) slot.
   6. Supply Voltage: 120 VAC.
   7. Communications:
      a. Ethernet/IP.
      b. RS-232 Serial.
      c. ControlNet.

d. Physically connect only the communications methods as shown on Drawings.

8. Mounting: Unit shall be mounted on the front face of enclosure, as indicated on the Drawings.
9. Provide 12 protective overlays for screen.
10. NEMA 4X enclosure and display minimum.

C. Operating System and Application Software:
1. Windows CE 6.0 operating system.
2. FactoryTalk View ME software, version 6.0 or later.
3. Provide all drivers and cards needed for communications to the PLCs.
4. Manufacturer and Model:
a. Model PanelView Plus 7 Model 2711P-T15C4A8, (Display Screen Size: 15.0 inches, diagonally measured, backlit) as manufactured by Allen-Bradley.
b. Or equal.

2.10 OPERATOR INTERFACE TERMINALS (REMOTE I/O PANEL)

A. General: The OIT shall provide a means of communicating with the local PLC. The OIT shall continue to function in the event of a failure of the Fiber Optic/Ethernet Backbone for the PLC network. Provide an OIT where indicated on the Drawings and connect to the local PLC.

B. The OIT shall meet the following requirements:
1. Display Screen Resolution: 1024 X 768 pixels, 256k colors minimum.
2. Display type: Color Active Matrix Thin Film Transistor.
3. Touch Screen.
4. RAM Memory: 4 GB DDR3 installed, 16 GB max, solid state drive.
5. Primary Storage Media: 32 GB SLC, 2.5 in. SATA, or 256 GB MLC, 2.5 in.
6. Available Processor: Intel i3-4102E.
7. Available Windows Operating Systems: 7 Pro SP1 64 bit or 10 IoT Enterprise 64 bit.
8. Supply Voltage: 120 VAC.
9. Communications:
a. Ethernet/IP.
b. RS-232 Serial.
c. ControlNet.
d. Physically connect only the communications methods as shown on Drawings.
10. Mounting: Unit shall be mounted on the front face of enclosure, as indicated on the Drawings.
11. Provide 12 protective overlays for screen.
12. NEMA 4X enclosure and display minimum.

C. Application Software:
1. FactoryTalk View ME software, version 6.0 or later.

2. Provide all drivers and cards needed for communications to the PLCs.
3. Manufacturer and Model:
    a. Model VersaView 6181P-17TPXPSS, (Display Screen Size: 17.0 inches, diagonally measured, backlit) as manufactured by Allen-Bradley.
    b. Or equal.

2.11 MANAGED INDUSTRIAL ETHERNET SWITCH

A. General Switch Information:
1. Provide a managed, DIN rail mount Ethernet switch for segment connection of the remote site PLCs, radios, operator workstations, and other related network devices, as shown on the Drawings.

B. Required Features:
1. Minimum of six (6) 10/100Base-T Ethernet ports (RJ-45).
2. Minimum of two (2) gigabit Ethernet uplinks.
3. Flash Memory: Minimum 64 MB onboard.
4. DRAM: Minimum 256 MB with ECC memory.
5. Forwarding Rate: 6.5 Mbps with 64-byte packets.

C. Operating Conditions:
1. Power Supply: Dual input, plug-in terminal block, 3-pin.
2. Operating Voltage: 24 VDC.
3. Operating Temperature: -40 to 75 degrees Celsius.
4. Relative Humidity: 5 to 95 percent noncondensing.
5. Mounting: DIN Rail.

D. Performance Features:
1. Support spanning tree protocol.
2. Configurable for multiple VLANs.
3. Layer 3 Routing: IPv4 and IPv6.
4. Switch Management: Auto SmartPort, Web Device Manager, Telnet, HTTPS access, SNMP, CNA, and Cisco Prime Infrastructure 1.2.1.
5. Comply with IEEE 802.3x Full-Duplex on 10Base-T ports.
6. Security: 802.1x, port security, and DHCP allow dynamic port-based authentication; Secure Shell (SSHv2); SNMPv3 provides encrypted administrator traffic during Telnet and SNMP sessions; TACACS+ and RADIUS authentication facilitate centralized control and restrict unauthorized users.

E. Product Manufacturer and Model:
1. IE 2000 managed switches, as manufactured by Cisco.
2. Or equal by N-Tron.

2.12 INPUT/OUTPUT SCHEDULE

A. An Input/Output (I/O) schedule for the programmable controller system is included in Section 40 61 93. CONTRACTOR shall provide the input/output capacity necessary to facilitate the system functional requirements as specified and shown on the Drawings.

2.13 SPARE PARTS AND EXPENDABLE MATERIALS

A. The following spare parts and expendable materials shall be provided as a minimum, for the PLC System:
   1. Two (2) of each type I/O module for each ten or fraction thereof used in the system.
   2. One of each type of the following modules used in the system:
      a. Processor modules.
      b. Communications modules.
      c. Any other type of special function modules.
   3. One (1) replacement power supply and interconnecting cable for each type used in the system.
   4. One (1) replacement I/O chassis for each size used in the system.
   5. Ten (10) percent of total quantity of each type of fuse used in the system.
   6. Ten (10) percent of total quantity of each type of lamp used in the system.

B. All spare parts shall be individually packaged for protection against impact, moisture, and dirt. Each package shall be clearly labeled as to its contents with a description and part number.

C. All spare parts shall become the property of the OWNER. CONTRACTOR shall maintain the spare parts inventory as listed above, and replace, at no additional cost, all spare parts consumed during the one-year warranty period.

PART 3 – EXECUTION

3.1 INSTALLATION REQUIREMENTS

A. General:
   1. Install all equipment and components in accordance with the Drawings, approved Shop Drawings, and installation instructions furnished by the manufacturer.
   2. Do not begin installation of system hardware and panels until building construction is completed and major equipment has been installed.
   3. Maintain areas where instruments, control panels, and enclosures are being or have been installed, dust free and within the environmental conditions specified for the equipment.
   4. Inspect each instrument, panel and other items for damage and defects before installation. Replace deficient items.

5. The PLC and I/O racks shall be installed such that all LED indicators and switches are readily visible with the panel door open and such that repair and/or replacement of any PLC component can be accomplished without disconnecting any wiring or removing any other components.
6. Comply with the other specific installation, start-up, and testing requirements as specified in the other Division 40 Sections.

+ + END OF SECTION + +

SECTION 40 67 17

PROCESS CONTROL PANELS AND ENCLOSURES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope of Work:
   1. CONTRACTOR shall furnish, install, test, and place into satisfactory operation the control panels, enclosures, and panel devices as shown on the Drawings and specified herein.
   2. Operational and functional requirements for the various panels are shown in control schematics, pneumatic diagrams, and/or functional instrumentation diagrams on the Instrumentation (I) drawings and Electrical (E) drawings.
   3. The Drawings and Specifications illustrate and specify functional and general construction requirements of the panel components and do not necessarily show or specify all components, wiring, piping, and accessories required to make a completely integrated system. CONTRACTOR shall provide all piping, wiring, accessories, and labor required for a complete, workable, and integrated system.
   4. Process system equipment control panels which are to be furnished as part of a "packaged" system by the various system equipment vendors, are identified by asterisks (*) on the Instrumentation (I) drawings. Operational and functional requirements for these panels are specified in the various Division 40, 43, and 46 Sections and are shown on the Process and Instrumentation Diagrams.

1.2 QUALITY ASSURANCE

A. Standards, Codes and Regulations:
   1. Construction of panels and the installation and interconnection of all equipment and devices mounted within shall comply with applicable provisions of the following standards, codes, and regulations:
      a. National Electrical Code (NEC).
      b. National Electrical Manufacturer's Association (NEMA) Standards.
      c. Institute of Electrical and Electronics Engineers, Inc (IEEE).
      d. Local and State Building Code.
      e. Operational Safety and Health Administration (OSHA) Regulations.
      f. American Society for Testing and Materials (ASTM).
      g. Where any conflict arises between codes or standards, the more stringent requirement shall apply.
   2. All electrical materials and equipment shall be new and shall bear the label of the Underwriters Laboratory (UL), Inc., Factory Mutual (FM) or equivalent where standards have been established and label service regularly applies.

B. Acceptable Manufacturers:
   1. Furnish panel instruments and devices by the named manufacturers or equal equipment by other manufacturers.
   2. The named manufacturers have been specified to establish the standard of quality and performance of the equipment to be supplied.
   3. Obtain all instruments or devices of a given type from the same manufacturer.

C. General Design Requirements:
   1. Comply with the requirements of Section 40 61 13, Process Control System General Provisions.

D. Factory Assembly and Testing:
   1. Fully assemble and test each enclosure and panel at the factory prior to shipment, demonstrating that all specified functions are performed.
   2. Comply with the requirements of Section 40 61 21, Process Control System Factory Testing.

1.3 SUBMITTALS

A. Comply with the requirements of Section 40 61 13, Process Control System General Provisions.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Comply with the requirements of Section 40 61 13, Process Control System General Provisions.

PART 2 – PRODUCTS

2.1 GENERAL CONSTRUCTION REQUIREMENTS

A. Provide all electrical and/or pneumatic components and devices, support hardware, fasteners, interconnecting wiring and/or piping required to make the control panels complete and operational units. Provide bulkhead fittings for all air piping and tubing penetrating control enclosures.

B. Locate and install all devices and components so that connections can be easily made and so that there is ample room for servicing each item.

C. Components for installation on panel exterior shall be located as shown on the Drawings. Layouts shall be submitted for approval as per Section 40 61 13, Process Control System General Provisions. All exterior panel mounted instruments shall have a NEMA rating equal to the enclosure. For devices that cannot be obtained with a NEMA rating equal to the enclosure, mount the device behind a transparent viewing window as specified below. The window shall maintain the NEMA rating of the enclosure.

D. Where permitted by location and layout as shown on the Drawings, all panels and enclosures shall have full height rear access doors. Where rear doors are not possible, panels shall have full height front access doors.

E. Adequately support and restrain all devices and components mounted on or within the panel to prevent any movement.

F. Provide subpanels for installation of all internally mounted components. All free standing control panels shall include full height rear and side subpanels, where enclosure layout permits. All wall mounted, frame mounted, and floor mounted enclosures shall include full height rear subpanels.

G. Provide mounting strips for installation of all relays and other components where mounting strips are practical.

H. All wiring to panel connections from field instruments, devices, and other panels shall be terminated at master numbered terminal strips, unless otherwise specified.

I. Provide the following convenience accessories listed below inside of each free-standing control panel. The accessories are shown as the "utility circuit" on the Contract Drawings and shall have their own circuit breaker and separate power feed.
   1. At least one 120 VAC, 15A duplex, grounding type receptacle.
   2. One or more 120 VAC LED light fixtures with minimum 15 watt lamp and protective plastic shield, as required to span across a minimum of two-thirds of the panel width. LED shall activate upon opening the enclosure door.

J. The bottom 12 inches of free standing panels shall be free of all devices, including terminal strips, to provide ease of installation and testing.

K. Front panel indication and control devices shall be mounted within a range of 42 to 68 inches above the operating floor. No indication or control devices shall be mounted less than 36 inches above the operating floor level unless otherwise specified or shown on the Drawings.

2.2 IDENTIFICATION

A. Provide laminated plastic nameplates and legend plates for identification of panels, enclosures, and components mounted thereon as follows:
   1. Nameplates shall be of 3/32 thick laminated phenolic type with white matte finish and black letter engraving.
   2. Panel identification nameplates to have 1/2-inch high letter engravings.
   3. Panel mounted component identification (i.e. control devices, indicating lights, selector switches, etc.) nameplates and legend plates to have 1/4 inch high letter engravings, unless otherwise noted on the Drawings.
   4. Nameplates shall be attached to the panel face with two stainless steel self-tapping screws and self-backed adhesive.

5. Nameplate engravings shall include the descriptive title indicated on the Drawings and Specifications.

B. Tag all panel mounted instruments in accordance with Section 40 70 05, Primary Sensors and Field Instruments, Article 2.1.

C. Tag all electrical components and devices mounted within control panel enclosures with engraved nameplates as specified in Paragraph A. above. Tag all door-mounted devices on the rear of the door with engraved nameplates as specified in Paragraph 2.2A above. All interior panel nameplates shall be attached with self-backed adhesive.

D. Tag all pneumatic lines with plastic tags. Paper tags are not acceptable.

E. Numerically code terminals on terminal strips.

F. Numerically code wiring as required by applicable standards. Wires shall be identified at each end with permanent alphanumeric codes as specified below. All wiring not de-energized by the panel disconnect or circuit breaker shall be orange wire.

G. For all panels containing wiring not de-energized by the panel disconnect or circuit breaker, provide a warning nameplate on the front of the panel stating "WARNING ORANGE WIRING NOT DE-ENERGIZED BY PANEL DISCONNECT". The nameplate shall be amber with black, ¼- inch high letter engravings and shall be attached to the panel face with stainless steel screws and adhesive.

2.3 PANELS AND ENCLOSURES

A. General:
1. Panels and enclosures shall meet the NEMA requirements for the type specified and/or as shown on the Drawings.
2. Sizes shown on the Drawings are estimates. CONTRACTOR shall furnish enclosures of the size required to house all equipment, instruments, front panel mounted devices, power supplies, power distribution panels, wiring, tubing, and other components installed in the enclosures.

B. Construction Features:
1. All control panels shall be fabricated in accordance with the NEMA ratings specified and/or as shown on the Drawings.
   a. Provide lifting eye bolts to facilitate handling of the enclosures, where enclosure size requires. Bolt lifting eyes directly to the enclosure structural members.
   b. Continuously weld all exterior seams and grind smooth. Surface grind complete removal of corrosion, burrs, sharp edges, and mill scale.
   c. Reinforce sheet steel with steel angles where necessary to adequately support equipment and ensure rigidity and to preclude resonant vibrations.

d. Panel shall be flat within 1/16-inch over a 24-inch by 24-inch area, or flat within 1/8-inch for a larger surface. Flatness shall be checked by using a 72-inch long straight edge. Out-of-flatness shall be gradual, in one direction only, and shall not consist of obvious depressions or a series of wavy sections.
e. Use pan type construction for doors. Door widths shall not exceed 36 inches.
f. Mount doors with full-length heavy-duty piano hinge with stainless steel hinge pins.
g. Provide oil resistant gasket completely around each door or opening.
h. Use stainless steel fasteners throughout.
i. Provide interior mounting panels and shelves constructed of minimum 12-gauge steel with a white enamel finish. All free-standing control panels shall include full height rear and side subpanels where enclosure layout permits. All wall mounted, frame mounted, and floor mounted enclosures shall include full height rear subpanels.
j. Provide steel print pocket with white enamel finish.
k. Provide enclosure mounting supports and/or bases as required for floor, frame, or wall mounting and for free standing enclosures.
l. All panels outside of control rooms shall have solid bottoms.
m. Provide all holes and cutouts for installation of conduit and equipment. Cable and piping shall enter the enclosure through the bottom unless otherwise noted. All conduit and piping openings and all conduits shall be sealed watertight.

2. Control panels located in control or electrical room areas shall be NEMA 12 rated unless otherwise noted on the Drawings.
   a. Fabricate enclosures using minimum 14-gauge steel for wall or frame mounted enclosures and minimum 12 gauge for floor mounted and free standing enclosures. Steel shall be free of pitting and surface blemishes.
   b. For floor mounted enclosures, provide minimum 12 gauge steel floor stand kits bolted to the bottom of the enclosure and sealed and gasketed to maintain NEMA 12 rating. Floor stand heights shall be coordinated with enclosure sizes and base pads so as to comply with the general indication and control device mounting height requirements as specified herein and/or as shown on the drawings. Floor stands shall be mounted on base pads using anchor bolts and/or expansion anchors as specified in Paragraph 3.g below.
   c. Free-standing enclosures shall be constructed with an integral fully enclosed solid bottom section at least 6 inches in height from the bottom of the enclosure to the bottom edge of the enclosure door opening. Free-standing enclosures shall be mounted on base pads as specified in Part 3 below.
   d. Provide handle-operated, oil-tight, key-lockable three-point stainless steel latching system with rollers on latch-rods for easy door closing.
   e. Completely clean all interior and exterior surfaces so they are free of corrosive residue, oil, grease, and dirt. Zinc phosphatize for corrosion protection.

f. One coat of primer shall be applied to all interior and exterior surfaces immediately after corrosion protection has been applied. Exterior surfaces shall then be given sufficient coats of primer surfacer, applied with sanding and cleaning between coats, until a Grade 1 finish can be produced on the finish coat.

g. All interior surfaces shall be painted with 2 coats of semi-gloss white enamel.

h. All exterior surfaces shall be painted with a minimum of 3 finish coats of enamel to ultimately produce a Grade 1 finish (super smooth; completely free of imperfections). Color to be selected by Engineer from complete selection of standard and custom color charts furnished by the manufacturer.

i. Primer and finish paint shall be compatible and shall be a low VOC, high solids polyurethane enamel as manufactured by Sherwin Williams, or equal.

j. Provide one extra quart of touch-up paint for each exterior finish color.

3. All control panels located outside, or located in corrosive areas shall be NEMA 4X rated stainless steel.

a. Panels shall be Type 304 stainless steel construction with a minimum thickness of 12-gauge for all surfaces (except those areas requiring reinforcement) having a smooth brushed finish.

b. Provide stainless steel fast-operating clamp assemblies on three sides of each door.

c. Provide a rolled lip around three sides of door and along top of enclosure.

d. Provide a hasp and staple for padlocking. Provide padlock for each enclosure, all keyed alike.

e. Provide custom fabricated sun shields for all outdoor panels as shown on the Drawings.

1) Sun shields shall be fabricated from minimum 10 gauge aluminum, and shall be designed, fabricated, installed and supported to fully cover and shade the top, sides and back of the enclosure, and to partially shade the front panel of the enclosure, from direct exposure to sunlight from sunrise to sunset.

2) Sun shields shall not be attached directly to the enclosure by drilling holes through, or welding studs to, the enclosure surfaces, and shall be designed and mounted to provide a minimum 1 inch air gap all around the enclosure for air circulation and heat dissipation.

3) The top section of all sun shields shall be sloped at a minimum angle of 5 degrees from horizontal. For wall-mounted enclosures, the top section shall slope downward away from the wall and towards the front of the enclosure. For free standing, floor mounted and frame mounted enclosures the top section shall slope downward towards the backside of the enclosure.

4) The front edge of the top section of all sun shields shall incorporate a narrow and more steeply sloped drip shield segment which sheds water away from the front of the enclosure and prevents it from

dripping and/or running directly onto the front panel of the enclosures.

5) All seam welds used in sun shield fabrication shall be continuous and shall be ground smooth.
6) All exposed corners, edges and projections shall be smooth rounded or chamfered to prevent injury.
7) Contractor shall submit detailed sun shield fabrication and support drawings with the enclosure shop drawings for review and approval.

f. Provide a clear plastic, NEMA 4X, gasketed, lockable, hinged door to encompass all non-NEMA 4X front of panel instruments.
g. For floor mounted enclosures, provide 304 stainless steel floor stand kits bolted to the bottom of the enclosure and sealed and gasketed to maintain NEMA 4X rating. Floor stand heights shall be coordinated with enclosure sizes and base pads so as to comply with the general indication and control device mounting height requirements as specified herein and/or as shown on the Drawings. Floor stands shall be mounted on base pads using anchor bolts and/or expansion anchors as specified below.
h. Free standing enclosures shall be constructed with an integral fully enclosed solid bottom section at least 6 inches in height from the bottom of the enclosure to the bottom edge of the enclosure door opening. Free-standing enclosures shall be mounted on base pads as specified below.

2.4 ELECTRICAL SYSTEMS

A. Control of Environment (refer to Section 40 61 13, Process Control System General Provisions for ambient temperature design criteria):
1. Outdoor Panels:
a. Provide adequately sized automatically controlled heaters to maintain temperature inside each enclosure above the minimum required for component operation and to prevent/control interior condensation.
b. Provide automatically controlled closed loop heat exchangers or closed loop air conditioners with filtered air louvers if required to maintain temperature inside each enclosure below the maximum operating temperature rating of the components inside the enclosure. Panel cooling components shall maintain the NEMA rating of the enclosure.
c. Provide internal corrosion inhibitor devices, Hoffman HCI Series or equal, for corrosion control inside of each enclosure.
2. Indoor Panels:
a. Provide adequately sized automatically controlled heaters to maintain temperature approximately 10°F above ambient for condensation prevention inside panels.
b. Provide automatically controlled closed loop heat exchangers or closed loop air conditioners with filtered air louvers if required to maintain temperature inside each enclosure below the maximum operating temperature rating of the components inside the enclosure. Panel cooling components shall maintain the NEMA rating of the enclosure.

c. Provide internal corrosion inhibitor devices, Hoffman HCI Series or equal, for corrosion control inside of each enclosure.

3. Panel heaters shall be thermostatically controlled, fan-driven heaters, with all components mounted in anodized aluminum housing for sub-panel mounting. The heaters shall be powered from 115 VAC from a dedicated circuit breaker and shall be Hoffman Bulletin D-85, or equal.
4. Heat exchangers and air conditioners shall be of a dual loop design to isolate panel interior air from exterior air. The units shall be thermostatically controlled and shall be powered from 115 VAC from a dedicated circuit breaker. The units shall be Hoffman Bulletin D-85, or equal.

B. Power Source and Internal Power Distribution:
1. General: Control panel power supply source type, voltage, number of circuits and circuit ratings shall be as shown on the Electrical Drawings.
2. The panels and enclosures shall be provided with internal 120 VAC DIN rail mounted circuit breakers sized as required to distribute power to the panel components. Provide quantity of circuits as shown on the Drawings or as required. Circuit breakers shall be Allen Bradley Bulletin 1492-CB, 1492-GH, or equal. Each panel and enclosure shall contain two spare circuit breakers minimum. Provide a durable legend mounted near the circuit breakers in each panel which lists the circuit breaker numbers and functional descriptions.
3. Provide DC power supplies of quantities and sizes as required for powering DC signal and control loops.
4. Provide surge suppressors on all power sources as required to protect against damage from electrical surges.
5. All internal power distribution equipment shall be UL listed.

C. Electrical Wiring and Accessories:
1. Unless otherwise specified, internal wiring shall be Type THHN stranded copper wire with thermoplastic insulation rated for 600 V at 85°C for single conductors, color coded and labeled with wire identification.
2. For DC signal wiring, use No. 16 minimum AWG twisted pairs with overall shield.
3. For AC power wiring, use No. 12 minimum AWG. For AC signal and control wiring, use No. 14 minimum AWG. For wiring carrying more than 15 amps, use sizes required by NEC and IEEE standards.
4. Install wiring runs in wire troughs along horizontal or vertical routes to present a neat appearance. Angled runs are not acceptable.
5. Separate and shield DC signal wiring from power and control wiring by a minimum of 4 inches, using separate wire troughs.
6. Where possible or practical in the panels and enclosures, route the low voltage DC signal wiring along the right portion of the enclosure subpanel(s) and route the AC power and control wiring to the left portion of the subpanel(s), with the incoming power and distribution circuit breakers located to the upper left.
7. Group or bundle parallel runs of wire using covered troughs. Maximum bundle size to be 1 inch. Troughs shall have 40 % spare capacity.

8. Adequately support and restrain all wiring runs to prevent sagging or other movement.
9. Terminal Blocks:
    a. Terminate field wiring and internal panel wiring not associated with PLC I/O interface modules at 600 V barrier type terminal blocks, Phoenix Contact UK 5N, Allen-Bradley 1492-W4 or equal.
    b. Terminal blocks shall be tubular screw type with pressure plate capable of accepting #30-#10 wires and shall be mounted on DIN rail. DIN rail by terminal block manufacturer or equal.
    c. End anchors shall be provided on both ends of all terminal strips to firmly anchor the terminal blocks to the mounting rail and insulating end barriers shall be provided on one end of the terminal strip as necessary. End anchors by terminal block manufacturer or equal.
    d. No more than two wires shall be terminated at any single screw. Provide jumpers as required to join adjacent terminal blocks for additional wiring connection points.
    e. All terminal blocks shall be labeled with permanently affixed numeric identifiers on each block. Identifiers shall be self-stick plastic tape strips with permanent, machine printed numbers.
    f. Provide a separate terminal block for landing each analog signal cable shield.
    g. Provide separate terminal strips for DC signal and AC power wiring.
    h. Provide spare terminal blocks equal in number to 20 % of the terminals used for each type of wiring (i.e., DC signal and AC power).
    i. Terminal blocks shall not be installed lower than twelve inches from bottom of control panel.
10. Panel Front Face Port Interface:
    a. Equip Control Panels containing an Ethernet switch with a RJ-45 port and 120VAC (rated at least 3 amps) 3 wire outlet interface for panel mounting. Interface module shall have a dust cover with securing latch, for protection against dust and splashing water. Installation shall maintain the NEMA rating of the panel.
    b. Include External 120VAC outlet in panel power distribution wiring.
    c. Provide Ethernet cable internally from the RJ-45 interface to the Ethernet switch.
    d. Manufacturer and Model: Phoenix Contact HEAVYCON 5600573 or equal.
11. Wire Markers:
    a. All panel wires and field wires shall have an alphanumeric identification tag at each point of termination.
    b. Where practical, wire numbers shall be unique and continuous. Where wire numbers change, the appropriate drawings shall include both wire numbers, clearly indicated, at the point of transition.
    c. Each wire number shall be solid, machine printed, and not pieced from other single and/or double-digit tags.

d. Wire markers shall be heat, oil, water, and solvent resistant, vinyl, self-laminating, self-adhesive, wrap type labels as manufactured by the W.H. Brady Co. or equal.
e. All wire labels shall be clearly visible and not hidden by wire duct or other components in the enclosures.

12. All wiring shall be installed such that if wires are removed from any one device, power will not be disrupted to any other device.
13. All alarms generated external to the panel, spare alarm, and repeat contacts shall be wired out to terminal blocks.
14. Use separate, isolated 5/16-inch diameter copper grounding studs or 1/4 inch thick drilled and tapped copper bus bars for instrument signal cable shield grounding connections and instrument power/equipment grounding system. Shield grounds shall be completely isolated from the enclosure instrument power/equipment grounds.
15. Where wires pass through panel walls, provide suitable bushings to prevent cutting or abrading of insulation.
16. When DC power and/or low voltage AC power is required, provide and install the necessary power supplies and transformers in the panel.
17. Provide circuit breakers to protect each circuit, with no more than six instruments on a single circuit.
18. Provide surge suppressors on field signal wiring as required to protect against damage from electrical surges.
19. All spare field wires within each panel or enclosure shall be coiled, and each coil shall be labeled with the wire destination. Neatly arrange spare wire coils in the bottom of the enclosure.
20. Provide complete wiring diagram showing "as built" circuitry. Diagram shall be enclosed in transparent plastic and placed in easily accessible pocket built into panel door.

2.5 CONTROL PANEL SCHEDULE

A. Information specific to the various control panels furnished as part of the Instrumentation and Control System is listed in the schedule at the end of this Section. Information has been included for panels furnished under other Sections and notations have been made in the schedule accordingly.

B. Every effort has been made to include specific information on control panels, however, some panels may have been inadvertently omitted. If information for any panel has not been included in the schedule below, CONTRACTOR shall verify requirements with the ENGINEER.

Panel/Enclosure Identification	Description	Location	Mounting	Rating	Spec. Section
RIO-RTU-SH	Solids Handling Building RTU-SH Remote I/O Panel	Solids Handling Building Centrifuge Area	Floor Mount	NEMA 4X	40 67 17

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install equipment in conformance with NEC.

B. Unless otherwise noted, install indoor free standing and floor mounted panels on 4-inch grout pad. Lay grout after panel sills have been securely fastened down. Extend pad 4 inches beyond outside dimensions of base, all sides, solid, and face-to-face.

C. Unless otherwise noted, install all frame mounted indoor and outdoor panels and sun shields using strut style structural support framing system members, plates and fasteners as specified in Section 26 05 29, Hangers and Supports for Electrical Systems. Frame bases shall be installed on a minimum one inch thick non-shrink grout pad with edges sloped away from the base plate.

D. Install wall mounted enclosures and control panels and sun shields using strut style support channels securely anchored to wall surface to provide offset mounting for air circulation behind panel. Do not install wall mounted panels directly on wall surfaces. Comply with requirements of Section 26 05 29, Hangers and Supports for Electrical Systems, for support framing system materials and methods.

E. Install anchor bolts and anchor in accordance with Section 05 05 33, Anchor Systems.

F. Install and interconnect all equipment, devices, electrical hardware, instrumentation and controls, and process controller components into and out of and among the enclosures as indicated on the Drawings.

3.2 TESTING AND ADJUSTMENT

A. Perform system testing and make any adjustments necessary in accordance with this Section and with Section 40 61 23, Process Control System Start-up and Field Testing.

B. Perform power supply, voltage adjustments to tolerances required by the appurtenant equipment.

+ + END OF SECTION + +

SECTION 40 70 05

PRIMARY SENSORS AND FIELD INSTRUMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish, install, calibrate, test, adjust and place into satisfactory operation all primary sensors and field instruments shown and specified herein.
   2. Contract Documents illustrate and specify functional and general construction requirements of the sensors and field instruments and do not necessarily show or specify all components, wiring, piping and accessories required to make a completely integrated system. CONTRACTOR shall provide all components, piping, wiring, accessories and labor required for a complete, workable, and integrated system.
   3. CONTRACTOR shall be responsible for installing in-line flow elements (magnetic flow meter flow tubes, insert flow tubes, propeller flow meters) and for providing taps in the process piping systems for installation of other flow, pressure, and temperature sensing instrumentation.

B. Coordination: Coordinate with other suppliers for installation of all items specified herein and required to ensure the complete and proper interfacing of all components and systems.

C. Related Sections:
   1. Section 40 61 13, Process Control System General Provisions.
   2. Section 40 61 23, Process Control System Startup and Field Testing.
   3. Section 40 61 26, Process Control System Training.
   4. Section 40 05 05, Exposed Piping Installation.

1.2 QUALITY ASSURANCE

A. Comply with the requirements of Section 40 61 13, Process Control System General Provisions.

B. Acceptable Manufacturers:
   1. Furnish primary process measurement devices by the named manufacturers or equal equipment by other manufacturers.
   2. The named manufacturers have been specified to establish the standard of quality and performance of the equipment to be supplied.
   3. Obtain all sensors and field instruments of a given type from the same manufacturer.

C. Manufacturers' Responsibilities and Services:
   1. Design and manufacture the primary process measurement devices in accordance with the applicable general design requirements specified in Section 40 61 13, Process Control System General Provisions, and the detailed Specifications herein.
   2. Field supervision, inspection, start-up and training in accordance with the requirements of Section 40 61 23, Process Control System Startup and Field Testing, and Section 40 61 26, Process Control System Training.

1.3 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Comply with the requirements specified in Section 40 61 13, Process Control System General Provisions.

B. Primary process measurement devices shall not be delivered to the Site until all product information and system Shop Drawings for the sensors and instruments have been approved by the ENGINEER.

1.4 SUBMITTALS

A. Comply with the requirements specified in Section 40 61 13, Process Control System General Provisions.

1.5 MATERIALS OF CONSTRUCTION FOR WETTABLE PARTS

A. Provide compatible materials of construction for primary sensors and field instrument (wetted) parts that come in contact with the process fluids listed in the Instrument Index.

1.6 IDENTIFICATION TAGS

A. Performance Requirements:
   1. Tag numbers of sensors and field instruments shall be as shown and as specified. For items not shown or specifically tagged, the item tag number shall be established by the system supplier. All instruments, whether field or panel mounted, shall have an identification tag.
   2. Information to be permanently engraved onto the tag shall include the identifying tag number, manufacturer, model number, service, and range.
   3. The tags shall be fastened to the device with self-tapping stainless steel screws. Where fastening with screws cannot be accomplished the tags shall be permanently attached to the device by a circlet of stranded stainless steel wire rope and clamp.
   4. All sensors and field instruments mounted on or within control panels and enclosures shall have the identification tag installed so that the engravings are easily visible to service personnel. Panel mounted devices shall have the tag attached to the rear of the device.

B. Construction Features:
   1. Tags shall be engraved with 3/16-inch letters and constructed as follows.
      a. 3/32-inch thick laminated phenolic for engraving composed of core, laminated on both sides with a matte (non-glare) finish cover sheet.
      b. Core to be black; cover sheet to be white.
      c. Mounting holes to be centered on width and 1/4-inch from each end.

1.7 FILLING LIQUID

A. Use silicone except for process fluids containing chlorine. When the process fluid contains chlorine, the filling liquid shall be Halocarbon 63 or Flurolube 63.

PART 2 - PRODUCTS

2.1 PROCESS TAPS, SENSING LINES AND ACCESSORIES

A. Water Pressure Sensing Lines and Accessories for Flow and Pressure Transmitters:
   1. Material: Copper Water Tube, ASTM B-88, Type L, drawn temper or annealed.
   2. Pressure Rating: 150 psi.
   3. Size: 1/2-inch O.D. for water.
   4. Connections: Brass Compression Type, "Swagelok" by Crawford, or equal.
   5. Shut-off Valves:
      a. Type: Ball.
      b. Pressure Rating: 150 psi.
      c. Body, Ball and Stem: Brass.
      d. Packing: High Density TFE.
      e. Handle: Nylon with metal travel stops.
      f. Support Rings: TFE coated brass.
      g. End Connections: Removable "Swagelok", or equal.
      h. Model: Whitey 45 Series for water, or equal.
   6. Manifolds:
      a. Type: 5-valve and 3-valve meter manifolds.
      b. Materials: Type 316 stainless steel body, bonnets and stems; delrin seats; teflon packing.
      c. Products and Manufacturers: Provide one of the following:
         1) Anderson-Greenwood.
         2) Or equal.

B. Air Pressure Sensing Lines and Accessories for Air Flow/Pressure Transmitters:
   1. Material: Type 316 stainless steel tubing, ASTM A269, medium wall thickness.
   2. Pressure Rating: 150 psi.
   3. Size: 3/8-inch O.D. for air.

4. Connections: Type 316 stainless steel compression type, "Swagelok" by Crawford, or equal.
5. Shut-off Valves:
    a. Type: Ball.
    b. Pressure Rating: 150 psi.
    c. Body, Ball and Stem: Type 316 stainless steel.
    d. Packing: High density TFE.
    e. Handle: Nylon with metal travel stops.
    f. Support Rings: TFE coated Type 316 stainless steel.
    g. End Connections: Removable "Swagelok", or equal.
    h. Products and Manufacturers: Provide one of the following:
        1) 43 Series, as manufactured by Whitey.
        2) Or equal.
6. Manifolds:
    a. Type: 5-valve and 3-valve meter manifolds.
    b. Materials: Type 316 stainless steel body, bonnets and stems; delrin seats; teflon packing.
    c. Products and Manufacturers: Provide one of the following:
        1) Anderson-Greenwood.
        2) Or equal.

C. Pressure Tap Sensing Lines and Accessories for Pressure Gauges and Pressure Switches:
1. For Process Sensing Taps in Ductile Iron, Steel and Stainless Steel Piping Systems:
    a. Material and Fittings: Type 304 stainless steel pipe (ASTM A 312) and threaded fittings and adapters (ASTM A 403).
    b. Sizes: 1/2-inch minimum for main sensing piping and 1/4-inch gauge and switch connections.
    c. Pressure Rating: Equal to or greater than the applicable system test pressure as specified in the Exposed Piping Schedule in Section 40 05 05, Exposed Piping Installation.
    d. Accessories:
        1) For applications not requiring diaphragm seals, provide separate 1/2-inch Type 316 stainless steel threaded ball valve for each gauge and switch.
        2) For applications requiring diaphragm seals, provide a separate 1/2-inch threaded Type 316 stainless steel ball valve for seal process side shutoff.
2. For Process Sensing Taps in Copper and Thermoplastic Piping Systems:
    a. Pipe Material and Fittings: Use same type of pipe material and fittings as that used in the process piping system. PVC pipe and fittings shall be provided in accordance with the requirements of Section 40 05 31, Thermoplastic Process Pipe.
    b. Sizes: 1/2-inch minimum for main process sensing piping and 1/4-inch for gauge and switch connections.

c. Pressure Rating: Equal to or greater than the applicable system test pressure as specified in Section 40 05 05, Exposed Piping Installation.
d. Accessories:
1) For copper piping system taps with or without seals, provide a separate 1/2-inch minimum threaded brass or bronze ball valve for each gauge and switch.
2) For PVC piping systems with or without diaphragm seals, provide a separate 1/2-inch threaded ball valve for process sensing line shutoff.

2.2 AC POWER ON-OFF SWITCH

A. Function: Local power on-off selector switch for instruments. All four-wire transmitters, as identified in the individual instrument sub-sections below and as shown, shall be provided with a 120 VAC power on-off selector switch located at the instrument.

B. Construction Features:
1. Selector Switch: NEMA 4X rated, SPDT. Comply with the requirements of Section 40 78 00, Panel-Mounted Instruments and Devices.
2. Enclosure: NEMA 4X rated, non-metallic.
3. Products and Manufacturers: Provide one of the following:
a. Allen Bradley 800H rosite glass polyester enclosure.
b. Or equal.

2.3 PRESSURE SWITCHES

A. Type: Switch assembly with diaphragm/piston pressure sensor.

B. Function: Sense gauge or absolute pressure and open or close a contact when the pressure reaches the specified trip point.

C. Performance Requirements:
1. Operating Range: As specified in the Instrument Index.
2. Setpoint: As specified in the Instrument Index.
3. Setpoint Repeatability: ± One percent of range.
4. Output: Snap action switch, SPDT rated not less that ten amp resistive at 120 VAC and 1/2 amp resistive at 125 VDC.
5. Switch and Reset Action: Adjustable deadband.
6. Adjustable Deadband Range and Setting: As specified in the Instrument Index.
7. Ambient Temperature Limits: -4 degrees F to 140 degrees F.

D. Construction Features:
   1. Pressure Transducer Housing and Diaphragm Materials: Coordinate with the process piping materials.
      a. Water Service with Copper Pipe: Brass housing with Buna-N diaphragm.
      b. Other Services: Housing and diaphragm to be compatible with the process fluid as indicated in the Instrument Index.
   2. Set and Reset Point Adjustments: Adjustable external adjusting nuts and pressure setting scales in psi.
   3. Process Connection: 1/4-inch NPT.
   4. Housing: Copper-free die cast aluminum, NEMA 4. NEMA 7 construction required for hazardous locations.
   5. External Mounting Lugs.
   6. Adjusting Nuts Metal Cover with Gasket.
   7. Electrical Connection: 3/4-inch NPT.

E. Products and Manufacturers: Provide one of the following:
   1. Automatic Switch Company, Tri-point SA Series.
   2. Or equal.

2.4 PRESSURE INDICATING SWITCH

A. General: Combination switch/gauge pressure rated to 1.2 times full-scale reading.

B. Required Features:
   1. Photocell actuated DPDT relays rated at ten amps at 120 VAC with solid-state electronic circuitry and gold-alloy contacts.
   2. White dial; black scale; translucent styrene acrylonitrile housing to protect all electronic components; reading unaffected by switch operation.
   3. Knob controlled adjustable set points with tamper-proof knobs and visible switch set pointers.
   4. Zero adjustment screw.
   5. Deadband: One percent of full scale.
   6. Accuracy: ±Two percent of full scale.
   7. Power Supply: 120 VAC.
   8. Unit to be NEMA 4X, except in hazardous areas, provide explosion-proof (NEMA 7).
   9. Provide diaphragm seal.

C. Manufacturers: Provide products of one of the following:
   1. Dwyer Instruments, Inc.
   2. Or equal.

2.5 AIR FLOW SWITCH

A. General: Insertion type magnetically actuated switch, with free-swinging vane and solid metal switch body.

B. Performance Requirements:
   1. Output: One DPDT snap switch.
   2. Electrical Rating: 10A @ 125/250 VAC, UL, FM, models.
   3. Conduit connection: ¾" female NPT.
   4. Process Connection: 1-1/2" male NPT or 1-1/2" male BSPT.
   5. Wetted Materials: Vane: 316 SS; Body: Brass or 316 SS Standard; Magnet Keeper: 316 SS.
   6. Temperature Range: -4 to 275 degrees F standard.
   7. Pressure Limit: 316 SS body 2000 psig (138 bar).
   8. Mounting orientation: within 5 degrees of vertical for proper operation.

C. Manufacturers: Provide products of one of the following:
   1. Dwyer Series V4.
   2. Or equal.

2.6 SPARE PARTS AND TEST EQUIPMENT

A. Furnish and deliver the spare parts and test equipment as outlined below, identical to and interchangeable with similar parts furnished under this Section.

B. Spare parts shall be packed in containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.

C. The following shall constitute the minimum spare parts:
   1. Five of each type input-output relay for each 40 or less furnished for this Contract.
   2. One replacement power supply for each type and size furnished for this Contract.
   3. A one-year supply of all expendable materials.
   4. One per five of gauges, indicators and/or switches used in field complete with diaphragm seals, filled and ready for use.
   5. Provide one per ten, or part thereof, per range of field instruments including all insertion type instruments. No spares are required for in-line instruments such as magnetic flow meters and venturis that include flow tubes through which the flow passes.
   6. One dozen of each type and size of fuse used in instruments.

D. All spare parts shall have been operated and tested in the factory as part of factory testing prior to shipment of the control system.

E. For process sensors and all other analog instruments, the supplier shall submit a separate quotation for a recommended list of spare parts and test equipment. Each item recommended shall be listed and priced separately. The spare parts quotation shall contain a statement that the prices quoted are firm for a period of one year from the installation date of the equipment, and that the supplier understand that

the OWNER reserves the right to purchase none, any, or all of the parts quoted. The supplier is required to show that a stock of spare parts and test-equipment is obtainable within a 48-hour period.

PART 3 - EXECUTION

3.1 INSTALLATION

A. CONTRACTOR shall require the system supplier to furnish the services of qualified factory-trained servicemen to assist in the installation of the instrumentation and control system equipment.

B. Install each item in accordance with manufacturer's recommendations and in accordance with the Contract Documents. Transmitters and instruments, which require access for periodic calibration or maintenance, shall be mounted so they are accessible while standing on the floor. Care shall be taken in the installation to ensure sufficient space is provided between instruments and other equipment or piping to allow for easy removal and servicing.

C. All items shall be mounted and anchored using stainless steel hardware, unless otherwise noted.

D. All field instruments shall be rigidly secured to walls, stands or brackets as required by the manufacturer and as shown.

E. Conform to all applicable provisions of the NEMA standards, NEC and local, State and Federal codes when installing the equipment and interconnecting wiring.

3.2 START-UP, CALIBRATION, TESTING, AND TRAINING

A. Comply with the requirements of Section 40 61 13, Process Control System General Provisions, Section 40 61 23, Process Control System Startup and Field Testing, and Section 40 61 26, Process Control System Training.

+ + END OF SECTION + +

SECTION 40 78 00

PROCESS CONTROL PANEL INSTRUMENTS AND DEVICES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish, install, calibrate, test, adjust and place into satisfactory operation panel instruments and devices.
   2. Contract Documents illustrate and specify functional and general construction requirements of the panel components and do not necessarily show or specify all components, wiring, piping and accessories required to make a completely integrated system. CONTRACTOR shall provide all piping, wiring, accessories and labor required for a complete, workable and integrated system.

B. Coordination: Coordinate the installation of all items specified herein and required to ensure the complete and proper interfacing of all the components and systems.

1.2 QUALITY ASSURANCE

A. Comply with the requirements of Section 40 61 13, Process Control System General Provisions.

B. Acceptable Manufacturers:
   1. Furnish instruments and devices by the named manufacturers or equal equipment by other manufacturers.
   2. The named manufacturers have been specified to establish the standard of quality and performance of the equipment to be supplied.
   3. Obtain all instruments or devices of a given type from the same manufacturer.

C. Manufacturers' Responsibilities and Services:
   1. Design and manufacture the instruments and devices in accordance with the applicable general design requirements specified in Section 40 61 13, Process Control System General Provisions, and the detailed Specifications herein.
   2. Field supervision, inspection, start-up and training in accordance with the requirements of Section 40 61 23, Process Control System Startup and Field Testing, and Section 40 61 26, Process Control System Training.

1.3 SUBMITTALS

A. Comply with the requirements of Section 40 61 13, Process Control System General Provisions.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Comply with the requirements specified in Section 40 61 13, Process Control System General Provisions.

B. Instruments and devices shall not be assembled in the panels until all product information and system Shop Drawings for respective components have been approved.

1.5 IDENTIFICATION TAGS

A. All panel instruments and devices shall have an identification tag meeting the following requirements:
   1. Tag numbers shall be as listed in the Instrument Index.
   2. Identifying tag number shall be permanently etched or embossed onto a stainless steel tag which shall be fastened to the device housing with stainless steel rivets or self tapping screws of appropriate size.
   3. Where neither of the above fastenings can be accomplished, tags shall be permanently attached to the device by a circlet of 1/16-inch diameter stainless steel wire rope.
   4. All instruments and devices mounted within panels shall have the stainless steel identification tag installed so that the numbers are easily visible to service personnel. Front of panel mounted components shall have the tag attached to the rear of the device.
   5. Front of panel mounted components shall have nameplates, which comply with the requirements specified in Section 40 67 17, Process Controls Panels and Enclosures.

PART 2 – PRODUCTS

2.1 POWER SUPPLIES

A. General: Single unit and multiple unit power supplies, located in control room panels, remote terminal units and field panels as required.

B. Single Unit Required Features:
   1. Solid state circuitry.
   2. Surface mounting.
   3. Input Power: 120 VAC ±10 percent, 60 Hz.
   4. Output Power: 24 VDC or as required.
   5. Line/Load Regulation: ±0.005 percent.
   6. Ripple: 0.25 mV RMS.
   7. Polarity: Floating output.
   8. Ambient Temperature: -20°C to +71°C.
   9. Response Time: <20µS.
   10. Overload Protection: Internal preset.

11. Include mounting brackets, fuse, and mating connector for AC power plug.

C. Multiple Unit Required Features:
   1. Solid state circuitry.
   2. Standard 19-inch RETMA (EIA) rail mounting.
   3. Input Power: 120 VAC ±10 percent, 60 Hz.
   4. Output Power: 24 VDC or as required.
   5. Polarity: Floating output.
   6. Ambient Temperature: -10°C to +71°C.
   7. Response Time: <20µS.
   8. Include over-voltage protection, output current limiting protection, provisions for paralleling power supplies and front panel mounted indicating fuses.
   9. If the power supplies are connected in parallel, provide isolation diodes in series with the positive lead of each of the parallel connected power supplies.
   10. Connections:
      a. Twist-lock AC power connector.
      b. DC power terminal strip.

D. Products and Manufacturers: Provide one of the following:
   1. Acopian Corporation, Gold Box Series A.
   2. Or equal.

2.2 UNINTERRUPTIBLE POWER SYSTEM

A. Uninterruptible Power System (UPS) shall be furnished to provide a reliable source of uninterruptible power with no break in AC output power during a complete or partial interruption of incoming line power. UPS shall include audio/visual alarms. UPS shall be UL listed.

B. Rating: 120 VAC, 60 Hz, 1.4KVA/1.0KW minimum to provide uninterrupted conditioned power, fully loaded conditions for 15 minutes.

C. Description: On line dual track power conditioner and true (0 ms transfer time) uninterruptible power supply providing isolation, line regulation and conditioning, using sealed 48 VDC maintenance free batteries and switch mode power supply for uninterrupted power with 0.5 to 0.7 power factor and 2.7 to 3.5 crest factor.

D. Required Features:
   1. Lighting and Surge Protection: Inherent 2000: One spike attenuation.
   2. Regulation: One to three percent load regulation with less than 2pF effective coupling capacitance for line to load.
   3. Output Waveform: Computer grade sine wave with three percent maximum single harmonic and five percent maximum total harmonic distortion.
   4. Output Frequency: 60 Hz ±0.5 Hz.
   5. Operating Temperature: 1°C to 40°C.
   6. Relative Humidity: Five to 90 percent non-condensing.

7. Computer Interface: RS232 port for display of 22 meter functions and 15 alarm functions.
8. Input Protection: Independent battery charger fuse and DC fuses.
9. Output Protection: Inherently current limited ferro-resonant transformer.
10. Battery Charger: Two-step charger, 8 A and 2 A.
11. AC Input: 120 VAC, 60Hz, single phase, +15 percent, -20 percent.
12. AC Output: 120 VAC, 60Hz, single phase, +3 percent, -3 percent.

E. Products and Manufacturers: Provide one of the following:
1. Best Power Technology, Ferrups FE Series.
2. Or equal.

2.3 SELECTOR SWITCHES, PUSHBUTTONS AND INDICATING LIGHTS

A. General:
1. Selector switches, pushbuttons and indicating lights shall be supplied by one manufacturer and be of the same series or model type.
2. Type:
   a. Heavy duty, oil tight.
3. Provide legend plate for indication of switch, pushbutton or light function (e.g., "OPEN-CLOSED", "HAND-OFF-AUTO").
4. Mounting: Flush mounted on control panel front, unless otherwise noted.
5. NEMA rated to match panel in which mounted.

B. Selector Switches:
1. Type: Provide selector switches with number of positions as required to perform intended functions as shown and specified.
2. Contacts:
   a. Provide number and arrangement of contacts as required to perform intended functions specified, but not less than one single pole, double throw contact.
   b. Type: Double break, silver contacts with movable contact blade providing scrubbing action.
   c. Rating: Compatible with AC or DC current with devices simultaneously operated by the switch contacts, but not less than 10 A resistive at 120 VAC or DC continuous.
3. Switch Operator: Standard black knob.

C. Pushbuttons (Standard or Illuminated):
1. Type: Provide momentary lighted and/or unlighted, single and/or dual type pushbuttons as required to perform intended functions specified and shown.
2. Contacts: Comply with the requirements specified for selector switches.

D. Indicating Lights:
1. Type: Compact, integral transformer type.
2. Lamps: Six volt, long life (20,000 hours minimum).

E. Button and Lens Colors:
   1. Green for indication of open, on, running.
   2. Red for indication of closed, off (ready), stopped.
   3. Amber for indication of equipment malfunction, process trouble and alarms (e.g., "HIGH LEVEL", "LOW LEVEL", etc.).
   4. Blue for indication of electrical control power on.

F. Products and Manufacturers: Provide one of the following:
   1. Cutler-Hammer, Type E30.
   2. Allen Bradley, Series 800.
   3. Or equal.

2.4 CYCLE TIMER

A. Type: Adjustable, microprocessor-based multipurpose timer/counter.

B. Construction Features:
   1. Switch selectable ranges as follows:
      a. 0 to 0.99 seconds.
      b. 0 to 99.9 seconds.
      c. 0 to 999 seconds.
      d. 0 to 9.99 minutes.
      e. 0 to 99.9 minutes.
      f. 0 to 999 minutes.
      g. 0 to 99.9 hours.
      h. 0 to 999 hours.
   2. Repeat Accuracy:
      a. Timer: ±10 ms on all ranges.
      b. Counter: 100 percent on all ranges.
   3. Memory: Non-volatile memory that will retain entire program and present time/count periods at loss of power; programmable for both reset and non-reset power fail operation.
   4. Operating Temperature: 32 to 140°F.
   5. Cycle Progress Display: Three-digit display, programmable to run up to or down from the setpoint and to stop or continue up from zero after time-out/count-out.
   6. Time/Count Periods: Three programmable presets; pulse, early and main.
   7. Load Relays:
      a. Type: DPDT.
      b. Number: One early and one delayed.
      c. Contact Ratings: Seven amps at 120 VAC.
   8. Terminals: Screw terminals accessible at rear.
   9. Housing: Fully gasketed, dust and watertight.
   10. Power Input: 120 VAC.

C. Products and Manufacturers: Provide one of the following:
   1. Automatic Timing and Controls Company, Model 365M.
   2. Or equal.

2.5 ELAPSED TIME METER (HOUR METER)

A. General: Unit shall be a powered, non-resettable time indicator, with easy to read analog figures.

B. Required Features:
   1. Power: 120 VAC, or 4 to 40 VDC.
   2. Accuracy: Within one percent.
   3. Capacity: Up to 99,999.9 hours (automatic recycle at zero); one-tenth hour resolution.
   4. Operating Temperature: -40°C to +68°C.
   5. Sealed against dirt and moisture.
   6. Tamperproof.
   7. Shock resistant.
   8. Panel mountable.
   9. Nameplate below display shall read "TOTAL HOURS".

C. Products and Manufacturers: Provide one of the following:
   1. Dynapar/Veeder-Root, 7795 Series.
   2. Cutler-Hammer, E42DIR Series.
   2. Or equal.

2.6 CONTROL RELAY

A. Type: General purpose, plug-in type rated for continuous duty.

B. Construction Features:
   1. Coil Voltages: 24 VDC or 120 VAC, as required.
   2. Contacts:
      a. Silver cadmium oxide rated not less than 5 A resistive at 120 VAC or 24 VDC continuous.
      b. For switching low energy circuits (less than 200 mA) fine silver, gold flashed contacts rated not less than 3 A resistive at 120 VAC or 28 VDC continuous shall be provided.
   3. Relays to have clear plastic dust cover.
   4. Relays to have pilot light to show energized coil.
   5. Relays to be UL recognized.

C. Products and Manufacturers: Provide one of the following:
   1. Square D Company, Type R and/or Type K.
   2. IDEC, RU Series.
   3. Or equal.

2.7 TIME DELAY RELAY

A. Type: Dial adjustable, plug-in type time delay relay providing delay-on-make, delay-on-break or interval operation.

B. Construction Features:
   1. MOS digital circuit with transformer coupled power.
   2. Switch selectable ranges as follows:
      a. One second.
      b. Ten seconds.
      c. One minute.
      d. Ten minutes.
      e. One hour.
      f. Ten hours.
   3. Minimum Setting: Three percent of range, except 50 ms for one-second range.
   4. Setting Knob Accuracy: Ten percent.
   5. Contacts:
      a. Type: DPDT.
      b. Rating: 5 A resistive at 120 VAC, 5 A at 24 VDC.
   6. Housing: Plug-in design with dust and moisture resistant molded plastic case.
   7. Power Input: 120 VAC or 24 VDC as required.
   8. Operating Temperature: 0°C to 55°C.
   9. Unit shall have LED to show timing status.
   10. Relays to be UL recognized.

C. Products and Manufacturers: Provide one of the following:
   1. Automatic Timing and Controls Company, Series 328D.
   2. IDEC, Series GE1A.
   3. Or equal.

2.8 CURRENT ALARM RELAY

A. Type: Direct current, electronic setpoint control relay which accepts 4 to 20 mADC input signal and provides dry circuit contact output based on trip point setting.

B. Performance Requirements:
   1. Repeatability: Trip point repeats within ±0.2 percent of span.
   2. Trip Adjustment: 0 to 100 percent of span.
   3. Adjustable Deadband: 1 to 15 percent of span.

C. Construction Features:
   1. Trip Adjustment: Multi-turn front panel adjustment.
   2. Contacts: DPDT relays, rated 5 A at 120 VAC or 24 VDC non-inductive.
   3. Enclosure: Standard housing designed for internal panel mounting.
   4. Power Supply: 120 VAC, 60 Hz or 24 VDC, as required.

D. Products and Manufacturers: Provide one of the following:
   1. Ronan, X54 Series.
   2. Action Pak, Model AP 1080.
   3. Or equal.

2.9 CURRENT ISOLATOR

A. General: The isolating unit shall be a two wire, loop-powered device. It shall accept a 4 to 20 mADC input signal and deliver a 4 to 20 mADC output.

B. Required Features:
   1. Repeatability: ±One percent of span.
   2. Ambient Temperature Range: 0°C to 50°C.
   3. Ambient Humidity Range: 0 to 95 percent, non-condensing.
   4. Accuracy: 0.5 percent.
   5. Linearity: ±0.1 percent of full scale.
   6. Provide one spare isolator.

C. Products and Manufacturers: Provide one of the following:
   1. Ronan, X57 Series.
   2. Action Instruments, G408 Series.
   3. Crompton Instruments, 250 Series.
   4. Or equal.

2.10 VIBRATION AND TEMPERATURE MONITORING SYSTEM

A. General: Monitoring system shall be a card cage, rack mountable, instrument system consisting of:
   1. Instrument rack.
   2. Analog vibration monitor.
   3. Analog temperature monitor.
   4. Relay modules.
   5. Power supply.
   6. Analog displays.
   7. Transducers.
   8. Interconnecting cable and any other required appurtenances for a completely functional system.

B. Instrument Rack:
   1. Instrument rack shall provide the basic mounting enclosure together with electrical interconnections for the system monitors, relay modules and power supply.
   2. Barrier type terminal strips at the rear shall provide termination points for wiring from panel terminal blocks.

C. Analog Vibration Monitor:
   1. Analog vibration monitor shall plug directly into the instrument rack. The monitor shall contain two complete channels of vibration monitoring each of which shall include two alarms, signal conditioning, transducer power supply, transducer failure detection and a separate bargraph display.
   2. Required Features:
      a. Front panel or keyboard controls for warning and shutdown setpoints.
      b. Alarm circuitry to continuously monitor vibration warning and shutdown levels in excess of preset limits.
      c. Warning and shut down alarm relay drive signals independent or common to both channels.
      d. Transducer failure relay drive signals common to both channels.
      e. Two vibration signals for inputs.
      f. Adjustable alarm time delay from zero to six seconds.
      g. Temperature Rated: 0 to 43°C.
      h. Relative Humidity Limit: 95 percent non-condensing.
      i. Bargraph: Minimum 50 segment LCD.

D. Analog Temperature Monitor:
   1. Analog temperature monitor shall plug directly into the instrument rack. Monitor shall continuously monitor a minimum of two and a maximum of twelve RTD inputs.
   2. Required Features:
      a. Compatible with standard RTD's.
      b. Individually adjustable alarm setpoints for each channel.
      c. LED or LCD indication of alarm conditions.
      d. Input: Three-wire, 100 ohm platinum transducer.
      e. Relay drive capability.
      f. Temperature Rated: 0 to 43°C.
      g. Relative Humidity Limit: 95 percent non-condensing.
      h. Input Display: Minimum 50 segment LCD bargraph or four 7-segment LCDs.

E. Relay Modules:
   1. The relay modules shall plug directly into the instrument rack.
   2. Required Features:
      a. Contact Rating: Five amps at 120 VAC.
      b. Contact Material: Gold flashed.
      c. Contact Arrangement: Alarm relay to be DPDT; common transducer failure relay to be SPDT.
      d. Construction: Hermetically sealed metal enclosure.
      e. Temperature Rated: 0 to 43°C.
      f. Relative Humidity Limit: 95 percent non-condensing.

F. Power Supply:
   1. Power supply shall plug directly into the instrument rack.

2. Required Features:
    a. Power: 115 VAC ±10 percent, 60 Hz.
    b. Temperature Rated: 0 to 43°C.
    c. Relative Humidity Limit: To 95 percent, non-condensing.
    d. Output: 24 VDC.
    e. System common reset.
    f. Power up inhibit.
    g. Alarm relay drive circuitry.
    h. Provide regulated voltages for analog monitors.

G. Vibration Transducer Proximity Type:
1. Transducer shall be a non-contacting eddy current, gap-to-voltage transducer which is sensitive to distance, and dynamic change in distance, between the probe tip and the conductive material it is observing.
2. Required Features:
    a. Probe:
        1) 8-mm (5-mm trip with protective cover).
        2) High Strength Shield: Teflon jacketed lead.
        3) Miniature coaxial connector.
    b. Proximitor:
        1) Oscillator/demodulator for transducer.
        2) Generates RF signal which drives probe.
        3) Demodulates returning signal.
        4) Provides linear output to monitoring system.
        5) Armored, Teflon cable; minimum 25 feet.

H. Acceleration Transducer:
1. The acceleration transducer shall consist of a piezo-electric crystal located between the accelerometer base and an internal reference mass, which generates an electric charge upon machine vibration.
2. Required Features:
    a. Accelerometer:
        1) Sensitivity: 25 mV/g 0 to peak, ±5 percent.
        2) Acceleration Range: 75 g's peak.
        3) Frequency Response: 10 Hz to 20 Hz ±3dB.
        4) Mounted Resonant Frequency: 30 KHz minimum.
        5) Amplitude Linearity: ±1 percent to 50 g's, ± percent to 75 g's.
        6) Temperature Range: -20°F to +250°F.
        7) Relative Humidity: 0 to 95 percent non-condensing.
    b. Interface Module:
        1) Input: -18 to -24 VDC at 15 mA.
        2) Output: 100 mV/g.
        3) Armored, Teflon cable; minimum 25 feet.

I. Temperature Sensor - RTD Type:

J. Products and Manufacturers: Provide one of the following:
   1. 3300 System, as manufactured by Bently Nevada Corporation.
   2. 3000 Series, as manufactured by PMC/Beta.
   3. Or equal.

2.11 ELECTRONIC HORN

A. General: The horn shall be of the multi-tone electronic audible type.

B. Required Features:
   1. Internal volume control.
   2. Field selection of up to 16 different tones.
   3. Power: 120 VAC or 24 VDC (provide power supply as required).
   4. Operating Temperature: 32 to120°F.
   5. Enclosure Rating: NEMA 4X.

C. Products and Manufacturers: Provide one of the following:
   1. Panalarm, Model NTZ.
   2. Or equal.

2.12 SPARE PARTS AND TEST EQUIPMENT

A. CONTRACTOR shall furnish and deliver the spare parts and test equipment as outlined below, all of which shall be identical and interchangeable with similar parts furnished under this Section.

B. The spare parts shall be packed in containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.

C. The following shall constitute the minimum spare parts:
   1. Five of each type of input-output relay for each 40 or less furnished for this Contract.
   2. One replacement power supply for each type and size furnished for this Contract.
   3. A one-year supply of all expendable materials.
   4. One per ten (two, if fewer than twenty) of each type of panel mounted instrument including lights, pushbuttons and PLC equipment.
   5. One dozen of each type and size of fuse used in panels and instruments.

D. All spare parts shall have been operated and tested in the factory as part of factory testing prior to shipment of the control system.

E. For analog instruments, the supplier shall submit a separate quotation for a recommended list of spare-parts and test equipment. Each item recommended shall be listed and priced separately. The spare parts quotation shall contain a statement that the prices quoted are firm for a period of one year (with escalators for the next

two years) subsequent to the OWNER'S acceptance of the equipment, and that the supplier understands that the OWNER reserves the right to purchase none, any, or all of the parts quoted. The supplier is required to show that a stock of spare-parts and test equipment is obtainable within a 48-hour period.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install each item in accordance with manufacturers recommendations and in accordance with the Contract Documents.

B. All items shall be mounted and anchored in compliance with Section 40 67 13, Process Control Panels and Enclosures.

3.2 START-UP, CALIBRATION, TESTING AND TRAINING

A. Comply with the requirements of Section 40 61 23, Process Control System Startup and Field Testing, and Section 40 61 26, Process Control System Training.

+ + END OF SECTION + +

SECTION 41 22 23

HOISTS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, tools, equipment, and incidentals as shown, specified, and required to furnish and install hoisting systems complete and operational.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate installation of items that must be installed with or before hoist systems Work.
   2. Notify other contractors in advance of the installation of hoisting equipment to provide them with sufficient time for installing items included in their contracts that must be installed with or before hoisting systems Work.

C. Related Sections:
   1. Section 05 12 00, Structural Steel Framing.
   2. Section 09 91 00, Painting.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. ANSI/AGMA 6013-A, Standard for Industrial Enclosed Gear Drives.
   2. ASME B30.16, Overhead Hoists (Underhung).
   3. ASME HST-2, Performance Standard For Hand Chain Manually Operated Chain Hoists.

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer:
      a. Minimum of five years of experience producing substantially similar equipment and able to furnish documentation of at least five installations in satisfactory operation for at least five years in the United States.
   2. Installer:
      a. Engage an experienced installer to perform the Work under this Section, who is experienced in installing hoisting systems similar to that required for the Project, and is acceptable to hoisting systems manufacturer.

b. Submit name and qualifications, and the following information for at least three successful, completed projects:
   1) Names and telephone numbers of each owner and architect or engineer responsible for project.
   2) Approximate contract cost of hoisting equipment.
   3) Number of installations.

B. Component Supply and Compatibility:
   1. Obtain all equipment included in this Section regardless of component manufacturer, from a single hoisting equipment manufacturer.
   2. Hoisting equipment manufacturer shall review and approve or prepare all submittals for components furnished under this Section.
   3. Components shall be specifically constructed for the specified service conditions and shall be integrated into overall equipment assembly by hoisting equipment manufacturer.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Complete description of materials and equipment in sufficient detail to allow comparison with requirements of this Section.
      b. Manufacturer's certified clearance diagram showing arrangement of system and clearances, including plan and sections.
      c. Weight of hoist and trolley.
   2. Product Data:
      a. Manufacturer's literature, illustrations, specifications identifying the materials of construction, rated capacities, dimensions of individual components, and finishes.
      b. Make, model, weight and horsepower of each component.
   3. Testing Plans: Plan for load testing at the Site.

B. Informational Submittals: Submit the following:
   1. Certificates:
      a. Affidavits of compliance with referenced standards and codes.
      b. Manufacturer's installation certification.
   2. Manufacturer's Instructions:
      a. Special shipping, storage and protection, and handling instructions.
      b. Routine maintenance requirements prior to start-up.
   3. Field Quality Control Submittals:
      a. Load test report, including copy of certification of test weights.
   4. Manufacturer's Reports: Submit written report of results of each visit to Site by Supplier's service technician, including purpose and time of visit, tasks performed, and results obtained.
   5. Qualifications Statements:
      a. Manufacturer, when qualifications are requested by ENGINEER.

b. Installer, when qualifications are requested by ENGINEER.

C. Closeout Submittals: Submit the following:
1. Operation and Maintenance Data:
a. Submit operation and maintenance manuals in accordance with Section 01 78 23, Operations and Maintenance Data.
b. Include acceptable test reports, maintenance data and schedules, description of operation, and list of spare parts recommended for one year of operation with current price list.

1.5 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling, and Unloading:
1. Deliver materials and equipment to Site to ensure uninterrupted progress of the Work. Deliver anchorage materials to be embedded in concrete in ample time to prevent delaying the Work.
2. Conform to Section 01 65 00, Product Delivery Requirements.

B. Storage and Protection:
1. Conform to Section 01 66 00, Product Storage and Handling Requirements.

1.6 WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive OWNER of other rights or remedies OWNER may otherwise have under the Contract Documents and shall be in addition to and run concurrent with other warranties made by CONTRACTOR under the Contract Documents. Obligations of CONTRACTOR under the Contract Documents shall not be limited in any way by provisions of specified special warranty

B. Special Warranty on Materials and Equipment:
1. Provide manufacturer's written warranty, running to the benefit of OWNER, agreeing to correct or, at option of OWNER, remove and replace, materials and equipment specified in this Section found to be defective during period of 5 years after date of Substantial Completion.

PART 2 – PRODUCTS

2.1 SYSTEM PERFORMANCE

A. System Description:
1. Hoists shall conform to headroom, hook elevation, and side clearance requirements shown and indicated in the Contract Documents, and shall provide required available lift height and capacity.

B. Performance Criteria:
   1. Manually Operated Chain Hoists:

Designation:	Monorail 1
General Location:	Sludge Handling Building, First Floor
Hoist Type:	Chain
Ambient Conditions:	Indoor
Number Required:	3
Capacity (tons):	4
Required Lift (feet):	15
Max Required Hook Elevation:	See Drawings
Maximum Chain Effort to Lift Full Load (lbs.):	60
Trolley Type:	Manual Geared

2.2 MANUFACTURERS

A. Manually-Operated Chain Hoists:
   1. Model YLHA by Coffing.
   2. Zepher Swivel Truck Low Headroom, by Chester Hoist.
   3. or equal.

2.3 DETAILS OF CONSTRUCTION

A. Manual Chain Hoists:
   1. Comply with ASME B30.16 and ASME HST-2.
   2. Design Stresses: Provide load bearing components so that stresses at rated load shall not exceed 20 percent of average ultimate strength of material.
   3. Shop welding shall be in accordance with AWS D14.1.
   4. Hooks: Provide latch-type hooks, free to rotate through 360 degrees under all loading conditions. Hooks shall be heat-treated drop forged steel.
   5. Hoisting Chain: Hardened alloy steel.
   6. Lift Wheel: Machined and heat treated alloy steel with hardened steel chain guides.
   7. Gearing: Machined and heat treated spur gear system. Hoist gear box shall be in accordance with AGMA 6013-A. Provide means for adequate lubrication of gearing.
   8. Bearings: Bearings shall be permanently lubricated type.
   9. Load Brake: Hoist shall include Weston-type load brake, providing instant brake and release action for positive control of load.
   10. Provide overload protection device that prevents lifting of loads beyond rated capacity.
   11. Housing and Covers: Cast aluminum.
   12. Provide supports, fasteners, brackets and all accessories required.

B. Manual Geared Trolleys:
   1. Trolley shall be constructed to accept specified hoist using lug-mounted

suspension, and shall be of sufficient size and strength to transport rated load of associated hoist.

2. Trolley frame shall have steel side plates that wrap around trolley to provide protective lug to prevent trolley from falling off monorail in event of wheel axle failure.
3. Wheels: Wheels shall be fabricated of hardened steel, with uniform surface hardness of minimum 200 Brinell, and shall be constructed to run on specified beam.
4. Trolley shall be geared to provide hand chain driven locomotion.
5. Gearing: Machined and heat-treated. Gearbox shall be in accordance with AGMA 6013-A. Provide means for adequate lubrication of gearing.
6. Bearings: Bearings shall be ball or roller type, permanently lubricated.

2.4 FINISHING

A. Surface Preparation and Painting:
   1. Surface preparation and shop painting is required for ferrous metals, equipment, and accessories. Do not paint stainless steel and machined surfaces.
   2. Clean and apply in the shop prime coat in accordance with Section 09 91 00, Painting.
   3. Apply manufacturer's standard factory finish.

B. Gears, bearing surfaces, and other machined surfaces shall receive a heavy application of rust-inhibiting coating that shall be maintained during storage and until equipment is placed into operation.

2.5 IDENTIFICATION

A. Identify component subassemblies with stainless steel nameplates and each labeled with the following:
   1. Manufacturer and model number.
   2. Date of manufacture with pertinent ratings, operation, and maintenance information.
   3. Certification, stamp, or approval to applicable Laws and Regulations.

PART 3 – EXECUTION

3.1 INSPECTION

A. Examine conditions under which materials and equipment are to be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

B. Inspect and verify that no part of the building, structure, piping, mechanical systems including ductwork, electrical systems including lighting and conduit, or other elements that will interfere with proper operation of hoist along the entire length of monorail track.

3.2 INSTALLATION

A. Install materials and equipment in conformance with Laws and Regulations, applicable standards, manufacturer's instructions and recommendations, and the Contract Documents.

B. Refer to Section 05 12 00, Structural Steel Framing, for requirements for hoisting system's supporting steel.

3.3 FIELD QUALITY CONTROL

A. Site Tests:
   1. After installing equipment and associated controls, perform at the Site running tests for hoisting equipment and appurtenances. Should testing indicate malfunction, make repairs and adjustments as required. Repeat testing and adjusting until, in ENGINEER's opinion, installation is complete and equipment is functioning properly and accurately, and is Substantially Complete. Equipment will not be Substantially Complete until field tests are successfully completed.
   2. Load Test:
      a. Perform load tests under supervision of manufacturer's factory-trained service technician, in presence of ENGINEER.
      b. Weights used in load testing shall be certified. Submit weight certification as part of the load test report.
      c. Load testing shall conform to the following:
         1) Trolley travel full length of monorail with rated load, while verifying that all functions operate properly.
         2) Hoist brake drift test with rated load: Lift weight, measure distance to floor, allow five minutes to elapse, and re-measure. Record the results measured.
         3) Criteria for Acceptance: No difference in measurements.
      d. Load Test Report: Submit results of load testing as report that lists tests performed, data collected, results of each test, and corrective actions taken (if any). Test report shall be signed by manufacturer's service technician present during testing.

B. Manufacturer's Services: Provide a qualified, factory-trained service technician to perform the following:
   1. Instruct CONTRACTOR in installing equipment and assist in the installation of equipment.

2. Inspect and adjust equipment after installation and ensure proper operation, and supervise initial operations and load tests.
3. Instruct OWNER's personnel in operating and maintaining the equipment.
4. Technician shall revisit the Site as often as necessary until installation is acceptable.
5. Manufacturer's Installation Certification: Submit certification that manufacturer's technician has checked completed installation and equipment, as specified in the Contract Documents, has been provided in accordance with manufacturer's recommendations, and that operation of equipment is satisfactory. Certification shall be signed by manufacturer's technician present at the Site and CONTRACTOR.
6. Training: Furnish services of Supplier's qualified factory trained specialists to instruct OWNER's operations and maintenance personnel in recommended operation and maintenance of equipment. Training requirements, duration of instruction, and qualifications shall be in accordance with Section 01 79 23, Instruction of Operations and Maintenance Personnel.
7. All costs, including expenses for travel, lodging, meals and incidentals, and cost of travel time, for visits to the Site shall be included in the Contract Price.

+ + END OF SECTION + +

SECTION 43 26 23

STAINLESS STEEL SLIDE GATES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install stainless steel slide gates and appurtenances complete and operational.
   2. Included are stainless steel slide gates, anchorage systems and all appurtenances.
   3. Extent of the equipment is shown on the Stainless Steel Slide Gate Schedule located at the end of this Section.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before the stainless steel slide gates Work.

C. Related Sections:
   1. Section 09 91 00, Painting.
   2 Section 46 76 33, Dewatering Centrifuges.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:
   1. American Society for Testing and Materials, (ASTM):
      a. ASTM A 276, Specification for Stainless Steel Bars and Shapes.
      b. ASTM B 584, Specification for Copper Alloy Sand Castings for General Applications
      c. ASTM A29/A29M, Standard Specification for General requirements for Steel Bars, Carbon and Alloy, Hot-Wrought.
   2. American Society of Mechanical Engineers (ASME):
      a. ASME B1.20.1, Pipe Threads, General Purpose (Inch).
   3. American Water Works Association (AWWA):
      a. AWWA C541, Hydraulic and Pneumatic Cylinder and Vane-Type Actuators for Valves and Slide Gates.
   4. National Electrical Code, (NEC).
   5. National Electrical Manufacturers' Association, (NEMA).

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications:
   1. Manufacturer shall have a minimum of five years of experience of producing substantially similar equipment and shall be able to show evidence of at least five installations in satisfactory operation for at least five years.
   2. Stainless steel slide gates shall be the product of one manufacturer.

B. Component Supply and Compatibility:
   1. Obtain all equipment included in this Section regardless of the component manufacturer from a single stainless steel slide gate manufacturer.
   2. The stainless steel slide gate equipment manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.
   3. All components shall be specifically designed for the specified service and shall be integrated into the overall assembly by the stainless steel slide gate equipment manufacturer.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Fabrication, assembly and installation diagrams.
      b. Setting drawings, templates, and directions for the installation of anchor bolts and other anchorages.
      c. Wiring diagrams for electric motor operators.
   2. Product Data:
      a. Manufacturer's literature, illustrations, specifications and engineering data.
      b. Deviations from the Contract Documents.
      c. Lubricant Specification: Furnish a lubricant specification for the type and grade necessary to meet the requirements of the equipment.

B. Informational Submittals: Submit the following:
   1. Support Design Information:
      a. Submit for record purposes only the weight of each slide gate and expected opening and closing thrust loads on the supporting structure.
   2. Shop Test Results:
      a. Submit results of required shop tests.
   3. Field Test Results:
      a. Submit a written report giving the results of the field tests required.

C. Closeout Submittals:
   1. Operation and Maintenance Manuals:
      a. Submit complete Installation, Operation and Maintenance Manuals including, test reports, maintenance data and schedules, description of operation and spare parts information.

b. Furnish Operation and Maintenance Manuals in conformance with the requirements of Section 01 78 23, Operations and Maintenance Data.

1.5 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling and Unloading:
   1. Deliver materials to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices which are to be embedded in cast-in-place concrete in ample time to prevent delay of that Work.
   2. Handle all stainless steel slide gates and appurtenances properly, in accordance with manufacturer's recommendations. Stainless steel slide gates, which are distorted or otherwise damaged, will not be acceptable. Protect all bolt threads and ends from damage.

B. Storage and Protection:
   1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
   2. Store all mechanical equipment in covered storage off the ground and prevent condensation.

C. Acceptance at Site:
   1. All boxes, crates and packages shall be inspected by CONTRACTOR upon delivery to the Site. CONTRACTOR shall notify ENGINEER, in writing, if any loss or damage exists to equipment or components. Replace loss and repair damage to new condition in accordance with manufacturer's instructions.

PART 2 – PRODUCTS

2.1 SERVICE CONDITIONS

A. General:
   1. Design stainless steel slide gates to safely withstand conditions listed in Stainless Steel Slide Gate Schedule, located at the end of the Section.
   2. Stainless steel slide gates shall be substantially watertight with leakage less than 0.5 gpm per foot of seating perimeter at design head.
   3. Manual operators shall turn right to close, unless otherwise specified. Operators shall indicate the direction of operation.
   4. Bolts, studs, cap screws, and adjusting screws shall be of ample section to withstand the force created by operation of the gate under a full head of water.

2.2 MANUFACTURERS

A. Manufacturers: Provide equipment of one of the following:
   1. Rodney Hunt Company, North American Valve and Gate Group.
   2. Fontaine, North American Valve and Gate Group.

3. RW Gate.
4. Orbinox.
5. Whipps, Inc.
6. Or equal.

2.3 FABRICATION

A. Materials of Construction:
   1. Stainless Steel: For frame, slide, rail and yoke, ASTM A 276, Type 316 stainless steel. All metal for stainless steel slide gate parts shall have a minimum thickness of 1/4-inch.
   2. Bronze Casting: For operating nut, thrust nut and lift nut, ASTM B 584 Alloy 865.
   3. All bolts, studs, cap screws and adjusting screws shall be of Type 316 stainless steel.
   4. Bolts and nuts shall have hexagon heads.
   5. Gasket material and installation shall conform to manufacturer's recommendations.

B. Disc:
   1. Fabricate the slide or disc of ASTM A 276, Type 316 stainless steel plate reinforced with structural shapes attached by welding.
   2. Provide reinforcing to limit deflection under full head to not more than 1/360 of the span.
   3. Extend reinforcing ribs into the guides overlapping the seating surface of the guide.
   4. Weld stem mounting guides to the disc.

C. Disc Guides:
   1. Guides shall be of Type 316 stainless steel incorporating a sandwich type construction using plates and structural angles.
   2. Guides shall be designed for maximum rigidity as columns to take the thrust developed during the stainless steel slide gate operation under maximum head.
   3. Guides shall extend beneath the opening a sufficient amount to support the disc in the fully open or closed position.

D. Stem:
   1. Operating stems shall be of Type 316 stainless steel and designed as specified below.
   2. Design stem to transmit in compression at least 2-1/2 times the rated output of the operating mechanism with an 80-pound effort on the crank or handwheel. Determine the critical buckling load using the Euler column formula, using C = 2. Where hydraulic cylinder lifts are used, the stem design force shall not be less than 1.25 times the output thrust of the hydraulic cylinder with a pressure equal to the maximum working pressure of the hydraulic fluid supply. Where electric motor driven lifts are used, the stem design force shall not be less than 1.25 times the output thrust of the unit in the stalled motor condition.

3. Stems shall have a slenderness ratio (L/R) less than 200.
4. Threaded portion of the stem shall have machined cut threads of the Acme type. Join stems of more than one section by stainless steel couplings threaded and keyed, or bored and pinned to the stems. All threaded and keyed couplings of the same size shall be interchangeable. Couplings shall be designed to be of greater strength than the stems.
5. Connect the stem to the disc by means of a bolted connection.
6. Provide rising stems with an adjustable stop collar on the stem above the floorstand lift nut.

E. Yoke (For Self Contained Type Gates):
1. Furnish tops of the extended guides with a yoke for mounting of the lifting device.
2. Construct the yoke of structural shapes of sufficient strength to take the full thrust created by operating the gate under the maximum specified head.
3. Attach the yoke to the framework by bolting or welding to permit removal of the gate slide and stem.

F. Lower Seals:
1. Mount a specially shaped resilient neoprene seal on the bottom of the disc to provide flush-bottom closure for stainless steel slide gates. As an alternate, a poured urethane seal shall be mounted in the invert of the frame to form a flush bottom seal.
2. Shape of the seal shall produce a seating surface having a minimum width of 3/4-inch, and the seal will extend beyond the seating surface of the frame.
3. Vertical face of the seal shall be in contact with the seating surface of the guide to provide a proper seal at the corners.

G. Side and Upper Seals:
1. Side and upper seals shall be fabricated from ultra high molecular weight (UHMW) polyethylene or UHMW polymer. UHMW bearing strips shall be mechanically retained to lock seat in place.

2.4 APPURTENANCES

A. Anchor Bolts:
1. Provide Type 316 stainless steel anchor bolts as required for stem guides, floorstands, and all equipment or appurtenances, which must be secured to concrete walls or floors. Anchor bolts shall be of ample size and strength for the purpose intended, and shall be furnished by the manufacturer. Anchor bolts shall be hooked, and provided for direct embedment during placement of concrete.

B. Manual Operators:
1. Manual operation shall be by handwheel or crank operated floorstand or benchstand as shown and specified.

2. Handwheel-operated type shall be without gear reduction and crank-operated type will have either a single or double gear reduction, as required. Each type shall be provided with a threaded cast manganese bronze lift nut to engage the operating stem.
3. Provide anti-friction bearings to properly support both opening and closing thrusts.
4. Stands shall operate the gates under the specified operating head with not greater than a 40-pound pull on the crank or handwheel.
5. All components shall be totally enclosed in a cast-iron weather-proof housing. Provide positive mechanical seals to exclude moisture and dirt and prevent leakage of lubricant out of the unit.
6. Provide lubricating fittings for all gears and bearings.
7. Removable cranks shall be cast-iron with a revolving brass grip. Removable handwheel shall be fabricated steel designed for rough treatment and minimum weight.
8. For self-contained type stainless steel slide gates, the distance between handwheel or crank operator and the operating floor shall be 36-inches minimum and 48-inches maximum.
9. Crank-operated gates shall be provided with nut-operator drives as noted on Stainless Steel Slide Gate Schedule.
10. Operators shall be furnished with a limit switch to indicate fully closed position, where shown.
11. Provide mechanical stops adjustable ±five degrees at each end of travel.

C. Electric Operators:
1. Electric motor operators shall be furnished for continuous duty, open-close operation.
2. Electric motor operator shall be capable of providing not less than 1-1/2 times the required operator torque for opening and closing of the stainless steel slide gate.
3. Operator shall be of NEMA 4X construction and furnished with a handwheel for manual operation.
4. Operator gear reducer shall be provided with a pair of limit switches and torque switches and a reversing contactor. The torque switches shall be adjustable.
5. Limit switches furnished for all stainless steel slide gates shall be equipped with 16 contacts (four rotors with four contacts each). Contacts shall open and close as shown.
6. Reversing starter, limit switches, and torque switches shall be supplied in NEMA 4X enclosures, furnished and mounted on the operators.
7. Where shown, furnish a resistance-to-current converter for remote position indication.
8. Electric motor shall be totally enclosed, sized to open or close the stainless steel slide gate full cycle in approximately 15 seconds, and suitable for operation on 480 volt, 3 phase, 60 Hz power. All electrical equipment, which is mounted on the operator, shall be housed in NEMA 4X enclosures.
9. Starter shall include an adequately sized, fused, control power transformer, 480 volt primary and 120 volt secondary.

10. Manufacturer shall comply with all requirements of the electrical control schematic diagrams as shown.
11. The stainless steel slide gates shall be controlled as shown.
12. Where shown or specified, provide electric operator for modulating continuous duty service.
13. Provide mechanical stops adjustable ±five degrees at each end of travel.
14. Electric motor operator shall include a thermostatically controlled space heater.
15. A handwheel shall be provided for manual operation. It shall not rotate during motor operation. The change from motor operation to handwheel operation shall be accomplished by a positive declutching device, which shall disengage the motor and motor gearing mechanically, but not electrically. Hand operation shall not require more than 80 pounds of rim effort at maximum required torque.
16. Each stainless steel slide gate actuator shall be provided with an integral dial-type disc position indicator.
17. Manufacturers: Provide equipment of one of the following:
    a. AUMA.
    b. EIM.
    c. Or equal.

D. Identification: Identify each stainless steel slide gate with a stainless steel nameplate stamped with the approved designation as shown in the Stainless Steel Slide Gate Schedule, located at the end of this Section. Nameplate shall be permanently fastened to the gate at the factory.

2.5 SURFACE PREPARATION AND PAINTING

A. Clean, prime coat, and finish coat ferrous metal surfaces of equipment in the shop in accordance with the requirements of Section 09 91 00, Painting.

B. Coat machined, polished and non-ferrous surfaces bearing surfaces and similar unpainted surfaces with corrosion prevention compound, which shall be maintained during storage, and until equipment begins operation.

C. CONTRACTOR shall certify, in writing, that the shop primer and coating system conforms to the requirements of Section 09 91 00, Painting.

2.6 SOURCE QUALITY CONTROL

A. Shop Tests:
1. Test each stainless steel slide gate fully assembled in the vertical position for proper seating.
2. Fully open and close gate disc in its guide system to ensure that it operates freely.
3. Operate and test floor stands, bench stands and motor operators to ensure proper assembly and operation.

2.7 SLIDE GATE SCHEDULE

A. The Stainless Steel Slide Gate Schedule is located at the end of this Section. Conform to type, size, operation and other data specified, unless otherwise approved by ENGINEER.

B. Provide all stainless steel slide gates as shown and listed in the schedule.

C. Schedule Abbreviation:
   1. Type:
      a. EF - Embedded Frame.
      b. SM - Surface Mounted Frame.
      c. WG - Downward Opening Weir Gate.
   2. Operator Type:
      a. CO - Crank Operated.
      b. HW - Handwheel.
      c. MO - Motor Operated.

D. The seating and unseating design head as stated in the Stainless Steel Slide Gate Schedule is based on the head measured to the centerline of the gate in its closed position.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install stainless steel slide gate equipment in accordance with manufacturer's instructions and recommendations.

B. Adjust all parts and components as required to provide correct operation.

C. Manufacturer's representative shall check and approve the installation prior to operation. Manufacturer's representative shall field test and calibrate the equipment to assure that the system operates to the design engineer's satisfaction.

3.2 START-UP AND FIELD TESTS

A. After CONTRACTOR and ENGINEER have mutually agreed that the equipment installation is complete and ready for continuous operation, CONTRACTOR and a qualified field service representative of the manufacturer shall conduct a functional field test and a leakage test of each stainless steel slide gate in the presence of ENGINEER to demonstrate that each stainless steel slide gate furnished will function correctly and that maximum permissible leakage is not exceeded.
   1. Functional Tests:
      a. Each stainless steel slide gate with appurtenances shall be field-tested. Tests shall demonstrate to ENGINEER that each part and all parts

together function in the manner intended. All necessary testing equipment and manpower shall be provided by CONTRACTOR at their expense. OWNER will furnish all power, and incidental material and labor required for the tests.

2. In the event that the manufacturer is unable to demonstrate to ENGINEER that their equipment meets the requirements of the tests, the deficient equipment will be rejected and CONTRACTOR shall adjust and/or modify and retest the equipment as often as necessary to meet the specified requirements. No separate payments shall be made for adjustments and/or modifications.

Gate ID	Location	Type	Opening Size (W x H)	Frame	Mounting	Design Head (Seating/ Unseating)[1]	Operator
Solids Diverter Slide Gate Nos. 1 through 3	Centrifuge Nos 1 though 3 Sludge Cake Discharge Chute	SM	As recommended by Centrifuge Manufacturer	Self-contained	Flange	0.2 psig / 0 psig	MO (with manual override)

Note 1: Design head measured from invert of gate.

+ + END OF SECTION + +

SECTION 46 33 33

POLYMER BLENDING AND FEED EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment and incidentals required to furnish and install the polymer blending and feed equipment complete and operational to handle and automatically meter, mix and pump liquid polymer chemical and its mixed solution as shown and as specified, herein. The polymer blending and feed equipment shall include components:
      a. Non-mechanical liquid polymer activation chamber.
      b. Neat polymer metering pump and SCR motor controller.
      c. Neat polymer check valve.
      d. Dilution water inlet manifold.
      e. Solution discharge piping.
      f. Local control panel.
      g. Stainless steel frame.
      h. Neat polymer flow meter.
      i. Dilution water flow meter.
      j. Associated pressure gages, transmitters, valves and solenoid valves required for operation detailed in this Section and as shown.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before the polymer blending and feed equipment Work.

C. Related Sections:
   1. Section 03 30 00, Cast-In-Place Concrete.
   2. Section 05 05 33, Anchor Systems.
   3. Section 46 33 44, Peristaltic Pumps.
   4. Section 40 67 17, Process Control Panels and Enclosures.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:
   1. American National Standards Institute, (ANSI).
   2. American Society for Testing and Materials, (ASTM).
   3. American Water Works Association, (AWWA).
   4. Hydraulics Institute, (HI).
   5. Institute of Electrical and Electronics Engineers, (IEEE).
   6. National Electrical Code, (NEC).

7. National Electrical Manufacturers' Association, (NEMA).
8. National Fire Protection Association, (NFPA).
9. National Sanitation Foundation, (NSF).
10. Uniform Building Code, (UBC).
11. U.S. Department of Labor, Occupational Safety and Health Administration, (OSHA).
    a. Safety and Health Standards 29 CFR 1910.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications:
   1. Manufacturer shall have a minimum of five years' experience producing substantially similar equipment and shall be able to show evidence of at least five installations in satisfactory operation for at least five years.

B. Component Supply and Compatibility:
   1. Obtain all equipment included in this Section regardless of the component manufacturer from a single polymer blending and feed equipment manufacturer.
   2. The polymer blending and feed equipment manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.
   3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the polymer blending and feed equipment manufacturer.

C. Unit Responsibility: CONTRACTOR shall assign Unit Responsibility to the polymer blending unit manufacturer or supplier for the equipment specified in this Section. A Certificate of Unit Responsibility shall be submitted.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Certificates:
      a. Certificate of Unit Responsibility attesting that CONTRACTOR has assigned, and that the manufacturer accepts unit responsibility in accordance with the requirements of this Section. No other submittal material will be reviewed until the certificate has been received and conforms to the specified requirements.
   2. Product Data:
      a. Manufacturer's literature, illustrations, specifications, and engineering data, including dimensions, materials, size, weight, and performance data for all equipment specified in this specification.
      b. Motor tests and data as described in Part 2 of this specification.
   3. Shop Drawings:
      a. Fabrication, assembly, installation and wiring diagrams.

B. Informational Submittals: Submit the following:
   1. Source Quality Control Submittals:
      a. A schedule of the date of shop testing.
      b. Description of factory test procedures and equipment.
      c. Copies of all tests results.

C. Closeout Submittals: Submit the following:
   1. Operation and Maintenance Manuals:
      a. Submit complete Installation, Operation and Maintenance Manuals, including, test reports, maintenance data and schedules, description of operation, and spare parts information.
      b. Furnish Operation and Maintenance Manuals in conformance with the requirements of Section 01 78 23, Operations and Maintenance Data.

D. Maintenance Material Submittals: Furnish the following:
   1. Spare Parts:
      a. Furnish all required spare parts as specified in Part 2 of this specification.
   2. Tools:
      a. Furnish all required special tools as specified in Part 2 of this specification.

E. Warranty
   1. The polymer blending system shall be covered by a two-year conventional warranty. The mixing chamber shall be covered by a lifetime warranty covering the repair or replacement of the mixing chamber or any part of the mixing chamber which fails for any reason, excluding weather related or over-pressure failures. In addition, the mixing chamber shall be warranted against plugging for any reason. If plugging occurs, the mixing chamber shall be repaired or replaced at no cost to the OWNER. Metering pumps, options, and accessories shall be covered by a conventional one-year warranty.
   2. Submit manufacturer's warranty prior to Substantial Completion.

1.5 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling and Unloading:
   1. Deliver materials to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices which are to be embedded in cast-in-place concrete in ample time to prevent delay of that Work.

B. Storage and Protection:
   1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.

C. Acceptance at Site:
   1. All boxes, crates and packages shall be inspected by CONTRACTOR upon delivery to the Site. CONTRACTOR shall notify ENGINEER, in writing, if any loss or damage exists to equipment or components. Replace loss and repair damage to new condition in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1 EQUIPMENT PERFORMANCE

A. Design Criteria:
   1. The polymer blending and feed equipment shall be provided to meet the following performance and design requirements:
      a. Polymer Type: Liquid emulsion (45 percent active).
      b. Neat Polymer Feed Rate, (gallons/hour):
         1) Minimum: 1.0.
         2) Maximum: 10.0.
      c. Polymer Solution Feed Rate, (gallons/hour/application point):
         1) Minimum: 100.
         2) Maximum: 1000.
      d. Diluted Polymer Concentration, Percent Total Active:
         1) 0.25 - 1.0 percent.
      e. Dilution Water Supply Pressure, (psi): 70 - 80.
      f. Polymer Blending System Dimensions (Max L x W x H): 32” by 40” by 70”.
      g. Discharge Pressure, (psi):
         1) Maximum: 45.

2.2 DETAILS OF CONSTRUCTION

A. Polymer Blending and Feed Systems:
   1. General:
      a. Each polymer-blending unit shall be a complete package that automatically dilutes, activates and feeds liquid polymer and water. Blenders shall instantaneously invert neat polymer into solution, producing a thoroughly diluted and completed activated homogenous blend, free of “fish-eyes” and unblended polymer.
      b. Pressure gages shall be liquid filled, stainless steel. Pressure gages shall conform to the requirements of Section 40 70 05, Primary Sensors and Field Instruments.
      c. The discharge pressure at the polymer blending unit skid limit shall be as specified in Paragraph 2.1, above, at the maximum flow rates specified in Paragraph 2.1, above.
   2. Liquid Polymer Activation Chamber:
      a. Provide a multi-staged, non-mechanical hydrodynamic blending device specifically designed to dilute and activate emulsion, dispersion

and solution type polymer with viscosity up to 75,000 cps and active contents up to 46 percent.

b. The liquid polymer activation chamber mixing energy shall be staged such that it provides for high, non-damaging mixing energy over the full operating range of the system which then dissipates through a series of concentric chambers. The system shall be designed for use with either potable or reuse dilution water. The type of dilution water used shall not affect the specified performance in any way. A mixing chamber drain valve with 1/2-inch fitting shall be provided and routed to the nearest approved floor drain. The mixing chamber shall have a maximum rated pressure of 150 psi. The mixing chamber shell or body shall be constructed of Type 304 stainless steel. CPVC internal components are acceptable.

c. Provide a neat polymer check valve designed to isolate neat polymer from dilution water. The valve construction shall be CPVC, stainless steel and Viton. The valve shall be readily accessible for cleaning and shall be easily disassembled. Valve shall be located outside of the mixing chamber and shall not require mixing chamber disassembly for servicing.

3. Neat Polymer Metering Pump:

a. A horizontal, peristatic hose type metering pump shall be provided. Pumping action shall be accomplished using rollers or sliding shoes. The pump shall comply with Section 46 33 44, Peristaltic Metering Pumps. The pump shall have a continuous output that includes the range specified in Paragraph 2.1, above, and have a 20:1 operating range. The pump shall be mounted to the frame with a Type 304 stainless steel bracket which positions the pump suction no more than 18-inches off the base to maintain ideal pump suction conditions. The speed of the pump shall be controlled by an SCR motor controller mounted in the NEMA 4X control panel.

1) Products and Manufacturers: Provide one of the following:

a) Watson-Marlow Bredel, Inc.
b) Verder.
c) Periflo.
d) Or equal.

b. A metering pump calibration assembly shall be provided. The calibration assembly shall have both ml calibrations and direct reading flow in gallons per hour based on a one-minute drawdown. The calibration column shall be integrally mounted to the system, designed to provide a 5 second drawdown at 100 percent pump capacity. The calibration column shall be installed such that it is openly accessible for reading. The calibration column shall be rigidly mounted to the system frame. Supporting the calibration column by polymer piping is not acceptable.

4. Dilution Water Inlet Manifold:

a. The dilution water inlet assembly shall include a motor actuated ball valve, a strainer, pressure gauge, and rate-adjusting needle valve to control the dilution water flow. The needle valve shall be contained

within the package system. The needle valve shall be constructed of stainless steel and brass and shall be designed to allow orifice replacement without disassembly of any other part of the system.

b. Plant effluent water shall be supplied as shown.

5. Discharge Assembly:
   a. The discharge assembly shall include an adjustable mixing chamber pressure relief valve piped to the mixing chamber drain and a pressure gauge.
6. Control Panel:
   a. A NEMA 4X Type 316 stainless steel control panel shall be provided for each polymer-blending unit supplied. The panel shall, as a minimum, include "START/STOP" and "LOCAL/OFF" controls, microcontroller or relay logic/isolated I/O that includes ratio control, status and alarms. In the "LOCAL" position, the polymer solution and feed rate can be set and the polymer-blending unit started or stopped manually.
   b. Control panel shall conform to the requirements of Section 40 67 17, Process Control Panels and Enclosures.
   c. The following alarms shall be available at the control panel:
      1) Low Water Flow
      2) Low Polymer Flow
   d. The panel shall have provisions for the following inputs:
      1) Remote On-Off (Discrete)
      2) Metering Pump Flow Pacing (4-20 mA DC)
   e. The following outputs shall be provided at the control panel:
      1) Running (Discrete)
      2) Auto Flush Mode (Discrete)
      3) Low Water Flow Alarm (Discrete)
      4) Polymer Pump Rate (4-20 mA DC)
      5) Low Polymer Flow Alarm
   f. Panel instruments shall conform to the requirements of Section 40 78 00, Panel-Mounted Instruments and Devices.
   g. Provide (2) 120V, 20A, 1-pole circuit breakers for powering the associated skid mounted peristaltic pumps. See 46 33 44, Peristaltic Metering Pumps.
7. Polymer Solution Flow Meter: A continuous measuring flow meter for the prepared solution shall be provided. The flow meter shall provide an output signal of 4 to 20 mADC corresponding to the solution volume flow rate. Flow meters with moving parts or flow separators will not be considered.
   a. Polymer-water ratio control for in-line polymer blending unit shall be provided.
8. Stainless Steel Skid:
   a. All components of the polymer-blending unit shall be integrally mounted on a frame of Type 316 stainless steel construction. No mild steel shall be used. The frame shall be constructed of 3/16-inch angle or structural stainless steel tubing. The panel supporting the control panel shall be a minimum of 12-gauge. Vertical frame members shall be gusseted.

b. All pipe supports shall be Type 316 stainless steel. Piping and valves shall be mounted with rigid pipe clamps.
c. The skid shall be designed to be capable of being forklifted and shall have holes for mounting to concrete.
d. The frame shall be designed for an integral dilution water pump.

9. Neat Polymer Flow Meter:
   a. A continuous measuring flow meter for all types of neat polymer shall be provided. The flow meter shall operate on the Coriolis force principle and provide an output signal directly proportional to the liquid mass flow rate.
   b. The flow meter shall conform to the following requirements:
      1) Primary Sensor Requirements:
         a) Flow head wetted parts shall be constructed of Type 316L stainless steel.
         b) Flow head shall consist of a single tube configuration and shall incorporate a system to minimize external plant vibrations to reduce mass measurement error.
         c) Flow head shall be designed to allow meter installation in an industrial environment with normal plant vibration without special mounting requirements.
         d) Flow head shall be able to withstand process temperatures from 32 °F to 100 °F and process pressure to 2,300 psig, depending on the end connection type and rating.
      2) Signal Converter and Transmitter Output:
         a) Converter shall have the following standard functions:
            i. Mass flow rate.
            ii. Volumetric flow rate.
            iii. Totalized mass flow rate.
            iv. Totalized volumetric flow rate.
         b) Current output: 4 to 20 mADC into a maximum load of 800 ohms.
         c) System accuracy shall fall within the following limits:
            i. For 5:1 Range: +/- 0.20 percent of rate.
            ii. For 10:1 Range: +/- 0.30 percent of rate.
      3) Construction Features:
         a) Flow Head:
            i. Flow head enclosure shall be constructed of Type 304 stainless steel with a satin glass bead-blast finish.
            ii. End Connections: Standard threaded or ANSI 150 flanged, depending on size of the primary flow head sensor.
            iii. Electrical Connections: 3/4-inch NPT tapped holes for power conduit fitting and signal conduit fittings.
         b) Converter/Transmitter:
            i. Die-cast aluminum alloy, NEMA 4X enclosure, epoxy coating finish.

ii. A manufacturer provided shielded cable assembly of sufficient length for connection between flow head and converter/transmitter shall be supplied.

4) Manufacturers: Provide equipment of one of the following:
   a) Krohne.
   b) Or equal.

10. Dilution Water Flow Meter:
    a. A continuous measuring flow meter for the dilution water shall be provided. The flow meter shall provide an output signal of 4 to 20 mADC corresponding to the dilution water flow rate.
11. Stainless Steel Water Buffer Tank:
    a. Provide a Type 304 stainless steel buffer tank with a Type 304 stainless steel automatic floating valve to ensure atmospheric separation of the feed water system. The buffer tank shall feed dilution water to the water booster pump.
    b. The buffer tank shall have a 1-1/4-inch inlet connection equipped with a wye screen and a pressure reduction valve allowing the unit to operate with water pressures of up to 250 psi.
12. Manufacturers: Provide equipment of one the following:
    a. DynaBlend Polymer Blending Unit, as manufactured by Fluid Dynamics.
    b. Or equal.

2.3 TOOLS AND SPARE PARTS

A. Polymer blending and feed equipment shall be furnished with one complete set for each size being provided including the following additional materials as a minimum for Alternative A or Alternative B:
   1. The following spare parts shall be packed in a sturdy waterproof galvanized metal box with clear indelible identification markings:
      a. Two complete sets of special tools required for normal operation and maintenance.
      b. One complete set of gaskets and o-rings for all gasketed covers and connections.
      c. One polymer ball check valve assembly.
      d. One rotor for progressing cavity pump.
      e. One stator for progressing cavity pump.
      f. One mechanical seal for progressing cavity pump.
      g. One dilution water needle valve.
      h. One repair kit for wear parts not specified.

B. Spare parts shall be packed in sturdy containers with clear indelible identification markings and shall be stored in a dry, warm location until transferred to the OWNER at the conclusion of the Project.

2.4 SURFACE PREPARATION AND SHOP PAINTING

A. Pumps, motors, drives, frames, baseplates, appurtenances, etc., shall receive shop primer coating conforming to the requirements of Section 09 91 00, Painting.

B. Surface preparation and painting shall conform to the requirements of Section 09 91 00, Painting.

C. All gears, bearing surfaces, machined surfaces and other surfaces which are to remain unpainted shall receive a heavy application of grease or other rust-resistant coating. This coating shall be maintained during storage and until the equipment is placed into operation.

D. CONTRACTOR shall certify, in writing, that the shop primer coating system is compatible with the finish coating system in accordance with Section 09 91 00, Painting.

2.5 SOURCE QUALITY CONTROL

A. Shop Tests:
   1. Each pump casing shall be hydrostatically tested to twice the discharge head or 1-1/2 times the shutoff head, whichever is greater.
   2. Running Test: Each pump assembly shall be operated from zero to maximum capacity as shown on the approved curve. Results of the test shall be shown in a plot of test curves showing head, flow, horsepower, efficiency and current. Readings shall be taken at a minimum of five evenly spaced capacity points including shut-off, design point and minimum head for which pump is designed to operate.
   3. Tests shall be witnessed by a Registered Professional Engineer who may be an employee of the manufacturer. The Registered Professional Engineer shall sign and seal all copies of curves and shall certify that hydrostatic tests were performed. Tests shall be conducted in conformance with the Standards of the Hydraulics Institute.
   4. Pumps shall not be shipped until the ENGINEER has approved the test reports.

PART 3 - EXECUTION

3.1 INSPECTION

A. CONTRACTOR shall verify that structures, pipes and equipment are compatible.

B. Make adjustments required to place system in proper operating condition.

3.2 INSTALLATION

A. Manufacturer's representative shall check and approve the installation prior to operation. Manufacturer's representative shall field test and calibrate the equipment to assure that the system operates to the OWNER'S satisfaction.

3.3 FIELD QUALITY CONTROL

A. All equipment will be given running tests by CONTRACTOR at the job Site following installation of the equipment and controls. Should the tests indicate any malfunction, CONTRACTOR shall make any necessary repairs and adjustments. Such tests and adjustments shall be repeated until, in the opinion of the ENGINEER, the installation is complete and the equipment is functioning properly and accurately, and is ready for permanent operation.

B. A factory trained representative shall be provided for installation supervision, start-up and test services and operation and maintenance personnel training services. The representative shall make a minimum of three visits, minimum four hours on-Site for each visit, to the Site. The first visit shall be for assistance in the installation of equipment. Subsequent visits shall be for checking the completed installation, start-up of and training on the system. Manufacturer’s representative shall test operate the system in the presence of the ENGINEER and verify that the equipment conforms to the requirements. Representative shall revisit the Site as often as necessary until all trouble is corrected and the installation is entirely satisfactory.

C. All costs, including travel, lodging, meals and incidentals, for additional visits shall be at no additional cost to the OWNER.

+ + END OF SECTION + +

SECTION 46 76 33

DEWATERING CENTRIFUGES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish a system of sludge dewatering centrifuges, complete and operational.
   2. Equipment to be furnished for each centrifuge shall include, but not necessarily be limited to:
      a. Rotating assembly consisting of a bowl and scroll conveyor with main bearings, mounted on a frame.
      b. Electric main motor drive system consisting of an AC inverter duty motor and variable frequency drive (VFD).
      c. Scroll drive system, consisting of an AC inverter duty motor and VFD.
      d. Centrifuge Control Panel (CCP) with complete controls for each centrifuge consisting of an operator interface terminal (OIT), programmable logic controller (PLC), an Ethernet switch to communicate with existing plant supervisory, control, and data acquisition (SCADA) panel RTU-SH, motor starters, VFDs and associated controls. The centrifuge VFD/PLC control panel (CCP) shall be separated into two distinct compartments, one with 480 VAC distribution and the second with 120 VAC PLC controls; the compartments shall be separated vertically with a protective barrier and have separate doors for protection. All PLC and application programming and OIT configuration along with ancillary equipment specified shall be provided by centrifuge manufacturer.
      e. Vibration monitors on centrifuges with display indication in CCP.
      f. Vibration isolators for the centrifuge and main motor.
      g. Centrate chute with sample port and cup drain.
      h. Solids discharge chute with sample port.
      i. Flexible connections for the centrate and solids chutes.
      j. Solids diverter slide gate assembly.
      k. Auxiliary and accessory devices, equipment, or materials necessary for system operation, or to interface equipment provided under this Section with equipment referenced under other Sections.
      l. Auxiliary and accessory devices, equipment, or materials where not specified shall be as recommended by the manufacturer and approved by ENGINEER.
      m. External oil or grease lubrication system for main bearings.
      n. Anchorages, including nuts, bolts, and hardware.
   3. The centrifuge manufacturer shall provide and have overall system responsibility for variable frequency drives as specified in Section 26 29 23,

Low-voltage Variable Frequency Drives, and shall be responsible for coordination of the overall variable speed drive system application. This shall include coordination of the centrifuge and motors with the variable frequency drive units, as well as coordination of the drive system interfacing with the electrical work and instrumentation and control functions specified in Division 26 and Division 40, respectively. Overall system responsibility shall include field testing, start-up, training, calibration and overall successful operation of the equipment.

4. The centrifuge manufacturer shall provide equipment indicated in this Section and provide VFDs that meet requirements in Section 26 29 23, Low-voltage Variable Frequency Drives. Equipment shall be furnished by a single system Supplier who shall be responsible for the completeness, performance, adequacy, and proper operation of the system in accordance with the requirements herein.
5. Centrifuge Manufacturer Services: Centrifuge manufacturer shall provide the following services including, but not necessarily limited to:
   a. Supervision of unloading of all centrifuges.
   b. Installation training of the Contractor.
   c. Programming of all centrifuge monitoring and controls through their respective CCPs.
   d. Check-out of the installation of all centrifuges.
   e. Start-up assistance for all centrifuges.
   f. Training of Owner's personnel for the centrifuges.
   g. Field acceptance testing for all centrifuges using polymer system provided under Section 46 33 33. Polymer (Solenis K290FLX) for this test shall be provided by Contractor.
   h. Disassembly of one centrifuge after field acceptance testing, to demonstrate disassembly and re-assembly to OWNER's personnel.
   i. Power quality testing at two points of common coupling (PCC) and a final power quality report.
   j. Other services as specified.

B. An existing plant wide SCADA PLC-based system is used for dewatering systems control. All remote control and process monitoring in the dewatering process, including sludge feed pumps, polymer system, booster pumping system, centrifuges, and other appurtenant equipment, shall be via this system. Centrifuge manufacturer is responsible for technical support required to establish data communications between the CCPs and the plant SCADA system via Ethernet network. Plant SCADA improvements are not included in the centrifuge manufacturer scope of Work.

C. Coordination:
   1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before, the dewatering centrifuge Work.
   2. Centrifuge manufacturer shall fully cooperate with the CONTRACTOR in all aspects of delivery, unloading, installation, start-up, testing and training for the centrifuge dewatering equipment.

3. Manufacturer shall attend up to two working meetings up to 4 hours each with representatives of the OWNER and centrifuge manufacturer's control engineer to coordinate centrifuge manufacturer's control system requirements with the existing controls system and overall design. Meetings will be held in the Canton, Ohio area.
4. Centrifuge manufacturer shall coordinate all control interfaces with equipment provided by CONTRACTOR.
5. Centrifuge manufacturer shall provide assistance required to integrate CCPs to the plant network. This includes technical support and coordination required to establish data communications between the CCPs and plant SCADA, including the assignment of registers and tags for monitoring and control information, and joint testing functionalities of plant SCADA.
6. Two control system workshops (up to 1 full day per each workshop) shall be held at the project Site to coordinate the system integration between the manufacturer and the system integrator. One workshop shall focus on interfacing between the plant SCADA system and CCPs. The other shall focus on plant PLC-based SCADA and CCPs. Centrifuge manufacturer's software programmer who completed the PLC/OIT software shall attend both workshops. The workshops shall coordinate interfacing and testing protocols for CONTRACTOR, to which the centrifuge manufacturer shall subsequently demonstrate and test the interfacing between dewatering systems SCADA and CCPs, and between plant SCADA and CCPs, including tagging, communication, controls and monitoring, diagnostics, and backup switchover. The design engineer and CONTRACTOR's personnel or Subcontractor(s) responsible for controls integration will attend both workshops.
7. An independent testing agency (i.e., not the CONTRACTOR or centrifuge manufacturer) shall complete the Power Quality testing as required in this Section.

D. Field assembly and installation of the equipment furnished in this Section shall be supervised by centrifuge manufacturer's representative. All equipment shall be provided as completely assembled as possible. Items which cannot be shipped assembled shall be identified in the Shop Drawings.

E. Related Sections:
1. Section 03 00 05, Concrete.
2. Section 05 05 33, Anchor Systems.
3. Section 09 91 00, Painting.
4. Section 26 29 23, Low-voltage Variable Frequency Drives.
5. Section 40 05 05, Exposed Piping Installation.
6. Section 40 05 06, Couplings, Adapters and Specials for Process Piping.
7. Section 40 05 93, Common Motor Requirements for Process Equipment.
8. Section 40 61 13, Process Control System General Provisions.
9. Section 40 61 96, Process Control Descriptions.
10. Section 40 64 00, Programmable Logic Controllers.
11. Section 40 67 17, Process Control Panels and Enclosures.
12. Section 40 78 00, Panel-mounted Instruments and Devices.

13. Section 43 26 23, Stainless Steel Slide Gates.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. ASME B16.1, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
   2. ASTM E329, Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.
   3. ASTM G65, Standard Test Method for Measuring Abrasion Using the Dry Sand/Rubber Wheel Apparatus.
   4. IEEE 519, Recommended Practice and Requirements for Harmonic Control in Electric Power Systems.
   5. ISA TR20, Specification Forms for Process Measurement and Control Instruments.
   6. ISO/IEC 17025, General Requirements for the Competence of Testing and Calibration Laboratories.
   7. NIST Standard Reference Materials (SRM).
   8. NFPA 79, Electrical Standard for Industrial Machinery.

1.3 QUALITY ASSURANCE

A. Centrifuge Manufacturer Qualifications:
   1. Centrifuge manufacturer shall have a minimum of 5 years of experience of producing substantially similar equipment (both in size and application) and shall be able to show evidence of at least 5 installations in satisfactory operation operating at a bowl speed equivalent of 3,000 G-force on the bowl inner wall for at least 5 years. Each installation shall be for dry solids installations of the size specified or larger, with high torque capacity, for a minimum of one year on municipal wastewater sludge.
   2. Centrifuge manufacturer's manufacturing facilities shall have testing facilities capable of performing the specified shop tests. The centrifuge manufacturer shall be certified for ISO 9001 Quality Assurance in the design, development, production, installation and servicing of machines and installations for mechanical separation.

B. Component Supply and Compatibility:
   1. All equipment included in this Section regardless of the component manufacturer shall be from a single centrifuge equipment manufacturer. The centrifuge shall be manufactured to tolerances specified herein and interchangeable between identical models.
   2. Centrifuge manufacturer shall review and approve or shall prepare all Shop Drawings and other submittals for all components furnished under this Section.
   3. All components shall be suitable for the specified service conditions and shall be integrated into the overall assembly by the centrifuge manufacturer.

C. Testing Laboratory Qualifications:
   1. Comply with applicable requirements of ASTM E329.
   2. Testing laboratory shall be licensed to operate in the same state as the Site. Where applicable, laboratory shall be certified by the authority having jurisdiction for the types of testing required.
   3. Testing equipment used by laboratory shall be calibrated at maximum intervals of twelve months by devices of accuracy traceable to one of the following: NIST SRM, ISO/IEC 17025, certified by state or local bureau of weights and measures, or values of natural physical constants generally accepted in the engineering and scientific community.

1.4 SUBMITTALS

A. Action Submittals: Submit the following within 6 weeks of Contractor issuing Purchase Order to manufacturer (Contractor shall issue Purchase Order within 2 weeks of Notice To Proceed):
   1. Shop Drawings:
      a. A complete and detailed submittal indicating equipment and controls to be provided, including a list of in-house manufactured key components, and system operation and sequencing, prior to equipment fabrication. All submitted materials to be in English or will otherwise be grounds for rejection.
      b. Drawings generally representing fabrication approach/assembly, and installation instructions and details, including:
         1) Setting drawings and/or templates for the positioning of anchor bolts and other anchorages.
         2) Location drawings for anchor bolts and other concrete embedded items shall be submitted and approved prior to their shipment to the project.
      c. Drawings of control panels, including instruments, panel wiring, PLCs, including input and output identification and register location, and other information.
         1) Provide control narratives with control panel submittal documentation describing centrifuge start-up and shutdown procedures, operation, control, and monitoring in plain language.
         2) Prior to CCP factory acceptance test, provide system documentation including memory loading, input/output (I/O) configuration, programming, and I/O data list for all PLC points. The data list shall include a description of each point and the exact address location of the data. This list will be used by others to produce dewatering systems SCADA screens for the centrifuges and appurtenances.
         3) Prior to CCP factory acceptance test, provide a color copy of all OIT screens for review.
         4) Panels, Consoles, and Cabinets:
            a) Layout Drawings, including the following:
               i) Front, rear, and internal panel views to scale.
               ii) Dimensional information.

iii) Tag number and functional name of components mounted in and on panel, console, or cabinet.
iv) Product information on all panel components.
v) Nameplate location and legend including text, letter size, and colors to be used.
vi) Location of anchoring connections and holes.
vii) Location of external wiring and/or piping connections.
viii) Mounting and installation details (coordinate with actual application).

b) Wiring and/or piping diagrams, including the following:
i) Name of panel, console, or cabinet.
ii) Wiring sizes and types.
iii) Piping sizes and types.
iv) Terminal strip numbers.
v) Color coding.
vi) Functional name and manufacturer's designation for components to which wiring is connected.

c) Calculations substantiating panel heating and cooling provisions proposed. List and utilize the following parameters in the calculations:
i) Enclosure dimensions.
ii) Minimum and maximum temperature outside the enclosure: 40-100 degrees Fahrenheit.
iii) Minimum and maximum desired temperature inside the enclosure based upon the manufacturer's stated operating temperature range of the panel components.
iv) Internal heat load.

d) Provide UPS power demand calculations for CCPs.

5) Electrical control schematics shall be in accordance with NFPA 79 standards.

6) Field Wiring Diagrams: Provide point-to-point interconnection wiring diagrams of all field wiring associated with furnished equipment. The diagrams shall include the following information:
a) Field wiring between each piece of equipment, panel, instrument, and other devices and wiring to control stations, VFDs, and motor starters.
b) Numbered terminal block identification for each wire termination.
c) Identification of the assigned wire numbers for all interconnections. Each wire shall be assigned a unique number.
d) Schedule showing the wiring numbers in which the numbered wire is installed.
e) Identification of all equipment and the Shop Drawings transmittal number for equipment from which the wiring requirements and termination information was obtained.

7) Control schematics shall be in accordance with convention indicated in Annex D of NFPA 79. Standardized wiring diagrams that do not

accurately reflect actual wiring to be furnished are unacceptable. Tables or charts for describing wire numbers are unacceptable.

8) Stock list or bill of materials for each panel including tag number, functional name, manufacturer's name, model number and quantity for components mounted in or on the panel or enclosure.

d. Motor Shop Drawings in accordance with Section 40 05 93, Common Motor Requirements for Process Equipment.

2. Product Data:
   a. Manufacturer's literature, illustrations, specifications, data sheets, fabrication, handling and lifting instructions, assembly and mounting drawings for all components adequate for installation of the equipment
   b. Total equipment weight and live loads created by individual pieces of equipment as well as the total weight of each centrifuge and ancillary equipment.
   c. Arrangement drawings and specifications of all items and equipment showing dimensions, weights, forces, parts, and construction details and materials required to demonstrate compliance with Contract Documents, including, but not limited to:
      1) Centrifuge bowl materials of construction.
      2) Conveyor details of construction and surfacing materials.
      3) Gear reducer model number, AGMA horsepower rating, insulation and enclosure details, efficiency at full, 3/4, and 1/2 load.
      4) Motors test data in accordance with Section 40 05 93, Common Motor Requirements for Process Equipment.
      5) VFD information, including what is required in Section 26 29 23, Low-voltage Variable Frequency Drives, and the following:
         a) Drive enclosure arrangement drawing of each drive system showing nameplate legends, fabrication details, and enclosure operating temperature-rise calculations. Fabrication details shall include interior door front and rear views, back panel layout and terminal block layout.
         b) A complete list of equipment and material proposed, containing an adequate description of each separate item of equipment or material recommended. Manufacturer's catalog data describing and depicting each drive system and equipment in sufficient detail to demonstrate compliance with the Contract Documents.
         c) One-line diagram for each VFD assembly, and control schematic and wiring diagram of the unit. The wiring diagrams shall show the interconnections of conductors and cables to remote devices.
      6) Sensors/transducers and field instruments, including:
         a) Manufacturer's product name and model number of devices proposed for use, including manufacturer's name and address.
         b) Instrument tag number from Contract Documents.
         c) Functional name.

d) Manufacturer's standard catalog product data:
   i) Catalog information shall be tailored for this Project by indicating all options and accessories provided or deleting or crossing out all non-applicable options or information.
   ii) Provide electronic editable copies (MS Work, Excel) and paper data sheets conforming to the latest ISA TR20 format, or other organized format, for review and approval. For all instrumentation, provide completely filled out ISA TR20 documents.
   iii) Centrifuge manufacturer shall include on ISA TR20 data sheets, or other organized format, for all elements including:
      a. Failure position for actuator-controlled devices.
      b. Indicating defined failure position for power failure.
      c. Indicating failure position for loss of control signal.
      d. Valve failure is defined as loss of power or loss of signal.
      e. Instrument failure position and signal response.
e) Description of construction features.
f) Performance and operation data.
g) Installation and mounting details, instructions, and recommendations.
h) Service requirements.
i) Dimensions of instruments and details of mating flanges, pipe sizes for insertion instruments, and upstream/downstream straight run pipe lengths required.
j) Range of each device and calibration information.
k) Descriptions of materials of construction and listing of NEMA ratings for equipment.

7) Paint system description, including paint manufacturer's technical bulletins.
8) Expected sound levels during factory testing of the centrifuge equipment at one meter from the units, measured in decibels in the A-weighted scale.
9) Listing of manufacturer's recommended spare parts. The list shall describe each part, the quantity recommended, the unit price of the part, and the name, address, and telephone number of an appropriate, viable supplier for that spare part.

B. Informational Submittals: Submit the following:
   1. Certificates:
      a. Certification of Compliance:
         1) Manufacturer shall provide certification on manufacturer letterhead stating that the Contract Documents have been examined, and that furnished equipment will operate satisfactorily under the conditions described in the Contract Documents and that the equipment meets all specified requirements.

2) Provide a list of any and all parameters, ratings, or other characteristics where the proposed centrifuge equipment deviates from the requirements set forth in the Contract Documents. Provide justification for exceptions, variations, deviations, or changes. Engineer will determine the acceptability of exceptions, variations, deviations, or changes. Exceptions, variations, deviations, or changes may result in rejection of equipment.
3) Certification by centrifuge manufacturer's representatives is not acceptable.
4) Provide certification before submitting Shop Drawings. Shop Drawings will not be reviewed prior to receipt of certification.
5) Acceptance of the certification shall not relieve centrifuge manufacturer of responsibility for compliance with the Contract Documents.

b. Certification from the drive and motor manufacturers that the approved equipment has been reviewed and that the drive and motors are compatible and will be provided in accordance with the Contract Documents.
c. Certification that the proposed equipment complies in all respects to the Occupational Safety Health Act.
d. Certified letter describing storage maintenance performed on centrifuges, if required.
e. Certified letter for each centrifuge unloading at the Site stating that centrifuge equipment was handled by CONTRACTOR in accordance with centrifuge manufacturer's instructions and meets centrifuge manufacturer's warranty.
f. Certified letter for each centrifuge installation at the Site stating that centrifuge equipment has been installed in accordance with centrifuge manufacturer's instructions and meets centrifuge manufacturer's warranty.
g. Certified letter following hands-on maintenance training stating that the centrifuge has been properly re-assembled in accordance with centrifuge manufacturer's instructions.

2. Manufacturer Instructions:
   a. For all components of equipment as appropriate, including setting drawings and instructions for installation of anchor bolts, including tolerances.
3. Testing Laboratory:
   a. Qualifications Statements:
      1) Qualifications statement indicating experience and facilities for tests required under the Contract Documents.
      2) Copy of report of inspection of facilities during most recent NIST inspection tour. Include memorandum of remedies of deficiencies reported during inspection.
      3) Copy of certificate of calibration for each instrument or measuring device proposed for use, by accredited calibration agency.
   b. Quality control submittals and test reports: Third-party testing laboratory retained by CONTRACTOR shall promptly submit to

centrifuge manufacturer, OWNER, CONTRACTOR, AND ENGINEER results of testing, including:
1) Project Title, number, and name of the Site.
2) Date issued.
3) Testing laboratory name and address.
4) Name and signature of inspector or person obtaining samples.
5) Date of sampling.
6) Identification of centrifuge tested.
7) Type of test.
8) Results of tests.

4. Source Quality Control Plans, Procedures, and Limitations:
   a. Shop Tests: Submit proposed shop testing procedures for the centrifuges, motors, and other appurtenances at least 60 days prior to conducting shop tests. At a minimum, shop tests shall include:
      1) Vibration testing per the manufacturer's standard vibration test.
      2) Curve(s) of starting current and kW vs. time.
      3) Plot(s) of brake horsepower vs. hydraulic feed rate at a bowl speed equivalent to 3,000 G-force on the bowl inner wall and torque set point at 75-percent of the back drive trip point.
   b. Control Panel Factory Acceptance Tests: Submit a factory acceptance test procedure for approval prior to the factory acceptance test.
5. Source Quality Control Results:
   a. Shop Tests: Submit the results of all shop tests conducted on the centrifuges within 30 days of the completion of the shop tests and prior to shipping the equipment from the manufacturing and testing facility.
   b. Control Panel Factory Acceptance Tests: Submit the results of the factory acceptance test and obtain Engineer's acceptance of the test before shipping the panels from the testing facility.
6. Installation and Demolition Procedure:
   a. At least 45 days prior to installing the first centrifuge, or ten days prior to removing existing equipment to be demolished (whichever occurs first), submit procedure for installing the centrifuge and removing existing equipment. Indicate how handling will comply with manufacturer's instructions.
   b. Procedure shall include the following:
      1) Total weight of the equipment to be moved.
      2) Type, size, quantity, and location of the rolling mechanisms, jacks, or other concentrated loads.
      3) Information relative to temporary pull points attached to existing structure, such as come-alongs, expansion anchors, or other temporary anchorages.
      4) A field-measured drawing showing the proposed path to be taken through the building. Where such movement of heavy items has potential to affect the existing structure, submit structural evaluation by professional engineer (structural engineer) possessing valid license and registration in the same jurisdiction as the Site. Such evaluation will demonstrate that proposed movement of heavy items

and method(s) of handling in existing structures will not damage or adversely affect such structure.

c. ENGINEER's review, regardless of whether the work product of a separate professional engineer engaged by CONTRACTOR is submitted, will not extend to CONTRACTOR's means, methods, procedures, techniques, or sequences of construction or the safety and protection procedures incident thereto. It is CONTRACTOR's responsibility to ensure adequacy of rigging, cables, chokers, chain, shackles, and other equipment used for installation and removals, and to protect existing structures and surfaces during the Work.

7. Field Quality Control Plans, Procedures, and Limitations:
   a. Field Tests: Submit a written test procedure for field testing, including detailed schedule for testing.
8. Field Quality Control Results:
   a. Field Tests: Submit results of all field tests conducted on the installed centrifuges within two weeks of completion of each test.
   b. Motor Tests: Submit results of motor tests at the Site in accordance with Section 40 05 93, Common Motor Requirements for Process Equipment.
9. Operations and Maintenance Training Plan: Submit operations and maintenance training plan per Section 01 79 23, Instruction of Operations and Maintenance Personnel.
10. Reports: Submit a report for each visit to the Site by centrifuge manufacturer's factory-trained field service representative, and field representatives of centrifuge manufacturers' of associated equipment, such as VFDs and control panels. Reports shall provide complete information on time, schedule, tasks performed, person contacted, problems corrected, test results, training, instruction and all other pertinent information and facts.

C. Closeout Submittals: Submit the following:
   1. Operation and Maintenance Data:
      a. Submit complete installation, operation, and maintenance manuals, including test reports, maintenance data and schedules, description of operation, and spare parts information, including a list of each spare part's current unit price in U.S. funds.
      b. Furnish installation, operation, and maintenance manuals in conformance with the requirements of Section 01 78 23, Operations and Maintenance Data.

D. Maintenance Material Submittals: Furnish the following:
   1. Spare Parts:
      a. For bowls provided with strips, furnish three complete sets of wear strips constructed of Type 316 stainless steel bar stock, 1-inch wide by 1/4-inch thick cut to length of the bowl, including the conical section.
      b. One feed tube.
      c. Three sets of main drive belts.
      d. Two sets of main bearings and seals.
      e. Two sets of scroll bearings and seals.

f. Two thrust bearings and seals if different from above main and scroll bearings.
g. Three sets of feed port and solids discharge port liners/inserts.
h. Three sets of solids discharge case protection liners.
i. Five percent of the total quantity of scroll tile assemblies provided on each centrifuge for each centrifuge.
j. Three sets of centrate dam plates (minimum three sizes per set) for each centrifuge.
k. One complete sets of parts for the bearing lubrication system, including spare pump (as applicable), two of each type of flow and temperature switches, control boards, and other recommended spare parts.
l. Three complete sets of gaskets, o-rings, and seals.
m. Six oil filter cartridges of each type required.
n. Two of each size of flexible connector installed.
o. Instrumentation and controls spare parts:
    1) Three spares of all expendable items, such as control fuses (for each size furnished), pilot lamps, and other items.
    2) One set of power fuses for each type of fuse installed.
    3) One programmable logic controller (PLC) for each unique processor installed.
    4) One memory card for each type of card installed.
    5) Ten percent (minimum of 2) of installed quantity of I/O cards for each unique type installed.
    6) One network interface, remote I/O, and communication module for each unique module installed.
    7) One specialty module for each type installed.
    8) Spare PLC power supplies for each unique power supply installed.
    9) One chassis for each unique chassis installed.
    10) One PLC I/O fast connector for each unique type installed.
    11) One network switch of each type installed.
    12) One media converter of each type installed.
    13) One manufacturer cable of each type installed.
    14) Five 10-foot long CAT-6 cables with connectors installed.
    15) Two relays and sockets for each type installed.
    16) Ten percent (minimum of 10) of installed quantity of fuses for each type and size installed.
    17) Ten percent (minimum of 2) of installed quantity of circuit breakers for each type and size installed.
    18) Ten percent (minimum of 10) of installed quantity of light bulbs for each type installed.
    19) Five percent (minimum of 3) of installed quantity of LED light for each type installed.
    20) Spare panel-mounted power supplies for each type installed.
    21) Two selector switches and pushbuttons for each type installed, including contact blocks.
    22) Spare unique components, including cables, for miscellaneous components.

2. Extra Stock Materials:
    a. One quart of touch-up paint for each type of paint used for centrifuge units.
    b. One-year supply of lubricants and fluids for all equipment.
3. Tools:
    a. One set (unless otherwise noted) of all special tools required for installation, maintenance, and operation, including at least the following, as applicable:
        1) Tension bar nut wrench (if applicable).
        2) Pillow block bearing nut wrench (if applicable).
        3) Plate dam removal wrench (if applicable).
        4) Thrust bearing puller (if applicable).
        5) Pillow block bearing remover (if applicable).
        6) Seal holder.
        7) Special wrenches and tools necessary for centrifuge disassembly.
        8) Scroll extracting tool.
        9) Bowl truck.
        10) Scroll truck.
        11) Electronic meters for main and back drives (if applicable).
        12) Feed tube lifter (if applicable).
        13) One set of all special tools required for normal operation and maintenance of each VFD.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling, and Unloading:
1. Deliver materials to the Site to ensure uninterrupted progress of the Work.
2. Conform to the requirements of Section 01 35 00, Product Delivery Requirements.
3. At the time of delivery, CONTRACTOR and centrifuge manufacturer shall:
    a. Inspect shipment for damaged or missing pieces.
    b. Inspect shipment for erroneously shipped equipment.
    c. Notify OWNER and ENGINEER, in writing, if any loss or damage exists to equipment or components.
    d. Initiate corrective action, as may be required. Replace missing components and repair damage to new condition.
4. CONTRACTOR shall unload and handle the equipment in accordance with the centrifuge manufacturer's recommendations. CONTRACTOR's unloading and handling of the dewatering centrifuge equipment and materials shall be supervised by centrifuge manufacturer's factory-trained serviceman.
5. Upon delivery to the Site, CONTRACTOR shall be responsible for protecting, rotating, lubricating, and maintaining equipment as recommended by centrifuge manufacturer.

B. Storage and Protection:
1. Centrifuge manufacturer may store the centrifuge equipment prior to delivery to the Site. Centrifuge manufacturer shall be responsible for exercising dewatering centrifuge equipment and materials as required during storage.

Centrifuge manufacturer shall provide certified letter describing the storage maintenance performed.

2. Conform to the requirements of Section 01 66 00, Product Storage and Handling Requirements.

1.6 WARRANTY

A. General Warranty:

1. The special warranty specified in this Article shall not deprive the OWNER of other rights or remedies the OWNER may otherwise have under the Contract Documents and shall be in addition to and run concurrent with other warranties made by the centrifuge manufacturer under the Contract Documents. The obligations of the centrifuge manufacturer under the Contract Documents shall not be limited in any way by the provisions of the specified special warranties.

B. Special Warranty on Materials and Workmanship: Centrifuge manufacturer shall guarantee the dewatering centrifuge equipment and material furnished under this Contract to be free from defects in materials and workmanship for a period of 18 months from final acceptance of dewatering centrifuge equipment and material. Dewatering centrifuge equipment and material will be accepted after they are satisfactorily field tested and the test results approved by OWNER, and the dewatering centrifuges are placed into full-time operation.

PART 2 – PRODUCTS

2.1 PRODUCT AND MANUFACTURER

A. Provide centrifuge equipment by one of the following, with no exceptions:

1. Model ALDEC G3-115, by Alfa Laval, Inc.
2. Model WaterMaster CF 7000, by GEA Westfalia Separator Division of GEA Mechanical Equipment U.S., Inc.

2.2 SERVICE CONDITIONS

A. General:

1. The centrifuges shall be high-solids, solid bowl, horizontal scroll-type units suitable for continuous operation requiring minimal maintenance at the service conditions listed. Continuous operation means 24 hours per day, 7 days per week, 52 weeks per year, less downtime for routine maintenance per centrifuge industry standard practice.
2. Centrifuge manufacturer shall furnish the equipment with all required motors, VFDs, internal wiring, control equipment and panels, connections, maintenance tools and other appurtenances or accessories to make a complete and operable system. All external piping and external electrical wiring between the various equipment components supplied, unless specified otherwise, will be provided by others.

3. Centrifuges shall utilize chemical conditioning by one liquid organic polyelectrolyte chemical, which is readily commercially available in bulk quantities.
4. Design Criteria: Design requirements of the unit specified shall be understood to establish the minimum requirements only. The equipment, when installed and operating, shall meet or exceed the specified minimum performance requirements.
   a. Quantity of centrifuges: 3
   b. Designation: Dewatering Centrifuge No. 1 through Dewatering Centrifuge No. 3
   c. Bowl speed at 3,000 G-force: 2,875 to 2,900 rpm
   d. Minimum G-force level: 3,000 x G
   e. Minimum G-volume at 3,000 G-force and neutral pond depth: 412,700 to 385,000 G-gallons
   f. Centrifuge dry weight (maximum): 16,600 lbs.
   g. Centrifuge operating weight (maximum): 22,100 lbs.
   h. Bowl/scroll removal location: Top access

B. Sludge Characteristics:
1. Type of sludge:
   a. Domestic Sludge: Membrane bioreactor waste activated sludge.
2. Sludge consistency:
   a. Minimum sludge dry solids: 0.8 percent
   b. Maximum sludge dry solids: 1.2 percent
   c. Average sludge dry solids: 1.1 percent
3. Volatile solids content:
   a. Minimum volatile solids content: 70 percent
   b. Maximum volatile solids content: 75 percent
   c. Average volatile solids content: 73 percent

C. Performance Requirements:
1. Design sludge feed flow rate to each centrifuge:
   a. Average Design Condition: 173 gpm
   b. Maximum Day Condition: 226 gpm
2. Design sludge feed dry solids mass to each centrifuge:
   a. Average Design Condition: 650 dry lbs/hour
   b. Maximum loading: 1,100 dry lbs/hour
3. Minimum solids content at design condition: 20.0 percent
4. Minimum solids recovery: 95.0 percent
   a. Solids recovery shall be defined as follows:

$$SR = [C/F] \times [(F-E) / (C-E)] \times 100$$

Where: SR = Solids recovery (% recovery)
C = Dewatered sludge total solids (%TS)
F = Sludge feed total suspended solids (%TSS)
E = Centrate total suspended solids (%TSS)

5. Maximum polymer usage of "basis of design" polymer (Solenis K290FLX) at design conditions: 27.0 active dry lbs/ton of sludge feed dry solids.
6. Maximum power consumption at design conditions (design sludge feed excluding polymer solution flow rate, minimum solids recovery, and maximum polymer usage, as specified): 0.25 kW/gpm.
7. Polymer solution addition to condition the sludge feed shall be introduced through centrifuge manufacturer's standard connection on the centrifuge feed pipe at the centrifuge. Three other points will also be available in the sludge feed piping upstream of the centrifuge for future optimization events:
    a. Upstream of the flexible coupling inlet to the centrifuge.
    b. Approximately 40 pipe diameters upstream of centrifuge inlet. Manufacturer to recommend final location of this feed point.
    c. Approximately 50 pipe diameters upstream of centrifuge inlet. Manufacturer to recommend final location of this feed point.
8. Maximum noise level shall be 89 dBA at a distance of 3 feet from the centrifuge during source quality assurance testing.
9. Maximum rated main motor horsepower: 100 Hp
10. Maximum rated back drive motor horsepower: 50 Hp
11. Rated motor voltage: 480 VAC, 3-phase, 60 Hz.

D. Environmental Conditions:
    1. Elevation: Approximately 1,040 feet above mean sea level.
    2. Relative Humidity:
        a. Indoors: 40 to 95 percent.
        b. Outdoors: 40 to 95 percent.
    3. Air temperature:
        a. Indoors: 45 degrees F to 104 degrees Fahrenheit.
        b. Outdoors: 0 degrees F to 90 degrees Fahrenheit.

2.3 DETAILS OF CONSTRUCTION

A. General:
    1. All appurtenant equipment and piping normally furnished as an integral component of the centrifuge (with the specific exception of the centrifuge feed pumps, polymer solution pumps and system, sludge cake conveyance system, cooling water connections, and effluent flushing water connections) and which is required for proper operation of the centrifuge shall be furnished, whether or not specific reference is made thereto in these Specifications.
    2. Centrifuges shall be completely factory assembled and tested unless otherwise specified herein. The assembly shall require only anchoring the centrifuge and connecting external piping, control cables and electrical wiring. Equipment that might be damaged during shipping if mounted on the unit shall be installed following receipt at the Point of Destination by a representative of the manufacturer. All electrical and control components located on the centrifuge shall be pre-wired at the factory.
    3. Design and construct the centrifuge in such a manner so as to be suitable for continuous heavy-duty use in a humid and corrosive environment.

4. Painting: All external centrifuge surfaces, motors, drives, frames, and appurtenances shall receive an epoxy polyamide painting system applied at the factory. The color of the equipment shall by the centrifuge manufacturer's standard color system. Stainless steel parts except for upper covers shall not be painted. Surface preparation and primer shall be in accordance with the paint manufacturer's recommendations. Provide corrosion protection compound on all centrifuge polished and non-ferrous surfaces.

B. Process Connections:
   1. The centrifuge sludge feed connection shall be 125-pound standard flange conforming to ANSI/ASME B16.1. Polymer solution addition and bowl effluent flushing water clean-in-place (CIP) connections shall be provided on the sludge feed piping.
   2. Flanged centrate discharge connection with adapter "funnel", including connections for sampling, future chemical addition, fume air discharge, and drain line return flange.
   3. Flanged cake discharge connection.
   4. Casing flush connections, if required.

C. Materials of Construction:
   1. Materials shall conform to the following, unless otherwise specified:

a. Bowl:	Duplex stainless steel.
b. Bowl Wear Strips (if applicable):	Type 316 stainless steel.
c. Scroll:	Type 316 or duplex stainless steel.
d. Scroll Tiles:	Sintered or flame-sprayed tungsten carbide.
e. Main Bearings:	Grease or oil lubricated, L-10 life of 100,000 hours.
f. Base:	Fabricated carbon steel or structural tubular steel with stainless steel cladding or inserts on all surfaces in contact with process material.
g. Upper Casing, if applicable:	Type 316 stainless steel, or fabricated carbon steel with stainless steel cladding on all surfaces in contact with process material.
h. Bottom Casing, if applicable:	Stainless steel or fabricated carbon steel with Type 316 stainless steel cladding on all surfaces in contact with process material.
i. Feed Tube:	Type 316 stainless steel.
j. Feed Compartment:	Type 316 stainless steel or centrifugally cast duplex stainless steel.
k. Feed Compartment Lining:	Field replaceable Adiprene liner or flame sprayed or sintered tungsten carbide or equal axial walls
l. Accelerators:	Fused nickel chrome boron

	alloy containing tungsten carbide particles on the wear surfaces or hard surfaced with sprayed tungsten carbide.
m. Sludge Feed Nozzle/Port:	Field replaceable Adiprene, silicon carbide, polyurethane, or sintered tungsten carbide liner.
n. Solids Discharge Port:	Field replaceable sintered tungsten carbide abrasion protection.
o. Solids Discharge Casing Protection:	Field replaceable Adiprene, urethane liner, stainless steel ring, or equal. The solids end casing liner shall extend to the bottom of the chute flex connector.
p. Solids Chute:	Type 316 stainless steel.
q. Centrate Chute:	Type 316 stainless steel.
r. Fasteners:	Type 316 stainless steel, unless higher strength is recommended by the manufacturer or specified herein.
s. Anchor bolts, nuts, and washers:	Type 316 stainless steel, sized as required by the manufacturer.
t. O-Rings and Lip-Type Seals:	Viton-A or Buna-N.

D. The supplier of stainless steel castings and abrasion-resistant materials shall supply certified copies of the mill test results certifying that the materials supplied are in accordance with the applicable ASTM standards. Three copies shall be forwarded to the Buyer prior to the initiation of centrifuge fabrication. The mill test reports shall include:
   1. The actual material analysis.
   2. ASTM standard.
   3. Date of manufacture.
   4. Place of manufacture.
   5. Manufacturer's name.
   6. Markings on the materials to denote the batch number.

E. Unless otherwise specified, all abrasion resistant materials shall have a volume loss less than 3 cubic millimeters when tested in accordance with the ASTM G65, Procedure A, Standard Test Method for Measuring Abrasion Using the Dry Sand/Rubber Wheel Apparatus. All test reports shall be furnished in English. Non-ASTM standards and requirements shall be referenced to appropriate ASTM standards. A certificate of previous materials tests on same materials used on same model of centrifuge may be submitted.

F. Fasteners shall be either all English or all metric; mixtures of both types is not acceptable. All wiring instructions shall be in English and electrical connections for others shall be in accordance with the NEC, NEMA and ANSI standards.

G. Bowl:
   1. Provide a cylindrical bowl with conical beach extension for each centrifuge.
   2. Bowl shall be centrifugally cast with surfaces free of cracks, shrinkage, porosity, or other defects; the presence of defects shall be determined by a liquid penetrant test. Nominal bowl thickness in the cylindrical and conical section shall be a minimum of 0.7 inches.
   3. Pool depth in the centrifuge bowl shall be adjustable via weir plate(s) located at the large diameter end of the bowl where centrate is discharged.
   4. Solids shall be discharged from the small diameter end of the bowl, opposite the centrate discharge end. The solids opening shall be protected by a hard surfaced insert or wear ring, including wear sleeves. All bowls shall be interchangeable.
   5. Provide evenly spaced longitudinal bowl strips or grooves machined in the bowl foundation material over the entire length of the bowl to trap solids and form a layer to protect the bowl from wear.
   6. The centrifuge bowl and scroll assembly shall be removable without removal of the drive motor in its operating position.

H. Scroll/Conveyor:
   1. Each centrifuge shall include a horizontal scroll conveyor equipped with helical flights.
   2. The scroll conveyor shall be independently balanced and mounted concentrically within the centrifuge bowl. All scrolls shall be interchangeable.
   3. The scroll conveyor shall utilize differential speed to convey sludge solids to the discharge end of the bowl without clogging and with a minimum of disturbance to the pool to take maximum advantage of the variable speed back drive.
   4. The edge and the face of the scroll conveyor flights for the entire length of the scroll shall be protected against abrasion from the solids by a series of abrasion protected tiles. Each protected tile shall be individually replaceable and shall include the ability to monitor wear by means of a visual inspection.
   5. The scroll shall be tiled in the feed port area, which shall include hard surfaced liners.
   6. The conveyor shall contain a Type 316 stainless steel disc on the solids end extending outwardly beyond the interface between the separated layers of light and heavy phase material.
   7. Conveyor bearings shall be anti-friction roller- or ball-type, and shall conform with the following:
      a. Sealed from process contamination, externally greaseable and easily accessible for proper maintenance.
      b. Rated with an L-10 bearing life of not less than 100,000 hours as defined by the AFBMA at the specified operating conditions, or as defined by SKF's New Life Theory.
      c. Bearings shall be guaranteed against replacement within the first 15,000 hour or three-year period, whichever occurs first. Annual replacement of conveyor bearings will not be acceptable.

I. Main Bearings:
   1. The centrifuge shall be designed so that the entire rotating assembly is supported by two main bearings. Each main bearing shall be spherical or cylindrical roller-type bearings mounted in split horizontal pillow blocks.
   2. Main bearings shall be grease or oil-mist lubricated.
      a. Grease lubricated bearings shall be via through suitably located fittings with a lithium-based grease.
      b. Oil-mist lubricated bearings shall use a high-performance lube oil, and consisting of the following components:
         1) Three liter oil reservoir.
         2) Oil reservoir level switch.
         3) Air pressure regulator.
         4) Solenoid valve (air-oiler valve).
         5) Low air pressure switches.
         6) Oil injection adjustment sleeves.
   3. Each pillow block shall be provided with a threaded female connection to permit the use of a lifting eye hook to facilitate inspection and maintenance of the main bearings.
   4. Main bearings shall have a L-10 life rating of not less than 100,000 hours as defined by the AFBMA, or by SKF New Life Theory, at the specified operating condition.
   5. Provide resistance temperature detectors (RTDs) for each bearing for continuous temperature monitoring, alarm and shutdown functions through the centrifuge control system.

J. Feed Arrangement and Flocculent Distribution:
   1. The scroll conveyor shall be designed such that the feed leaving the feed tube is accelerated in a feed zone that distributes the discharge into the bowl. The feed zone shall be provided with replaceable feed zone extensions and nozzles.

K. Base/Mounting Frame:
   1. The centrifuge unit components shall be mounted on a base or mounting frame.
   2. The drive motor stand shall incorporate a motor base plate.
   3. The back drive system components shall be mounted on the centrifuge or on a base installed near the centrifuge.
   4. Bases for hydraulic equipment shall be provided with collection pans and drains.
   5. The base shall be provided with lifting eyes or facilities which will permit the lifting of the entire assembled centrifuge unit.
   6. Machined surfaces shall be provided at all points where support loads are transferred to the base.
   7. The frame shall include a lug installed such that the equipment will be electrically grounded.

L. Casing:
   1. The centrifuge shall be enclosed in a casing.

2. If removable upper case is provided it shall be bolted or hinged.
3. The case shall also be designed to act as a protective guard and to provide a complete enclosure to minimize noise.
4. The solids end of the casing shall include a replaceable Adiprene, urethane or stainless steel liner. To limit splashing and air leakage, the casing shall be provided with Rulon, Espey, or equal seals where the bowl hubs intersect the casing, a neoprene gasket on the machined flanges where the upper and lower casings join, and a rubber Teflon lip seal or splash collector and drain on the feed tube.
5. The bottom of the casing shall contain flanged centrate and sludge cake discharge connections. Each end of the case shall be equipped with a covered handhole opening to facilitate inspection, adjustment and maintenance. The casing shall be provided with splash guards.
6. The casing shall be vented as recommended by the equipment manufacturer.
7. Lifting eyes shall be provided for lifting the casing.
8. The casing shall include a flushing connection for cleaning the casing. Provide a casing drain to drain the casing to the centrate chute or alternatively provide a casing that drains by gravity to its centrate chute.
9. The cover shall be partitioned to guide the centrate and the solids discharge to their respective discharge outlets and to prevent liquid solids contamination to the rest of the unit.

M. Feed Tube:
1. Sludge feed shall enter the centrifuge through a replaceable feed tube that extends into the feed zone of the scroll conveyor.

N. Gear Box for VFD-Driven Scroll Conveyor:
1. Provide a multi-stage planetary or cyclo gearbox to provide control of the differential speed between the bowl and scroll conveyor. Gear box shall be suitable for 24 hour per day continuous service and shall have a self-contained high-performance gear oil system.
2. The gearbox shall be designed with a minimum safety factor of 2.5 and meet the requirements of AGMA.
3. The gearbox shall be independently balanced from the centrifuge and interchangeable.
4. Each gearbox shall be protected from damage due to high torque overload. A thermal overload protection device in the drive motor shall not be considered as providing for sufficient protection for the gear unit.

O. Main Drive System:
1. Each centrifuge shall be furnished with an electric motor, VFD, and V-belt drive system, if applicable, complete with necessary vibration isolators for the individual support of the motor and centrifuge. The belt drive system shall consist of multiple belts as required to provide full capacity and withstand the full starting torque of the system. Belt, pulley, and gear box guards shall be provided for protection from all moving parts. An appropriate tensioning device for the belts shall be provided.

2. Main Motor:
    a. The main motor shall comply with Section 40 05 93, Common Motor Requirements for Process Equipment, including requirements for source quality control and field quality control.
    b. Motor Enclosure Type: Totally enclosed fan cooled (TEFC).
    c. Unusual Service Conditions: Severe-duty, inverter duty.
    d. The motor shall be provided with an oversized NEMA 4X, Type 316 stainless steel terminal box.
    e. The main drive motor shall be provided with six dual-type RTDs which shall be distributed around the stator, each embedded in the coil slot between the upper and lower coil. Leads shall be brought out to a separate NEMA 4X, Type 316 stainless steel terminal box through a flexible sleeve to protect the leads and assure their flexibility after dipping and baking of stator. One dual-type resistance temperature detector of the same rating and material as defined above shall be provided for each motor bearing and wired to a separate NEMA 4X, Type 316 stainless steel terminal box.
3. Variable Frequency Drive:
    a. A VFD shall be supplied to drive the main motor and control the set speed.
    b. The VFD shall be provided in accordance with Section 26 29 23, Low-Voltage Variable Frequency Drives. Main drive VFD shall be located in the CCP.
    c. The VFD main drive system shall operate on 480 VAC, 3 Phase, 60 Hz power.
    d. The VFD shall be connected to the centrifuge PLC via Ethernet.

P. Back Drive System for Electro-Mechanical VFD-Driven Scroll Conveyor:
1. Each centrifuge shall be furnished with an electric motor, VFD, and V-belt drive system, if applicable, complete with necessary vibration isolators for the individual support of the motor and centrifuge. The belt drive system shall consist of multiple belts as required to provide full capacity and withstand the full starting torque of the system. Belt, pulley, and gear box guards shall be provided for protection from all moving parts. An appropriate tensioning device for the belts shall be provided.
2. Back Drive Motor:
    a. The back drive motor shall comply with Section 40 05 93, Common Motor Requirements for Process Equipment, including requirements for source quality control and field quality control.
    b. Motor Enclosure Type: Totally enclosed fan cooled (TEFC) or totally enclosed blower cooled (TEBC).
    c. Unusual Service Conditions: Severe-duty, inverter duty.
    d. The back drive motor shall be protected with one temperature switch in each phase which shall be embedded in the motor windings.
3. Variable Frequency Drive:
    a. A VFD shall be supplied to drive back drive motor and control the set speed.
    b. The VFD shall be provided in accordance with Section 16261, Low-Voltage Variable Frequency Drives. Back drive VFD shall be located in the CCP.

c. The VFD back drive system shall operate on 480 VAC, 3 Phase, 60 Hz power.
d. The VFD shall be connected to the centrifuge PLC via Ethernet.

Q. Back Drive System for Hydraulic-Driven Scroll Conveyor: Hydraulic back drives are not acceptable.

2.4 GUARDS

A. OSHA-approved guards shall be provided for all gear boxes and belt drives.
1. The guards shall be minimum 11 gauge steel.
2. The guards shall completely enclose the entire drive system and shall be designed to minimize vibration and noise.
3. Guards, except for the main drive motor, shall have a hole with cover plate coinciding exactly with the shafts of all equipment to allow the rpm to be checked.
4. The guards shall be lined on the inside with minimum 1/2 inch thick sound absorbing rubber foam where permitted by guard design for noise attenuation
5. Fasteners shall be externally accessible.
6. Any lubrication points shall be extended outside the guards so lubrication may be performed without removing the guards; however, guards shall be removable.

2.5 VIBRATION ISOLATION AND FLEXIBLE CONNECTORS

A. Vibration Isolators:
1. Each centrifuge unit shall be mounted on rubber or spring type isolators. The number, capacity and vibrator constant of the isolators shall be as recommended by the manufacturer for the load and impact resulting from operation of the centrifuge provided.
2. Each spring type isolator shall be provided with built-in leveling bolts and built-in resilient shocks to control oscillation and withstand lateral forces in all directions.
3. The isolators shall be self-leveling or designed for internal leveling and adjustment.
4. Snubber inserts shall be oil resistant synthetic rubber.
5. Housings shall be welded steel and springs shall be oil tempered high carbon chrome vanadium steel.
6. After installation, the isolators shall be inspected and adjusted by a qualified representative of the isolator or centrifuge manufacturer.
7. A maximum of 1.75 inches of displacement at the top or bottom motor bearing at operating speed will be acceptable under dry run shop test conditions.

B. Flexible Connectors:
1. Provide flexible connectors to isolate the centrifuge from interconnecting structures, piping, conduit, and other connections.
2. Flexible pipe connectors shall have physical and chemical characteristics suitable for the particular service.

3. The following flexible connectors shall be provided:
   a. Centrate discharge flexible connector transition piece.
   b. Solids discharge flexible connector transition piece.
   c. Sludge feed piping.
   d. Bowl effluent flushing (CIP) water piping.
   e. Polymer solution feed piping.
   f. Casing drains (if provided).
   g. Other connectors sufficient for all other utility and piping connections to the centrifuge equipment furnished by centrifuge manufacturer.
4. Provide flexible piping connectors by one of the following:
   a. Red Valve Company, Inc.
   b. Redflex Flexible Pipe.
   c. General Rubber.
   d. Garlock Flexomatic Pipe.
   e. Or equal.
5. Flexible centrate and solids discharge connectors shall be provided between the centrifuge and discharge chutes. Flexible centrate and solids discharge connectors shall be black molded neoprene, two-ply fabric reinforced with polyester cord, and complete with stainless steel back-up flanges and hardware. Neoprene flanges shall match the dimensions of the centrifuge casing flanges.

2.6 DISCHARGE CHUTES AND SAMPLING PORTS

A. Provide a centrate discharge chute for each centrifuge. Discharge chute shall be rectangular with a top flange, which matches the flange of the centrate discharge connection. Chute shall include a 6 or 8-inch ANSI/ASME (vent) flange. The centrate chute shall have a bottom that tapers to a 10-inch diameter ANSI/ASME flange for centrate outlet, mounted on one side of the chute, and to an 8-inch ANSI/ASME flange to accept the startup semi-solid discharge from the solids discharge chute, mounted on the opposing side of the chute. Chute shall be independently supported so as to impose no weight on the centrifuge casing flange. Chute material shall be a minimum 10 gauge stainless steel.

B. Provide a solids discharge chute for each centrifuge. Discharge chute shall be a rectangular chute with a top flange, which matches the flange of the solids flexible discharge connection. The solids discharge chute shall extend from the solids flexible discharge connection, and shall have a rectangular bottom flange. Contractor shall connect the bottom of the solids discharge chute to the solids diverter slide (Slop) gate and, if needed, provide a second chute from the gate to immediately above existing Diverter Gate Chute. Solids Discharge Chute shall include two 1-inch diameter ANSI/ASME effluent flushing water flanges mounted as close to the top of the chute as possible. Chute shall include an 8-inch diameter ANSI/ASME flange for startup semi-solid discharge, mounted upstream of the solids diverter slide (Slop) gate, as close to the top of the chute as possible, and aligned to permit gravity drainage to centrifuge main drain when the solids diverter slide gate is in the closed position. Chute shall not taper and shall maintain the shape of the centrifuge casing discharge connection and shall have

sides as straight as possible to prevent solids from bridging or hanging up. Chute shall be independently supported and shall impose no weight on the centrifuge casing flange nor on the existing Diverter Gate Chute. Chute material shall be a minimum 10-gauge stainless steel

C. Sampling Ports and Other Ports:
   1. Provide 1-1/2-inch diameter sampling tap to sample centrate discharged from each centrifuge. Sampling taps shall be easily accessible from the centrifuge operating floor level. Provide sampling tap with a manually-operated ball valve suitable for wastewater/sludge service, and a down turned elbow on the centrate sampling tap.
   2. Provide a 2-inch diameter sampling tap drain to return sampled centrate to the centrate chute. Provide 6-inch diameter collection cup and 2-inch diameter drain trap.
   3. Provide 2-inch diameter sampling tap to sample solids discharged from each centrifuge. Sampling taps shall be easily accessible from the centrifuge operating floor level. Cake sampling tap shall include threaded and capped connection to the solids discharge chute, and a stainless steel sampling pipe with a cut-out for sampling sludge cake through the tap.
   4. Provide two 1-inch diameter NPT connections to the centrate discharge chute with threaded caps. Ports are for potential future chemical addition.
   5. If casing drains are included in centrifuge manufacturer's standard dewatering centrifuge, provide 2-inch diameter BSP connection to the centrate discharge chute for feed end casing drain discharge. Provide tubing and clamps of suitable material for conveying casing drain discharge to the centrate discharge chute.

2.7 START-UP SOLIDS DIVERTER SLIDE GATE

A. Provide a diverter gate assembly to route start-up semi-solid sludge discharged from the centrifuge solids discharge to the centrate discharge chute/drain. Diverter gate assembly shall consist of a fabricated chute with 6- or 8-inch diameter start-up semi-solid sludge discharge and slide gate. Diverter gate assembly shall conform to Section 43 26 23, Stainless Steel Slide Gates.

B. Provide slide gate with electric actuator. Size slide gate to match solids discharge from centrifuge.

C. Provide minimum of two flushing nozzles upstream of slide gate to assist with start-up semi-solid sludge drainage.

2.8 NOISE SUPPRESSION

A. Each centrifuge shall be equipped with noise suppression devices such that the average noise level three feet from the centrifuge equipment and drive motor, while operating at the shop tests at a bowl speed equivalent to 3,000 G-force on the inner surface of the bowl, shall not exceed 89 dBA in a free field test condition.

2.9 INSTRUMENTATION

A. Vibration detector systems shall be provided for monitoring and control of front and back bearing assemblies. The vibration detector system shall consist of vibration pick-up probe(s) and a monitoring unit with adjustable setpoint and output circuitry. Monitoring unit shall be provided with built-in power supply for a single 120 VAC, 60 Hz input. Output circuitry shall be designed for two form-C relay contacts and one analog output. Analog output signal(s) shall be compatible with PLC analog input card provided in CCP. The vibration monitor shall be the manufacturer's standard vibration detection system.

B. Two motion sensors and associated transducers shall be provided for each centrifuge to detect the rotation and the speed of the main drive and the speed of the back drive. Transducers shall be provided with built-in power supply for a single 120 VAC, 60 Hz input. Analog output signal(s) shall be compatible with PLC analog input card provided in CCP.

C. Additional Devices:
   1. Two bearing temperature probes for the front bearings.
   2. Bearing oil inlet and outlet temperature transmitters.
   3. Main drive motor bearing temperature, vibration sensor, and amp meter.
   4. Heat exchanger cooling water inlet and outlet temperature sensors.
   5. Differential motor torque meter, vibration sensor, and amp meter.

D. Devices by Others, Monitored by System:
   1. Feed sludge density, temperature, and pressure.
   2. Sludge feed pressure gage/transmitter.
   3. Polymer feed concentration sensor (local).
   4. Thickened sludge flow, pressure, and density.
   5. Thickened sludge level probes in the sludge discharge chute.
   6. Ambient temperature probe.

2.10 CONTROLS AND ACCESSORIES

A. General:
   1. Manufacturer shall supply an integrated instrumentation and control system for each centrifuge assembly. The major components of the instrumentation and control system shall include a local CCP and all power, control, and instrumentation devices for monitoring and control.
   2. The major components of the instrumentation and control system shall include three CCPs with OITs, and all power, control, and instrumentation devices for monitoring and control of the dewatering system, as shown and specified.
   3. It shall be the responsibility of the centrifuge manufacturer to coordinate with the Contactor's I&C Subcontractor to provide and obtain PLC addresses and registers for the control interlocks as specified in Section 40 61 96, Process Control Descriptions.

B. Each centrifuge control system shall include main drive system, scroll conveyor drive system, lubrication oil system, and auxiliary interlocks for sludge feed systems and polymer feed systems.

C. Centrifuge Control Panels (Typical for 3 panels) (CCP-1 through CCP-3): The centrifuge manufacturer shall provide a CCP for each centrifuge, to be installed as shown, each including a PLC with ladder logic programming, an integrated torque control module, a color touch screen OIT, and 480V equipment and a panel air conditioner on the PLC controls side of the panel. The control system shall be designed to work in manual and automatic modes. Centrifuge manufacturer shall provide the following:

1. UL508A-listed, NEMA 4X, stainless steel stanchion-mounted double door enclosure, meeting the requirements of Section 40 67 17, Process Control Panels and Enclosures. CCPs shall operate from a 60 Hz, 480V AC power supply and include step-down transformers as required.
2. PLC shall be Allen-Bradley CompactLogix. Provide all accessories, including but not limited to communication modules, 120VAC isolated input and output modules, power supplies, software, and licenses for a complete and functional system described herein. PLC shall be programmed to operate any and all necessary sequences, and include all control logic and algorithms. The PLC shall have adequate memory allowing 25 percent space for future program additions. PLC, I/O shall include monitoring and control of the following:
    a. Existing Thickened Sludge Pumps (2 sets of 3 pumps, with a maximum of 3 operating).
    b. New Polymer Blending Units (3 new units).
    c. Centrifuge Instrumentation: Sludge feed flow magmeters, all onboard instruments, interlock functions, slide gates, and electric actuators.
    d. Centrifuge VFDs – function control and safety interlocks.
    e. Existing conveyor system, two sets of press, load out, discharge and shuttle conveyors.
    f. The control of the new Water Booster system shall remain controlled by existing PLC-SH.
    g. See Drawings, particularly process and instrumentation diagrams (P&ID) for discrete and analog I/O to CCPs.
3. The PLC shall be capable of interfacing directly with a plant SCADA system (PLC-SH) via Ethernet/IP. A DIN-rail mounted Ethernet switch shall be provided for this connection.
4. An alarm horn shall be installed on the front door.
5. Each CCP shall include the following operators on the front face of the enclosure:
    a. CONTROL POWER ON indicating light.
    b. PLC FAIL indicating light.
    c. EMERGENCY STOP mushroom-head pushbutton.
    d. RESET pushbutton.
    e. SILENCE pushbutton.
6. The CCPs shall house the main drive VFD, scroll drive VFD, VFD controllers with short-circuit and overload protection for bowl and scroll motors, power

line reactor, DC bus fuses equipped with blown fuse switches and a control transformer, surge suppressor, power supply, and necessary appurtenances.

7. The VFD interface keypads shall be door-mounted to the CCPs, one for each VFD. VFD interface keypads shall be mounted for safe access to parameters while the panel is under power. Port shall limit maintenance personnel's exposure to arc flash dangers as detailed in NFPA 70E.
8. All components in CCPs shall be completely factory wired. All external control connection points shall terminate on a terminal strip. There shall be a minimum of 20 percent spare terminal connections supplied. Control of the dewatering system shall be from CCPs only.
9. Provide signals to/from the centrifuge PLC as shown in the I/O Schedule included at the end of this Section. In addition to the signals listed, provide any additional I/O needed for a complete, functioning system.

D. Operator Interface Terminals: The OITs shall meet the requirements of Section 40 64 00, Programmable Logic Controllers, and shall be utilized for operational adjustments. OITs shall at a minimum, be capable of:
   1. Automatic one-touch starting and stopping.
      a. Including automatic torque control and conveyor/diverter gate operation based on operator settable parameters.
      b. Automatic status indication and individual component status.
      c. Pause Mode
         1) Pause for process repairs.
         2) Pause for Bin Removal.
      d. Stop and start operations and status of each individual dewatering system component.
         1) Status indication and control including ancillary system components:
            a) Centrifuge start/stop.
            b) Wash water valve.
            c) Sludge pump(s).
            d) Polymer blending unit.
            e) Conveyor.
            f) Diverter gate system
         2) Safety interlocks shall remain active in manual mode.
      e. Clean-in-Place (CIP) one touch starting and stopping.
         1) CIP status indication and individual component status.
         2) CIP adjustments shall be configurable via password protected operator inputs.
   2. All pertinent system variables and settings.
      a. Display of system variables:
         1) Centrifuge drive motor amps and percent of full load.
         2) Centrifuge bowl speed (RPM actual and setpoint).
         3) Back drive speed (actual and setpoint).
         4) Differential speed (actual and setpoint).
         5) Torque (actual and setpoint).
         6) Bearing temperatures.
         7) Vibration.

8) Sludge flow rate.
9) Polymer flow rate.
10) Wake time.
11) Sleep time.

b. Display of all system related alarms:
   1) Centrifuge shutdown alarms: The OIT shall display fault messages with actual time and date. When one of these alarms is triggered an automated stop shall be initiated:
      a) Main motor over temperature.
      b) Main drive VFD fault.
      c) High-High vibration.
      d) Back drive motor over temperature.
      e) Back drive VFD fault.
      f) High-High torque.
      g) High-High feed end bearing temperature.
      h) High-High drive end bearing temperature.
      i) Trip alarm on main drive motor winding.
      j) Trip alarm on scroll drive motor winding (emergency shut down).
      k) Conveyor/system fault.
   2) Ancillary related alarms: A pause shall be initiated stopping all process related equipment. Once the alarm has been cleared the operator shall be able to resume the process. If the operation has not been reestablished within an hour the centrifuge shall be forced into auto stop mode.
      a) Sludge feed related faults.
      b) Polymer feed related faults.
   3) If three high vibration or high torque alarms occur within a ten-minute time limit an auto stop and flush sequence will be initiated.
      a) High torque.
      b) High vibration.
   4) Warning alarm: These will only set a warning horn and light but will not trigger any other actions.
      a) High drive end bearing temperature.
      b) High feed end bearing temperature.
      c) High torque.
      d) High vibration.
      e) Bowl speed low.
      f) Bowl speed high.
      g) Differential speed low.

c. Operator input control variables:
   1) Centrifuge operation and processing:
      a) Differential speed (set point in RPM).
      b) Torque (set point in percentage).
      c) Sludge flow (set point in gpm).
      d) Wake time (set point in 24 hour format).
      e) Sleep time (set point in 24 hour format).

2) Operator input variables related to process and operations calculations.
    a) Sludge feed flow solids content (registered in percent total solids (% TS) and based on lab analysis of samples collected).
    b) Polymer make down dilution (registered in percent dilution of polymer by volume), if an automatic polymer dilution system is provided. CCPs shall provide the proper inputs / outputs to the polymer blending/feed system.
    c) Centrate solids content (registered in percent suspended solids (% TSS) and based on lab analysis of samples collected).
    d) Dry cake solids (registered in percent total solids and based on lab analysis of samples collected).
3) Sum of mathematical calculations for determining production and optimization.
    a) Sludge feed flow in gpm.
    b) Sludge feed flow in gpd (to be automatically reset by internal clock at 12:00 am daily).
    c) Previous day total flow.
    d) Gallons processed (totalized)
    e) Wet pounds per hour.
    f) Daily run time (to be automatically reset by internal clock at 0:00 daily).
    g) Run time totalized (run time with sludge feed).
    h) Dry pounds per hour processed (based on real time feed flow rates).
    i) Pounds per ton of polymer dosage (based on real time polymer feed flow rates).
    j) Cubic yards of cake production per hour (based on real time feed flow rates).
    k) Capture efficiency.
    l) Supervisor input system variables.
4) Supervisor input parameters (password protected):
    a) Centrifuge bowl speed (setpoint).
    b) Centrifuge configuration settings (machine specific).
    c) Alarm limits.
    d) Scaling values.
    e) CIP settings.
    f) Torque PID settings.

d. The centrifuge setup parameters shall be fully configurable from password protected screens including alarm set points, scaling variables and CIP settings.

E. Provide the CCP PLC with a module for communication to the main drive VFD and to back drive VFD.

F. Construction: CCPs shall be constructed in accordance with the requirements of Section 40 67 17, Process Control Panels and Enclosures, with the following:
   1. Freestanding multi-door panels. Each door shall be provided with a three point locking mechanism and lockable handle. Provide Type 316L stainless steel material for a corrosive environment.
   2. Integral equipment mounting back panel and on the panel floor.
   3. VFD panels shall include a main thermal magnetic main circuit breaker with a padlockable external operating handle interlocked with the enclosure door to prevent opening the enclosure while the system is energized. Provide circuit breakers with internal ground fault trip or ground fault sensor and circuit breaker shunt trip.
   4. Control Transformers: 460 by 120 VAC with both primary legs fused and one secondary leg fused. The other secondary leg shall be grounded.
   5. Power Conductors: Sized in accordance with the NEC for the load served with a minimum wire size No. 12 AWG. Power conductor color-coding shall match the OWNER's system. Verify color-coding system with OWNER.
   6. Signal Cables: Individually twisted shielded pairs with outer PVC jacket with a minimum conductor sizes: 600 volt, No. 18 AWG.
   7. Provide all panel mounted devices with laminated acrylic nameplates located above the device indicating the device function and associated process variable range applicable.
      a. Nameplates: See Section 26 05 53, Identification for Electrical Systems.
      b. Lettering: Minimum 1-inch high.
   8. Lube oil system motors shall be controlled by a combination motor controller with circuit breaker or motor circuit protector and integral thermal overload protection by others. The contactor shall be NEMA type and rating as shown.
   9. Panel-mounted, five digit, non-reset, register type elapsed time meter.

G. Centrifuge Control System:
   1. Each centrifuge shall have a control system that can operate in "MANUAL" and "AUTOMATIC" modes. Should a disruption occur, the centrifuge monitoring system shall indicate the cause with a first out sequence and define the interruption. The fault alarm must be reset to continue.
   2. Centrifuge operation is controlled either:
      a. Manually at the CCP with individual control devices.
      b. Remotely through the plant SCADA.
      c. Centrifuge start shall be a local only function
   3. CompactLogix PLC shall be furnished and programmed to operate the necessary sequences and communicate with the existing plant SCADA over an Ethernet communication cable.
   4. The centrifuge microprocessor controller shall maintain process optimization within adjustable preset limitations and operate in differential speed and torque modes with 0.01 percent regulation.
      a. The scroll drive shall be controlled by a specially developed PLC algorithm that controls differential speed in the "MANUAL" mode and torque in the "AUTOMATIC" mode. In the "AUTOMATIC" torque mode, scroll-drive speed shall be automatically adjusted to maintain constant torque, thereby compensating for varying feed characteristics

while optimizing residence time and separation. The unit also provides digital display of bowl speed, differential speed and torque. Set points for the differential speed and torque values are entered via a numeric keypad.

b. The scroll drive system shall be operated in differential speed and torque modes of operation. Optimization of the process is obtained by inserting the torque required. The centrifuge shall now optimize itself and operate within the preset speed limits. The regulation of differential speed and torque shall not exceed 0.01 percent.

c. The operation of the scroll controller shall be self-tuning to maintain process optimization in auto torque and differential speed modes. Manual operation shall be used to obtain operating optimization data. Time delays shall be field adjustable and determined at process startup with an adjustable range from 1 to 99 seconds. Torque limits are preset at 80 and 90 percent respectively.

d. The first set point de-energizes the feed valve whereas the 90 percent level of torque also de-energizes the main drive system.

e. Data to be defined and displayable in English.

f. Analog outputs of 4 to 20 mADC shall be suitable for remote indication of bowl speed, differential speed and torque.

g. Fault messages shall be displayed, with actual time and date while saving up to the last 32 occurrences.

5. The centrifuge shall be equipped with a vibration monitoring system to protect against excessive vibration. The monitor system shall be interlocked to terminate centrifuge operation in case of excessive vibration.

H. Sequence of Operations:

1. The operational procedure of centrifuge shall allow each function to be initiated by pushing a graphical button on the OIT. Under alarm or "EMERGENCY-STOP" conditions, the shutdown sequence shall operate automatically. The following is a step-by-step description of the sequence of operations.

2. Machine Start-up and Operation:

a. The start-up sequence of the centrifuge shall be initiated by pushing the "ON" button. The control system shall verify that no fault conditions exist. The oil circulation pump motors shall then engage, pumping oil to the main bearings for pre-lubrication. The pre-lubrication cycle shall be factory set to ten minutes. After the pre-lubrication cycle, the motor start sequence shall begin.

b. The operator selected conveyor system (load out, discharge, and shuttle conveyors) shall start prior to starting the centrifuge. These systems are interlocked under existing control systems.

c. At any time during normal operation, should either of the selected conveyors stop running, the centrifuge operations shall shut down.

d. The main motor shall be engaged using the main drive variable frequency drive to ramp up the speed and to provide the necessary starting torque.

e. As part of the motor start sequence, the scroll drive motor shall start at the same time as the main motor. By running the scroll drive motor at normal operating speed during the start cycle, the scroll shall convey any

remaining solids out of the bowl before full-speed is reached. The system shall check the bowl speed and indicate that it is ready for operation with no existing fault conditions.

f. Once the machine has reached full speed with no faults, the sludge feed system and the polymer system shall be started by the CCP. Sludge feed and polymer feed shall be controlled through the plant SCADA system. The PLC shall monitor the operation of the centrifuge and provide a digital display of bowl speed, differential speed and torque, as well as other operational parameters. The desired sludge flow rate and desired polymer pacing shall be entered via setpoint on the OIT.

g. The differential speed shall be controlled either by a differential speed setpoint or a torque setpoint. While operating with a torque setpoint, the differential speed shall be automatically adjusted to maintain a constant torque; thereby, compensating for varying feed characteristics while optimizing residence time and separation.

h. Set points for the differential speed and torque shall be entered via the CCPs OIT. Bowl speed, differential speed and torque shall be provided as analog outputs to the PLC and shall be available to viewing by the plant SCADA via data communication.

3. Clean-in-Place (CIP) Sequence: If a CIP cycle is initiated manually or automatically the following shall occur automatically:
   a. Sludge feed and polymer solution feed pumps shall stop.
   b. The solids diverter slide slop gate shall close, and the 3-inch and 1-inch flushing water valves shall open based on a signal from the CCP after an adjustable period of time (approximately 10 seconds) required for the centrifuge to empty. This period of time allows the centrifuge to empty all sludge cake. The time period shall be field-adjustable at the CCP.
   c. The sludge feed and polymer solution feed valves shall close.
   d. If the CIP cycle was manually started during centrifuge operation, a "re-start" command in the CCP shall initiate the start-up procedure at the end of the CIP cycle.
   e. If the centrifuge is to shut-down after the CIP cycle, the sludge cake cross conveyor shall shut down automatically.
   f. The CIP cycle shall operate after any shutdown of the Centrifuge.
4. Flush Sequence: The flush sequence shall be triggered manually with a single push of the “FLUSH WATER” pushbutton on a centrifuge CCP OIT or automatically through the PLC sequence. Flush sequence shall be as follows:
   a. Sludge feed permissive "OFF".
   b. Water flush system timer started.
   c. Sludge feed permissive "ON" can be initiated at each centrifuge CCP OIT.
   d. Water flush system "ON".
   e. Water Flush Timer Times Out: Water flush system "OFF".
   f. Sludge Feed Permissive "ON": Initiated at each centrifuge CCP OIT.
5. Machine Shutdown:
   a. The shut down sequence shall be triggered either with a single push of the "STOP" pushbutton, or via a fault condition.
   b. The system shall disengage the sludge feed permissive, initiate the automatic flush cycle, and disengage the main motor.

c. The flush cycle shall consist of flushing the bowl with approximately 50 gpm of plant water during the coast down of the bowl. The scroll shall continue to convey solids to the discharge ports and out of the bowl.
d. Controlled shutdown sequence shall be as follows:
    1) Sludge feed permissive "OFF".
    2) Main motor controlled deceleration.
    3) Water flush system timer started. Water flush system "ON".
    4) Timer for "SCROLL MOTOR TO STOP" initiated.
    5) Timer for "OIL LUBRICATION SYSTEM TO STOP" initiated.
    6) Water flush timer times out. Water flush system "OFF".
    7) Bowl decelerates to stop.
    8) Timer for "SCROLL MOTOR TO STOP" times out. Scroll motor shuts off allowing scroll to decelerate and stop.
    9) Timer for "OIL LUBRICATION SYSTEM TO STOP" times out and oil lubrication system shuts off.
    10) After shutdown of the main centrifuge and a short delay, the conveyor system will stop.

6. Emergency Shutdown: The Emergency Shutdown (initiated either by the "EMERGENCY-STOP" pushbutton or by system trip alarms) shall shut down all pieces of equipment simultaneously without going through the controlled shutdown sequence. After the condition clears and the "EMERGENCY-STOP" pushbutton is reset, the system can be restarted.
7. Equipment alarms:
    a. Bearing temperature high shall provide alarm indication at panel.
    b. Bearing temperature high shall initiate the controlled shut down sequence and alarm at panel. After the condition is cleared, operator shall acknowledge alarm via alarm “RESET” pushbutton.
    c. Centrifuge high vibration shall turn the "FEED PERMISSIVE OFF" alarm at panel and start bowl flush timer sequence. When high vibration alarm clears, bowl flush water sequence shall stop. Feed and polymer shall then be restarted locally by pressing the “FEED” button from each centrifuge CCP OIT.
    d. Centrifuge high vibration shall initiate the controlled shut down sequence and alarm at panel. After the condition is cleared, operator shall acknowledge alarm via alarm “RESET” pushbutton.
    e. High torque shall turn the "FEED PERMISSIVE OFF" alarm at panel and start bowl flush timer sequence. The scroll differential speed shall also be increased to maximum. When high torque alarm clears, bowl flush water sequence shall stop and the scroll differential speed resumes normal operation. Feed and polymer can then be restarted.
    f. High torque shall initiate the controlled shut down sequence and alarm at panel. After condition is cleared, operator shall acknowledge alarm via alarm “RESET” pushbutton.
    g. Lube oil low flow, low level, or low pressure at the oil lubrication system shall provide alarm indication at panel and remote alarm to the CCP.
    h. Low speed indication shall initiate controlled shutdown and alarm at the CCP. After condition clears, operator shall acknowledge alarm via alarm “RESET” pushbutton.

i. Low speed differential indication shall initiate controlled shut down sequence and alarm at panel. After condition is cleared, operator shall acknowledge alarm via alarm "RESET" pushbutton.
j. High speed indication shall initiate controlled shut down sequence and alarm at panel. After condition is cleared, operator shall acknowledge alarm via alarm "RESET" pushbutton.
k. Motor winding thermistor trip on main drive motor shall initiate controlled shut down sequence and alarm at panel. After condition is cleared, operator shall manually reset alarm annunciator.
l. Motor winding thermistor trip on scroll drive motor shall initiate Emergency shut down (all pieces of equipment simultaneously, except for the bearing oil lubrication system). After lube oil system timer times out and condition is cleared, operator shall manually reset alarm annunciator.
m. Faults received from auxiliary equipment such as sludge pumps and polymer feed systems shall initiate a controlled shutdown and alarm at the CCP. After condition clears, operator shall acknowledge alarm via alarm "RESET" graphic button.
n. Faults received from the conveyor equipment such as emergency pull-cord switch and zero-speed detection shall result in an immediate shut down. After the condition clears, operator shall acknowledge alarm via "RESET" graphic button.

I. Plant SCADA Monitoring and Remote Control: The existing plant SCADA shall control the centrifuge sludge systems, polymer feed systems, and washwater systems, and monitor status and alarm signals via the communication link between the plant SCADA and the CCP PLC. In addition to the signals listed in the I/O Schedule included at the end of this Section, the following signals shall be exchanged:
1. Signals from CCP to the plant SCADA:
a. Digital signals via the Ethernet communication data link:
1) Centrifuge starting status.
2) Centrifuge running/ready status.
3) Centrifuge "EMERGENCY-STOP" status.
4) Lube oil pump running status.
5) Sludge feed permissive interlock.
6) Centrifuge sludge inlet valve "CLOSED" status.
7) Centrifuge flush water valve "OPEN" status.
8) High torque alarm.
9) Torque high-high alarm.
10) Machine bearing temperature alarm high.
11) Machine bearing temperature alarm high-high.
12) Lube system no oil flow, low level, or low pressure alarms.
13) Main drive VFD fault.
14) Scroll drive VFD fault.
15) Vibration high alarm.
16) Vibration high-high alarm.
17) Bowl speed low alarm.
18) Differential speed low alarm.

19) Bowl speed high alarm.
20) Trip alarm on main drive motor winding.
21) Trip alarm on scroll drive motor winding.
22) Centrifuge "LOCAL/REMOTE" control selector switch: "REMOTE" position.

b. Analog signals via the Ethernet communication data link:
1) Bowl speed.
2) Differential speed.
3) Torque.
4) Solids side bearing temperature.
5) Liquid side bearing temperature.
6) Vibration values from four vibration sensors.
7) Sludge feed flowrate setpoint.
8) Polymer feed flowrate setpoint.

2. Signals from plant SCADA to CCP:
a. Digital signals via the Ethernet communication data link:
1) Sludge feed system pumps status and control interlocks.
2) Polymer feed system status and control interlocks.
3) Water Booster system status and control interlocks.
4) Press conveyor and shuttle conveyor status and control interlocks.

b. Analog signals via the Ethernet communication data link:
1) Sludge feed flowrate.
2) Polymer feed flowrate.

J. The centrifuge shall also provide monitoring and control of the existing sludge pumps, centrifuge polymer systems, and existing conveyor system as described below.

K. Sludge Pumping:
1. General:
a. The sludge pumps consist of two sets of three pumps located in the Sludge Holding Building.

2. Local Control:
a. When the LOCAL-OFF-REMOTE selector switch on the sludge pump local control station (LCS) is in the LOCAL position, the LCS shall control the pump.
1) Operation of the START pushbutton shall start the pump.
2) Operation of the STOP pushbutton shall stop the pump.
3) Speed control shall be from the drive keypad.

b. When the LOCAL-OFF-REMOTE selector switch is in the OFF position, the pump shall not operate.

3. Remote Control:
a. When the LOCAL-OFF-REMOTE selector switch on the LCS is in the REMOTE position, the pump shall be controlled from the PLC in either a manual or automatic mode as selected at the CCP OIT:
1) Manual Mode: Pump shall be controlled from a start/stop selector switch on the OIT. Pump speed shall be controlled from the CCP OIT.

2) Automatic Mode: Pump shall be started and stopped automatically by the CCP PLC as part of the centrifuge startup and shutdown sequences as described above. Pump speed shall be automatically adjusted by the PLC to maintain flow rate setpoint.

4. Interlocks:
   a. Existing sludge pump interlocks shall remain.

L. Centrifuge Polymer Feed:
1. General:
   a. The centrifuge polymer feed system consists of three skids located in the lower level of the Solids Handling Building.
2. Local Control:
   a. When the HAND-OFF-REMOTE selector switch on the polymer system local control panel (LCP) is in the HAND position:
      1) The polymer system shall run.
      2) Speed control of the metering pump shall be from their respective speed potentiometers.
   b. When the HAND-OFF-REMOTE selector switch is in the OFF position, the polymer system shall not operate.
3. Remote Control:
   a. When the HAND-OFF-REMOTE selector switch on the LCP is in the REMOTE position, the pump shall be controlled from the CCP PLC in either a manual or automatic mode as selected at the OIT:
      1) Manual Mode: Polymer system shall be controlled from a start/stop selector switch on the CCP OIT. Metering pump speed shall be controlled from the CCP OIT.
      2) Automatic Mode: Polymer system shall be started automatically by the CCP PLC when the sludge pumps are called to run. Polymer system shall remain running until the sludge pumps are stopped. Metering pump speed shall be automatically adjusted by the CCP PLC to maintain solids concentration of centrifuge discharge as specified to meet centrifuge performance criteria.
4. Interlocks:
   a. None.

M. Press, Discharge, Loadout, and Shuttle Conveyor:
1. General:
   a. The existing conveyor system consists of two redundant sets of four conveyors. The press and discharge conveyors are located in the Solids Handling Building, and the shuttle conveyors are located in the Sludge Holding Building. The plant operator selects which of the two sets of conveyors that will operate with the centrifuge.
2. Local Control:
   a. When the LOCAL-OFF-REMOTE selector switch on the conveyor local control station (LCS) for any conveyor is in the LOCAL position, the LCS shall control the conveyor.
      1) Operation of the START pushbutton shall start the conveyor.
      2) Operation of the STOP pushbutton shall stop the conveyor.

3) Direction shall be selected from the FORWARD/REVERSE selector switch.

b. When the LOCAL-OFF-REMOTE selector switch is in the OFF position, the conveyor shall not operate.

3. Remote Control:
   a. When the LOCAL-OFF-REMOTE selector switch on the LCS is in the REMOTE position, the conveyor shall be controlled from the CCP PLC in either a manual or automatic mode, as selected at the CCP OIT:
      1) Manual Mode: Conveyor shall be controlled from start/stop forward and start/stop reverse selector switches on the CCP OIT.
      2) Automatic Mode: Conveyor shall be started and stopped automatically by the CCP PLC as part of the centrifuge startup and shutdown sequences as described above.
4. Interlocks:
   a. Existing conveyor system interlocks shall remain.

2.11 UNINTERRUPTIBLE POWER SUPPLY

A. Provide an uninterruptible power supply (UPS) in the CCP sized by the centrifuge manufacturer to distribute power to the micro-processor, PLC, instruments and other critical devices using a fused-disconnect type of terminal strip from Allen Bradley or Phoenix Contact. Size the fuses for the loads as required. UPS shall have capacity for orderly shutdown upon loss of power. Provide UPS meeting the requirements of Section 40 78 00, Panel Mounted Instruments and Devices.

2.12 FACTORY MOUNTED JUNCTION BOX AND SHOP WIRING

A. Provide a minimum of NEMA 4X Type 316 stainless steel control junction boxes (control and signal) with terminal blocks (one discrete for control wiring, one for instrumentation signal wiring) mounted on each centrifuge for the following devices:
   1. One RTD for each solid side main bearing and liquid side main bearing (factory wired).
   2. Six (two per phase) 100-ohm platinum main drive motor winding RTDs (factory wired).
   3. Back drive motor thermostat, one per phase (total of three) (field wired).
   4. Two motion sensors for main drive coupling or v-belts (factory wired).
   5. Two vibration probes and transmitters (vertical and horizontal) for each main bearing – solid side bearing and liquid side bearing (factory wired).
   6. Two vibration probes and transmitters (vertical and horizontal) for each motor of main drive and back drive (factory wired).
   7. Others as recommended by centrifuge manufacturer.

2.13 ANCHOR BOLTS

A. Centrifuge manufacturer-recommended anchorages shall be provided by Contractor.

2.14 PAINTING

A. Pumps, motors, drives, frames, baseplates, and appurtenances, shall receive manufacturer's standard finish paint system prior to shipment.

B. Machined, polished, and non-ferrous surfaces shall be coated with corrosion prevention compound.

C. Touch-up and field painting shall be in accordance with manufacturer's recommendations.

2.15 SOURCE QUALITY ASSURANCE

A. Centrifuge Construction: Prior to assembly all surfaces including the bowl, scroll, shafts, casing, base or mounting frame, supports, flanged connections shall be examined for cracks, shrinkage, porosity or other defects by means of a liquid dye penetrate test.

B. Shop Test: Upon completion of manufacture of each of the centrifuges, control panels, and appurtenances, conduct shop tests on each centrifuge and control panel as described below. The shop tests shall be conducted, at the factory, using the actual equipment, including motors, to be provided on this Project. Shop testing on all centrifuges included in the Contract shall be completed during a one week (5 days per week) period.
   1. Centrifuge Operation:
      a. Running test, machine and motor with controls, through normal start, normal stop, and emergency stop cycles and a minimum of 4 hours of continuous operation at proposed design operating speed.
      b. Demonstrate that all equipment is capable of running, stopping, and continuous operation in a satisfactory manner without mechanical defects or operational difficulties.
      c. Vibration Tests: Take vibration measurements to determine mechanical integrity while operating the bowl at a speed equivalent to 3,000 G-force on the inner surface of the bowl. Operational full load vibration shall not exceed 2.5 mils at the top or bottom motor bearing. Chassis vibration shall not exceed 3.0 mils. The vibration velocity shall not exceed 7.0 mm per second RMS at any position on the chassis or motor bearings.
      d. If necessary, tests shall be repeated until satisfactory results are obtained.
      e. The centrifuge shall be equipped with noise suppression devices such that the noise level measured at 3 feet around the periphery of the complete centrifuge assembly shall not exceed 89 dBA (A-weighted) when tested in a free field test condition at the manufacturing facility, without feed and with the discharge openings closed and operating the bowl at a speed equivalent to 3,000 G-force on the inner surface of the bowl. These devices shall not include items such as ventilated enclosures, which require additional power, but shall include items such as low noise motors (main drive), and may include insulation of the equipment.

C. Instruments and controls on the control panel shall be checked, adjusted and certified to be accurate. The control panel shall be tested in the factory in accordance with the requirements of this Specification. ISA TR20 sheets, or an organized document of similar content, shall be completed by centrifuge manufacturer.

D. All testing facilities, lubricants, instruments, equipment and electrical power shall be supplied by the centrifuge manufacturer at centrifuge manufacturer's expense.

E. Each test shall be witnessed by a professional engineer specializing in quality assurance of the tested equipment registered in the state or province of the manufacturing facility, who may be an employee of the manufacturer. The quality assurance engineer shall certify that the required tests were performed. Certification shall include the state or province of engineer's registration, registration number, seal with clear legible name of engineer, and include the serial numbers of all equipment tested. Shop test results shall include vibration (displacement), noise, speed of bowl, and speed of scroll, as well as a description of the testing procedure. Upon completion of the tests, provide five copies of the shop test results.

F. All defects or defective equipment revealed by, or noted, during tests shall be corrected or replaced promptly and centrifuge retested.

G. In the event that a centrifuge does not meet the requirements of the specifications during shop testing, the centrifuge manufacturer will be permitted to make changes to the equipment, and methods of operation at the centrifuge manufacturer's expense. After adjustments or modifications, the centrifuge manufacturer shall retest its equipment. A maximum of two retests shall be allowed. If the centrifuge, after shop testing is completed, does not meet the specification requirement, Engineer may reject the equipment in its entirety, or negotiate a reduced contract fee with the centrifuge manufacturer, at Engineer's discretion.

H. Centrifuge Control Panel Factory Acceptance Test Requirements:
   1. Provide factory acceptance test services for each CCP. Each control function shall be tested in the shop to verify its operation.
   2. Provide the following components at the factory test:
      a. Fully assembled and configured CCP.
      b. Software shall be loaded and installed by centrifuge manufacturer prior to the test.
   3. The configured program shall be used to test the CCP hardware.
   4. Factory test is a critical milestone in the project. The factory acceptance test will be witnessed by OWNER and ENGINEER. The centrifuge manufacturer shall submit a factory test procedure and schedule for review by ENGINEER within 30 days of the Notice to Proceed and shall schedule system checkout on dates agreed on by OWNER and ENGINEER. The test procedure shall be approved prior to the test and shall serve as the basis for the testing. Other tests not noted on the factory test procedure may be requested by OWNER and ENGINEER, to confirm compliance with the Specifications.

5. The CCPs shall not be shipped to the Site until ENGINEER has approved the panels. Approval of panels do not relieve the CONTRACTOR of satisfying the requirements of the Contract Documents.
6. Factory test shall at a minimum include the following:
    a. Review of all panel components, including enclosure and backplane;
    b. Demonstration of proper grounding;
    c. Demonstration of all inputs and outputs through the use of appropriate discrete and analog signal simulating devices;
    d. Demonstration of all monitoring and control functions where applicable.
    e. Demonstration of VFD operation by operating each VFD at full load for a minimum of two hours.
7. The factory test must demonstrate all functionality as described in this Specification.

I. Shipping Requirements:
1. Inspect prior to packing to assure that assemblies and components are complete and undamaged.
2. Protect machined surfaces and mating connections.
3. Protect bearings and gearing with a shop applied corrosion prevention coating.
4. Cover all openings into gearboxes with vapor inhibiting and water repellent material.
5. Adequately crate to prevent damage during shipment, delivery and storage.
6. Identify crate contents on a packing slip fastened to the outside of crate.
7. All control panels (including PLC and VFD) shall be shipped by air-ride truck with shock sensors mounted on the panels/crates.

PART 3 – EXECUTION

3.1 UNLOADING AND INSTALLATION ASSISTANCE

A. Installation of the equipment will be completed by the CONTRACTOR. Centrifuge manufacturer shall provide a factory-trained serviceman onsite during unloading of the dewatering centrifuge equipment and materials, and to train CONTRACTOR in handling and installing the dewatering centrifuge equipment and materials, and to place the equipment into initial operation, and shall notify the OWNER and CONTRACTOR within 24 hours of problems with the dewatering centrifuge equipment and materials. Provide a factory-trained serviceman at the Owner's job site as follows:
1. One day, not less than 8 hours per day, at the Site, excluding travel time, in one trip to train CONTRACTOR in handling and installing the dewatering centrifuge equipment and materials.
2. Two days, not less than 8 hours per day, at the Site, excluding travel time and time to check the inventory of received dewatering centrifuge equipment and materials, in two trips for supervision in unloading the dewatering centrifuge equipment and materials.

3. Up to three days, not less than 8 hours per day, at the location where dewatering centrifuge equipment and materials are to be installed, excluding travel time, in three trips for an intermediate check after the centrifuges are in place and while utility connections are being made.

B. CONTRACTOR shall inspect and verify that structures or surfaces on which dewatering centrifuge equipment and materials will be installed have no defects which will adversely affect installation.

C. CONTRACTOR shall inspect all materials and equipment prior to installation. Promptly advise ENGINEER of defects or missing items of which CONTRACTOR is aware.

D. Following hoisting/rigging of each centrifuge, centrifuge manufacturer shall submit a letter to the OWNER, with a copy to the ENGINEER, certifying that the equipment was handled in accordance with the centrifuge manufacturer's instructions and meets all criteria of the centrifuge manufacturer's warranty.

E. Centrifuge manufacturer shall furnish all required oil, lubricants, and hydraulic fluids required for initial operation and for one year of full-time operation. Centrifuge manufacturer shall oversee CONTRACTOR in the installation of these lubricants and fluids.

3.2 INSTALLATION

A. General: Contractor shall perform the following:
   1. Coordinate the Work and perform all operations required for the proper installation of dewatering centrifuge equipment and materials.
   2. Install dewatering centrifuge equipment and materials in a manner and to the tolerances recommended by the centrifuge manufacturer and the approved or accepted (as applicable) Shop Drawings and submittals.
   3. Utilize Shop Drawings and installation and start-up procedures by centrifuge manufacturer to install dewatering centrifuge equipment and materials.
   4. Confirm the correct positioning of the centrifuge and support pier structure in relation to the platform openings and the conveyors.
   5. Install the vibration isolators, solids chute, centrate chute, diverter slop gate, diverter piping, flexible connectors, piping, and appurtenant systems.

B. Piping shall be connected to the centrifuge using the flexible connectors furnished by centrifuge manufacturer.
   1. Installation, mounting, and adjustment of all supports and piping shall be performed by CONTRACTOR in accordance with centrifuge manufacturer's instruction. All adjustment to supports required due to irregular concrete shall be made by CONTRACTOR at no additional cost to OWNER.

C. Prior to startup, CONTRACTOR or centrifuge manufacturer shall check and fill with lubricants specified and furnished by centrifuge manufacturer all oil and grease lubricant levels.

D. Rigging and Support:
   1. The maximum dry weight of the centrifuge is approximately 17,000 pounds. CONTRACTOR is responsible for rigging and moving the entire centrifuge from the delivery vehicle to its final location in the Solids Handling Building. The centrifuge shall not be disassembled for installation.

3.3 FIELD PAINTING

A. Field painting shall conform to the requirements of Section 09 91 00, Painting. Do not field-paint centrifuges except for field touch-up of blemishes and surface marring caused during handling, storage, and installation. Field touch-ups, if any, shall be in accordance with manufacturer's instructions.

3.4 START-UP ASSISTANCE

A. Mechanical Check-out:
   1. Centrifuge manufacturer shall check installation of each centrifuge to ensure that the dewatering centrifuge equipment and materials have been installed in accordance with the centrifuge manufacturer's requirements.
   2. Centrifuge manufacturer shall provide a factory-trained serviceman for as long as necessary to perform a mechanical check-out after installation is completed.
   3. Centrifuge manufacturer shall perform a dry start of the centrifuge to ensure proper operation. If centrifuge has not been properly installed, CONTRACTOR shall make necessary modifications, as required, and centrifuge manufacturer shall repeat checkout and start up.
   4. Following installation and prior to start-up of each centrifuge, centrifuge manufacturer shall submit a letter to Owner and Engineer, with a copy to Contractor, certifying that the equipment has been installed in accordance with the centrifuge manufacturer's instructions and meets all criteria of the centrifuge manufacturer's warranty.

B. Process Start-Up: Process start-up shall follow completion of the centrifuge installation (including electrical and process piping and the completion of all other support systems) and the mechanical check-out. The centrifuge shall be started and placed into operation by the centrifuge manufacturer and ENGINEER. All signals, controls, interlocks, and alarms shall be verified. It is the responsibility of CONTRACTOR to have equipment associated with the centrifuge system operational and tested prior to beginning centrifuge process start-up. Centrifuge manufacturer shall take bearing lubrication samples for testing and provide the results to CONTRACTOR and ENGINEER.

3.5 TRAINING OF OWNER'S OPERATIONS AND MAINTENANCE PERSONNEL

A. Provide training per Section 01 79 23, Instruction of Operations and Maintenance Personnel.

B. Hands-on Maintenance Training: As part of the training provided under Section 01 79 23, Instruction of Operations and Maintenance Personnel, centrifuge manufacturer shall provide services related to disassembling and re-assembling one centrifuge as training for the OWNER's personnel, including removal of all interior components, bowl, and scroll. This training shall be provided when such maintenance of the first centrifuge in need is required, possibly during the Contract correction period. The centrifuge shall be reassembled under the strict supervision of centrifuge manufacturer's trainer who shall check all tolerances and torque limits. Centrifuge manufacturer shall prepare a letter certifying that the centrifuge has been properly re-assembled in accordance with centrifuge manufacturer's instructions. Centrifuge manufacturer shall provide and apply all appropriate touch-up paint after reassembly, if required. The hands-on demonstration will be scheduled by OWNER and shall coincide with the training provided under Section 01 79 23, Instruction of Operations and Maintenance Personnel.

3.6 FIELD ACCEPTANCE TESTING

A. Centrifuge manufacturer shall conduct field acceptance testing on furnished centrifuges and appurtenances using waste activated sludge of 1.1% solids content fromOWNER's membrane bioreactor wastewater treatment facility, and OWNER's new polymer system provided under this Contract. Contractor shall furnish polymer used during field acceptance testing.

B. Field acceptance tests shall be coordinated with OWNER and ENGINEER. Centrifuge manufacturer shall provide a factory-trained service representative onsite for the duration of each field acceptance test and utilize the services of independent laboratory acceptable to OWNER and ENGINEER. Services of independent laboratory shall be paid for by centrifuge manufacturer. Testing for each centrifuge shall be conducted over a test period of 8 continuous hours per day, Monday through Friday, during the normal plant daytime operating shift. Centrifuge manufacturer shall test all new centrifuges over the course of four consecutive weeks.

C. The test period will be conducted on weekdays and will consist of minimum1 day for polymer/operational optimization and minimum 3 days of intensive testing. At least 3 test runs (one per day) shall be conducted during the intensive test period, the results of which will be used by ENGINEER for performance evaluation. During the test period, the sludge feed rate and polymer solution feed rate shall be the same for all operating centrifuges included in the test, as outlined below.
    1. Samples of the sludge feed (for total solids), sludge cake (for total solids), and centrate (for TSS) shall be taken at the end of each hour of the 8-hour test runs. Centrifuge manufacturer may request that two additional sets of samples be taken at any time during the last two hours of a test run. Average results of the samples taken during each test run will be used to represent the performance during the field acceptance testing of the centrifuge.

2. Test information required for each test run is as follows:
    a. New centrifuge number.
    b. Test run number.
    c. Sludge feed rate in gpm.
    d. Percent dry solids of sludge feed.
    e. Percent dry solids of dewatered sludge cake.
    f. Percent water removed.
    g. Percent solids capture.
    h. Centrate dry solids in mg/l.
    i. Centrate discharge rate in gpm.
    j. Polymer solution feed rate in gpm.
    k. Polymer type, polymer activity, and polymer solution strength.
    l. Polymer consumption in active pounds/ton of sludge feed dry solids and total dry pounds of polymer/ton of sludge feed dry solids.
    m. Electrical:
        1) Power quality testing, which shall be monitored by the Engineer.
        2) Power use as described below.
3. Samples shall be taken simultaneously with readings obtained from field instruments.
4. The flow rate of the centrate leaving the machine will be determined by a solids mass balance calculation, based on the sludge feed flow rate and solids content and the cake solids content, or by any other method approved by ENGINEER.
5. Centrifuge manufacturer shall be responsible for collecting, marking and pick-up or delivery of samples to centrifuge manufacturer's independent testing laboratory for testing. The percent solids in the sludge feed and cake samples will be determined as Total Residue Dried at 103-105 C in accordance with *Standard Methods for Examination of Water and Wastewater*, edition in effect at the time of the bidding unless otherwise agreed to by OWNER, ENGINEER, and centrifuge manufacturer. Tests performed by the independent testing laboratory shall include tests for sludge feed, sludge cake, and centrate solids on hourly samples. Results of laboratory tests conducted on test samples shall be available within 24 hours of sampling during the testing period to determine the need for adjustments to the polymer or sludge feed or to the equipment.
6. Centrifuge manufacturer shall use the average sludge feed consistency and flow rate during a run for reporting purposes. Centrifuge manufacturer shall calculate the average sludge feed dry solids (mass/time) and provide curves showing plots of the sludge feed solids (mass/time) versus sludge feed solids content (percentage), sludge cake dry solids (mass/time), sludge cake dry solids content (percentage), and polymer use (pounds dry active polymer per ton of dry solids). The average values of percent dry solids and polymer dosage for each of the test runs shall be used to plot points to construct the curves.
7. The rates of unconditioned sludge feed to the centrifuge, polymer solution added to the sludge feed, and centrate discharged from the centrifuge shall be measured/calculated and recorded during the test runs whenever samples are taken.

8. Upon completion of the testing, ENGINEER will evaluate centrifuge manufacturer's test results in terms of machine throughput rate, polymer usage, solids capture, and sludge cake dry solids and make a determination as to the conformance of each machine with the specified process performance. Engineer's determination will be based on the average performance of each machine over the test period. The average process performance for each machine will be calculated on the basis of the total quantities of water and solids processed by each machine duing the test period. If ENGINEER determines that the dewatering equipment meets the specified process performance, the equipment will be acceptable, and OWNER, CONTRACTOR, and centrifuge manufacturer will be notified accordingly.
9. ENGINEER will notify OWNER and centrifuge manufacturer if a centrifuge fails to meet the specified performance. A second test will be allowed for machines which did not meet the specified performance during the initial test. The second test shall be conducted within 15 calendar days of the initial acceptance test and in accordance with the procedure described above for the initial test. Costs incurred by repeated field acceptance testing and independent laboratory analysis shall be paid by CONTRACTOR.
10. Upon completion of the second test, ENGINEER will evaluate the test results and will notify OWNER and centrifuge manufacturer as to equipment conformance with specified performance. If the equipment does not meet the specified performance during the second test, the situation shall be remedied by repair, modification, or replacement of the defective equipment. Additional testing of any equipment that has been repaired, modified, or replaced shall be conducted in accordance with the procedure for the initial acceptance test described above. Costs incurred by repeated field acceptance testing and independent laboratory analysis shall be paid by CONTRACTOR. Conformance with the specified performance shall be achieved before the equipment will be acceptable.

D. OWNER reserves the right to independently sample and analyze sludge feed, sludge cake, centrate, polymer, and power quality, to verify centrifuge manufacturer's data. OWNER's laboratory follows CWA 40 CFR Part 136 requirements. If the OWNER's and centrifuge manufacturer's tests for sludge cake or centrate disagree by more than one percentage point of dry solids, centrifuge manufacturer shall repeat the field acceptance testing run. Costs incurred by repeated field acceptance testing and independent testing laboratory analysis shall be paid for by CONTRACTOR.

E. Acceptance:
   1. In addition to the process performance requirements, each centrifuge shall not require any downtime for maintenance and repair during the test.
   2. In the event that the centrifuge does not meet the performance requirements of the Specifications during the field acceptance tests, centrifuge manufacturer will be permitted to make changes to the equipment and methods of operation at the centrifuge manufacturer's expense. The re-adjustments shall be made as soon as practicable within a period not to exceed 15 days. Following the re-adjustments, the centrifuge manufacturer shall

perform a second field acceptance test. Additional testing of equipment that has been repaired, modified or replaced shall be conducted in accordance with the procedure for the initial acceptance test described above. However, after initial start-up, the OWNER shall have the right to use the centrifuge as needed to process sludge until accepted or, if rejected, until acceptable replacement equipment is available for use. Additional field acceptance testing will be at no additional cost to the OWNER.

F. Satisfactory completion of the field acceptance tests does not release the centrifuge manufacturer from other guarantees required by the Contract Documents.

G. Upon successful completion of the field acceptance test, centrifuge manufacturer shall prepare a written report. CONTRACTOR shall submit this report to OWNER and ENGINEER, and report shall summarize pertinent details regarding the test as well as test results to demonstrate that the tested centrifuge will comply with specified performance criteria. Report shall be submitted to OWNER and ENGINEER no later than two weeks after completion of the field acceptance tests. Report shall be reviewed by OWNER and ENGINEER, who may provide comments. OWNER's and ENGINEER's comments on the report shall be promptly addressed by centrifuge manufacturer and a revised report submitted.

H. Upon successful completion of the field acceptance test, and concurrent with subparagraph H report preparation, the centrifuge manufacturer shall perform optimization testing on the centrifuges using the OWNER's current polymer. The factory-trained service representative shall be onsite for the duration of optimization which shall be up to 2 contiguous weeks. Sampling and testing will be performed by the OWNER for optimization testing.

3.7 PERFORMANCE DAMAGES

A. Damages will be assessed for the inability of any centrifuge to meet the operating conditions identified herein. The basis of performance damages will be the sludge cake dryness (percent solids) when centrifuges are being fed at 226 gpm of sludge feed and a maximum 27 active dry pounds of polymer per dry ton of sludge feed, and achieving 95 percent solids recovery.

B. Schedule of Performance Damages for Sludge Cake Dryness:
   1. The estimated 20-year present worth cost difference in disposing of sludge cake that is one percent solids less is $626,209.
   2. When the average sludge cake dryness (percentage of solids) of all centrifuges, as determined in the field acceptance testing, is less than the specified performance requirement of 20 percent, the Contract Price shall be

$$PD_{cake} = \$626,209 \frac{1}{n} \sum_{i=1}^{n} (GCD_{cake} - CD_{cake,i})$$

reduced by the sludge cake dryness performance damage (PD_{cake}) as determined by the following:

Where: PD_{cake} = Sludge Cake Dryness Performance Damage ($)
n = Quantity of centrifuges tested = 3
i = Testing event number (e.g., i=1 is the first centrifuge field acceptance test, i=2 is the second centrifuge field acceptance test, etc.)
GCD_{cake} = 20 percent total solids
$CD_{cake,i}$ = Average actual sludge cake dryness (percent solids) for testing event i, as determined in the field acceptance test

3. No bonus for better-than-specified performance will be paid; if a negative PD_{cake} is calculated, there will be no change in the Contract Price.
4. Sample Calculation:
   a. Field Testing Results:
      1) Centrifuge No. 1 achieve sludge cake with an average of 20.0 percent total solids at the specified operating conditions.
      2) Centrifuge No. 2 achieves sludge cake with an average of 20.1 percent total solids at the specified operating conditions.
      3) Centrifuge No. 3 achieves sludge cake with an average of 19.8 percent total solids at the specified operating conditions.
   b. Sludge Cake Dryness Performance Damages Calculation:

$$PD_{cake} = \$626{,}209 \times 1/3 \times [(20.0\% - 20.0\%)_{i=1} + (20.0\% - 20.1\%)_{i=2} + (20.0\% - 19.8\%)_{i=3}]$$

$$PD_{cake} = \$20{,}873.63$$

   c. Therefore, the total performance damage for sludge cake dryness equals $20,873.63 for this example (i.e., a Change Order for a credit of ($20,873.63) to the Contract Price shall be executed).

C. Additional Criteria:
   1. Any performance damages will be deducted from Contract Price via Change Order.

3.8 MANUFACTURER'S REPAIR SERVICES

A. Provide services of factory-trained representatives of the centrifuge manufacturer to correct defective dewatering centrifuge equipment and materials during the correction period specified in the General Conditions and Supplementary Conditions.

B. Replacement parts or equipment installed during the correction period shall be equal to or better than the original.

3.9 INPUT/OUTPUT SCHEDULE

A. The schedule listed below, following the “End of Section” designation, is a part of this Specification Section.

1. Input/Output Schedule.

+ + END OF SECTION + +

CITY OF CANTON, OH
WRF SLUDGE PROCESSING MODIFICATIONS
INPUT/OUTPUT SCHEDULE

MOD TYPE	DRAWING NUMBER	TAG	MODULE/POINT DESCRIPTION	RANGE	INPUT FROM/OUTPUT TO
DI	Contract 26 - 266	YI-602B	SLUDGE PUMP NO. 1 VFD RUNNING		SLUDGE PUMP NO. 1 VFD to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	Contract 26 - 266	GAI-602A	SLUDGE PUMP NO. 1 VFD FAULT		SLUDGE PUMP NO. 1 VFD to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	Contract 26 - 266	PSH-602A	SLUDGE PUMP NO. 1 VFD HIGH PRESSURE		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	Contract 26 - 266	YI-602A	SLUDGE PUMP NO. 1 VFD IN REMOTE		SLUDGE PUMP NO. 1 VFD to CENTRIFUGE CONTROL PANEL (ETHERNET)
DO	Contract 26 - 268	HS-602A	SLUDGE PUMP NO. 1 VFD START/STOP		CENTRIFUGE CONTROL PANEL to SLUDGE PUMP NO. 1 VFD (ETHERNET)
AO	Contract 26 - 268	SIC-602B	SLUDGE PUMP NO. 1 VFD SPEED CONTROL		CENTRIFUGE CONTROL PANEL to SLUDGE PUMP NO. 1 VFD (ETHERNET)
AI	Contract 26 - 266	SI-602A	SLUDGE PUMP NO. 1 VFD SPEED FEEDBACK		SLUDGE PUMP NO. 1 VFD to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	Contract 26 - 266	YI-602B	SLUDGE PUMP NO. 2 VFD RUNNING		SLUDGE PUMP NO. 2 VFD to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	Contract 26 - 266	GAI-602A	SLUDGE PUMP NO. 2 VFD FAULT		SLUDGE PUMP NO. 2 VFD to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	Contract 26 - 266	PSH-602A	SLUDGE PUMP NO. 2 VFD HIGH PRESSURE		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	Contract 26 - 266	YI-602A	SLUDGE PUMP NO. 2 VFD IN REMOTE		SLUDGE PUMP NO. 2 VFD to CENTRIFUGE CONTROL PANEL (ETHERNET)
DO	Contract 26 - 268	HS-602A	SLUDGE PUMP NO. 2 VFD START/STOP		CENTRIFUGE CONTROL PANEL to SLUDGE PUMP NO. 2 VFD (ETHERNET)
AO	Contract 26 - 268	SIC-602B	SLUDGE PUMP NO. 2 VFD SPEED CONTROL		CENTRIFUGE CONTROL PANEL to SLUDGE PUMP NO. 2 VFD (ETHERNET)
AI	Contract 26 - 266	SI-602A	SLUDGE PUMP NO. 2 VFD SPEED FEEDBACK		SLUDGE PUMP NO. 2 VFD to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	Contract 26 - 266	YI-602B	SLUDGE PUMP NO. 3 VFD RUNNING		SLUDGE PUMP NO. 3 VFD to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	Contract 26 - 266	GAI-602A	SLUDGE PUMP NO. 3 VFD FAULT		SLUDGE PUMP NO. 3 VFD to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	Contract 26 - 266	PSH-602A	SLUDGE PUMP NO. 3 VFD HIGH PRESSURE		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	Contract 26 - 266	YI-602A	SLUDGE PUMP NO. 3 VFD IN REMOTE		SLUDGE PUMP NO. 3 VFD to CENTRIFUGE CONTROL PANEL (ETHERNET)
DO	Contract 26 - 268	HS-602A	SLUDGE PUMP NO. 3 VFD START/STOP		CENTRIFUGE CONTROL PANEL to SLUDGE PUMP NO. 3 VFD (ETHERNET)
AO	Contract 26 - 268	SIC-602B	SLUDGE PUMP NO. 3 VFD SPEED CONTROL		CENTRIFUGE CONTROL PANEL to SLUDGE PUMP NO. 3 VFD (ETHERNET)
AI	Contract 26 - 266	SI-602A	SLUDGE PUMP NO. 3 VFD SPEED FEEDBACK		SLUDGE PUMP NO. 3 VFD to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	Contract 26 - 266	YI-602B	SLUDGE PUMP NO. 4 VFD RUNNING		SLUDGE PUMP NO. 4 VFD to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	Contract 26 - 266	GAI-602A	SLUDGE PUMP NO. 4 VFD FAULT		SLUDGE PUMP NO. 4 VFD to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	Contract 26 - 266	PSH-602A	SLUDGE PUMP NO. 4 VFD HIGH PRESSURE		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	Contract 26 - 266	YI-602A	SLUDGE PUMP NO. 4 VFD IN REMOTE		SLUDGE PUMP NO. 4 VFD to CENTRIFUGE CONTROL PANEL (ETHERNET)

MOD TYPE	DRAWING NUMBER	TAG	MODULE/POINT DESCRIPTION	RANGE	INPUT FROM/OUTPUT TO
DO	Contract 26 - 268	HS-XXX	SLUDGE PUMP NO. 4 VFD START/STOP		CENTRIFUGE CONTROL PANEL to SLUDGE PUMP NO. 4 VFD (ETHERNET)
AO	Contract 26 - 268	SC-XXX	SLUDGE PUMP NO. 4 VFD SPEED CONTROL		CENTRIFUGE CONTROL PANEL to SLUDGE PUMP NO. 4 VFD (ETHERNET)
AI	Contract 26 - 266	SI-XXX	SLUDGE PUMP NO. 4 VFD SPEED FEEDBACK		SLUDGE PUMP NO. 4 VFD to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	Contract 26 - 266	YI-602B	SLUDGE PUMP NO. 5 VFD RUNNING		SLUDGE PUMP NO. 5 VFD to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	Contract 26 - 266	GAI-602A	SLUDGE PUMP NO. 5 VFD FAULT		SLUDGE PUMP NO.5 VFD to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	Contract 26 - 266	PSH-602A	SLUDGE PUMP NO. 5 VFD HIGH PRESSURE		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	Contract 26 - 266	YI-602A	SLUDGE PUMP NO. 5 VFD IN REMOTE		SLUDGE PUMP NO. 5 VFD to CENTRIFUGE CONTROL PANEL (ETHERNET)
DO	Contract 26 - 268	HS-602A	SLUDGE PUMP NO. 5 VFD START/STOP		CENTRIFUGE CONTROL PANEL to SLUDGE PUMP NO. 5 VFD (ETHERNET)
AO	Contract 26 - 268	SIC-602B	SLUDGE PUMP NO. 5 VFD SPEED CONTROL		CENTRIFUGE CONTROL PANEL to SLUDGE PUMP NO. 5 VFD (ETHERNET)
AI	Contract 26 - 266	SI-602A	SLUDGE PUMP NO. 5 VFD SPEED FEEDBACK		SLUDGE PUMP NO.5 VFD to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	Contract 26 - 266	YI-602B	SLUDGE PUMP NO. 6 VFD RUNNING		SLUDGE PUMP NO. 6 VFD to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	Contract 26 - 266	GAI-602A	SLUDGE PUMP NO. 6 VFD FAULT		SLUDGE PUMP NO. 6 VFD to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	Contract 26 - 266	PSH-602A	SLUDGE PUMP NO. 6 VFD HIGH PRESSURE		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	Contract 26 - 266	YI-602A	SLUDGE PUMP NO. 6 VFD IN REMOTE		SLUDGE PUMP NO. 6 VFD to CENTRIFUGE CONTROL PANEL (ETHERNET)
DO	Contract 26 - 268	HS-602A	SLUDGE PUMP NO. 6 VFD START/STOP		CENTRIFUGE CONTROL PANEL to SLUDGE PUMP NO. 6 VFD (ETHERNET)
AO	Contract 26 - 268	SIC-602B	SLUDGE PUMP NO. 6 VFD SPEED CONTROL		CENTRIFUGE CONTROL PANEL to SLUDGE PUMP NO. 6 VFD (ETHERNET)
AI	Contract 26 - 266	SI-602A	SLUDGE PUMP NO. 6 VFD SPEED FEEDBACK		SLUDGE PUMP NO. 6 VFD to CENTRIFUGE CONTROL PANEL (ETHERNET)
DO	I-6G	HS-650A	CENTRIFUGE LUBE OIL SLOP DIVERTER GATE FLUSH WATER ON/OFF		CENTRIFUGE PLC (LOCATED IN CENTRIFUGE CONTROL PANEL) TO CENTRIFUGE STARTER (LOCATED IN CENTRIFUGE CONTROL PANEL)
DO	I-6G	HS-651A	CENTRIFUGE LUBE OIL COOLING WATER SOLENOID VALVE ON/OFF		CENTRIFUGE PLC (LOCATED IN CENTRIFUGE CONTROL PANEL) TO CENTRIFUGE STARTER (LOCATED IN CENTRIFUGE CONTROL PANEL)
DI	I-6G	PAL-652A	CENTRIFUGE LUBE OIL LOW PRESSURE		CENTRIFUGE PLC (LOCATED IN CENTRIFUGE CONTROL PANEL) TO CENTRIFUGE STARTER (LOCATED IN CENTRIFUGE CONTROL PANEL)
DI	I-6G	LAL-653A	CENTRIFUGE LUBE OIL LOW LEVEL		CENTRIFUGE PLC (LOCATED IN CENTRIFUGE CONTROL PANEL) TO CENTRIFUGE STARTER (LOCATED IN CENTRIFUGE CONTROL PANEL)
DI	I-6G	PAL-654A	CENTRIFUGE LUBE OIL SOLIDS SIDE PRESSURE LOW		CENTRIFUGE PLC (LOCATED IN CENTRIFUGE CONTROL PANEL) TO CENTRIFUGE STARTER (LOCATED IN CENTRIFUGE CONTROL PANEL)

MOD TYPE	DRAWING NUMBER	TAG	MODULE/POINT DESCRIPTION	RANGE	INPUT FROM/OUTPUT TO
DO	I-6G	HS-655A	CENTRIFUGE WASH SOLENOID VALVE ON/OFF		CENTRIFUGE PLC (LOCATED IN CENTRIFUGE CONTROL PANEL) TO CENTRIFUGE STARTER (LOCATED IN CENTRIFUGE CONTROL PANEL)
AI	I-6G	TI-656A	CENTRIFUGE BEARING TEMPERATURE LIQUID SIDE		CENTRIFUGE STARTER (LOCATED IN CENTRIFUGE CONTROL PANEL) TO CENTRIFUGE PLC (LOCATED IN CENTRIFUGE CONTROL PANEL)
AI	I-6G	TI-657A	CENTRIFUGE BEARING TEMPERATURE SOLIDS SIDE		CENTRIFUGE STARTER (LOCATED IN CENTRIFUGE CONTROL PANEL) TO CENTRIFUGE PLC (LOCATED IN CENTRIFUGE CONTROL PANEL)
AI	I-6G	SI-658A	CENTRIFUGE BOWL SPEED		CENTRIFUGE STARTER (LOCATED IN CENTRIFUGE CONTROL PANEL) TO CENTRIFUGE PLC (LOCATED IN CENTRIFUGE CONTROL PANEL)
AI	I-6G	SI-659A	CENTRIFUGE GEAR INPUT SPEED		CENTRIFUGE STARTER (LOCATED IN CENTRIFUGE CONTROL PANEL) TO CENTRIFUGE PLC (LOCATED IN CENTRIFUGE CONTROL PANEL)
DO	I-6G	HS-670A	BOWL MOTOR SPACE HEATER		CENTRIFUGE PLC (LOCATED IN CENTRIFUGE CONTROL PANEL) TO CENTRIFUGE STARTER (LOCATED IN CENTRIFUGE CONTROL PANEL)
AI	I-6G	TAH-671A	BOWL MOTOR HIGH TEMP		CENTRIFUGE STARTER (LOCATED IN CENTRIFUGE CONTROL PANEL) TO CENTRIFUGE PLC (LOCATED IN CENTRIFUGE CONTROL PANEL)
DO	I-6G	PB-672A	CENTRIFUGE STANDBY		CENTRIFUGE PLC (LOCATED IN CENTRIFUGE CONTROL PANEL) TO CENTRIFUGE STARTER (LOCATED IN CENTRIFUGE CONTROL PANEL)
DO	I-6G	PB-673A	CENTRIFUGE SHUTDOWN		CENTRIFUGE PLC (LOCATED IN CENTRIFUGE CONTROL PANEL) TO CENTRIFUGE STARTER (LOCATED IN CENTRIFUGE CONTROL PANEL)
DO	I-6G	PB-675A	LUBE PUMP START		CENTRIFUGE PLC (LOCATED IN CENTRIFUGE CONTROL PANEL) TO CENTRIFUGE STARTER (LOCATED IN CENTRIFUGE CONTROL PANEL)
DI	I-6G	YIR-674A	LUBE PUMP RUNNING		CENTRIFUGE STARTER (LOCATED IN CENTRIFUGE CONTROL PANEL) TO CENTRIFUGE PLC (LOCATED IN CENTRIFUGE CONTROL PANEL)
DI	I-6G	YIF-676A	LUBE PUMP MOTOR OVERLOAD		CENTRIFUGE STARTER (LOCATED IN CENTRIFUGE CONTROL PANEL) TO CENTRIFUGE PLC (LOCATED IN CENTRIFUGE CONTROL PANEL)
DO	I-6G	PB-677A	SCROLL DRIVE FORWARD		CENTRIFUGE PLC (LOCATED IN CENTRIFUGE CONTROL PANEL) TO CENTRIFUGE STARTER (LOCATED IN CENTRIFUGE CONTROL PANEL)
DO	I-6G	PB-678A	SCROLL DRIVE REVERSE		CENTRIFUGE PLC (LOCATED IN CENTRIFUGE CONTROL PANEL) TO CENTRIFUGE STARTER (LOCATED IN CENTRIFUGE CONTROL PANEL)
DO	I-6G	PB-679A	SCROLL DRIVE STOP		CENTRIFUGE PLC (LOCATED IN CENTRIFUGE CONTROL PANEL) TO CENTRIFUGE STARTER (LOCATED IN CENTRIFUGE CONTROL PANEL)
DI	I-6G	YIR-680A	SCROLL DRIVE RUNNING		CENTRIFUGE STARTER (LOCATED IN CENTRIFUGE CONTROL PANEL) TO CENTRIFUGE PLC (LOCATED IN CENTRIFUGE CONTROL PANEL)

MOD TYPE	DRAWING NUMBER	TAG	MODULE/POINT DESCRIPTION	RANGE	INPUT FROM/OUTPUT TO
DI	I-6G	YIF-681A	SCROLL DRIVE FAULT		CENTRIFUGE STARTER (LOCATED IN CENTRIFUGE CONTROL PANEL) TO CENTRIFUGE PLC (LOCATED IN CENTRIFUGE CONTROL PANEL)
AO	I-6G	SC-682A	SCROLL DRIVE SPEED CONTROL		CENTRIFUGE PLC (LOCATED IN CENTRIFUGE CONTROL PANEL) TO CENTRIFUGE STARTER (LOCATED IN CENTRIFUGE CONTROL PANEL)
AI	I-6G	SI-683A	SCROLL DRIVE SPEED FEEDBACK		CENTRIFUGE STARTER (LOCATED IN CENTRIFUGE CONTROL PANEL) TO CENTRIFUGE PLC (LOCATED IN CENTRIFUGE CONTROL PANEL)
AI	I-6G	SI-684A	SCROLL DRIVE SPEED TORQUE FEEDBACK		CENTRIFUGE STARTER (LOCATED IN CENTRIFUGE CONTROL PANEL) TO CENTRIFUGE PLC (LOCATED IN CENTRIFUGE CONTROL PANEL)
DI	I-6G	OAH-685A	SCROLL DRIVE HIGH TORQUE		CENTRIFUGE STARTER (LOCATED IN CENTRIFUGE CONTROL PANEL) TO CENTRIFUGE PLC (LOCATED IN CENTRIFUGE CONTROL PANEL)
DI	I-6G	OAHH-686A	SCROLL DRIVE HIGH-HIGH TORQUE		CENTRIFUGE STARTER (LOCATED IN CENTRIFUGE CONTROL PANEL) TO CENTRIFUGE PLC (LOCATED IN CENTRIFUGE CONTROL PANEL)
AI	I-6G	VI-696A	SCROLL DRIVE VIBRATION MONITOR		CENTRIFUGE STARTER (LOCATED IN CENTRIFUGE CONTROL PANEL) TO CENTRIFUGE PLC (LOCATED IN CENTRIFUGE CONTROL PANEL)
DI	I-6G	LAL-697A	SCROLL DRIVE GEARBOX LOW LUBE OIL		CENTRIFUGE STARTER (LOCATED IN CENTRIFUGE CONTROL PANEL) TO CENTRIFUGE PLC (LOCATED IN CENTRIFUGE CONTROL PANEL)
DO	I-6G	HS-698A	SCROLL DRIVE MOTOR SPACE HEATER		CENTRIFUGE STARTER (LOCATED IN CENTRIFUGE CONTROL PANEL) TO CENTRIFUGE PLC (LOCATED IN CENTRIFUGE CONTROL PANEL)
DI	I-6G	TAH-699A	SCROLL DRIVE SCROLL MOTOR HIGH TEMP		CENTRIFUGE STARTER (LOCATED IN CENTRIFUGE CONTROL PANEL) TO CENTRIFUGE PLC (LOCATED IN CENTRIFUGE CONTROL PANEL)
DO	I-6G	HS-649A	SCROLL DRIVE OPEN.CLOSE DISCHARGE CHUTE		CENTRIFUGE STARTER (LOCATED IN CENTRIFUGE CONTROL PANEL) TO CENTRIFUGE PLC (LOCATED IN CENTRIFUGE CONTROL PANEL)
DO	I-6G	HS-687A	BOWL DRIVE START/STOP		CENTRIFUGE PLC (LOCATED IN CENTRIFUGE CONTROL PANEL) TO CENTRIFUGE STARTER (LOCATED IN CENTRIFUGE CONTROL PANEL)
DI	I-6G	YA-688A	CENTRIFUGE ESTOP PRESSED		CENTRIFUGE STARTER (LOCATED IN CENTRIFUGE CONTROL PANEL) TO CENTRIFUGE PLC (LOCATED IN CENTRIFUGE CONTROL PANEL)
DI	I-6G	YIR-689A	BOWL DRIVE RUNNING		CENTRIFUGE STARTER (LOCATED IN CENTRIFUGE CONTROL PANEL) TO CENTRIFUGE PLC (LOCATED IN CENTRIFUGE CONTROL PANEL)
DI	I-6G	YIF-690	BOWL DRIVE FAULT		CENTRIFUGE STARTER (LOCATED IN CENTRIFUGE CONTROL PANEL) TO CENTRIFUGE PLC (LOCATED IN CENTRIFUGE CONTROL PANEL)
AO	I-6G	SC-391A	BOWL DRIVE SPEED CONTROL		CENTRIFUGE PLC (LOCATED IN CENTRIFUGE CONTROL PANEL) TO CENTRIFUGE STARTER (LOCATED IN CENTRIFUGE CONTROL PANEL)

MOD TYPE	DRAWING NUMBER	TAG	MODULE/POINT DESCRIPTION	RANGE	INPUT FROM/OUTPUT TO
AI	I-6G	SI-692A	BOWL DRIVE SPEED FEEDBACK		CENTRIFUGE STARTER (LOCATED IN CENTRIFUGE CONTROL PANEL) TO CENTRIFUGE PLC (LOCATED IN CENTRIFUGE CONTROL PANEL)
AI	I-6G	SI-693A	BOWL DRIVE SPEED LOAD FEEDBACK		CENTRIFUGE STARTER (LOCATED IN CENTRIFUGE CONTROL PANEL) TO CENTRIFUGE PLC (LOCATED IN CENTRIFUGE CONTROL PANEL)
AI	I-6G	SDI-694A	BOWL DRIVE SPEED DIFFERENTIAL		CENTRIFUGE STARTER (LOCATED IN CENTRIFUGE CONTROL PANEL) TO CENTRIFUGE PLC (LOCATED IN CENTRIFUGE CONTROL PANEL)
DI	I-6G	SAL-695A	BOWL DRIVE SPEED ALARM LOW		CENTRIFUGE STARTER (LOCATED IN CENTRIFUGE CONTROL PANEL) TO CENTRIFUGE PLC (LOCATED IN CENTRIFUGE CONTROL PANEL)
AI	I-3	FI-610A	CENTRIFUGE NO. 1 SLUDGE FLOW RATE		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
AI	I-3	FI-610B	CENTRIFUGE NO. 2 SLUDGE FLOW RATE		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
AI	I-3	FI-610C	CENTRIFUGE NO. 3 SLUDGE FLOW RATE		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DO	I-4	HS-611D	CENTRIFUGE POLYMER FEED SKID NO. 1 LCP START/STOP		CENTRIFUGE CONTROL PANEL to CENTRIFUGE POLYMER FEED SKID NO. 1 LCP (ETHERNET)
DI	I-4	YI-611A	CENTRIFUGE POLYMER FEED SKID NO. 1 LCP RUNNING		CENTRIFUGE POLYMER FEED SKID NO. 1 LCP to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-4	GAI-611A	CENTRIFUGE POLYMER FEED SKID NO. 1 LCP COMMON ALARM		CENTRIFUGE POLYMER FEED SKID NO. 1 LCP to CENTRIFUGE CONTROL PANEL (ETHERNET)
AO	I-4	FI-630A	CENTRIFUGE POLYMER FEED SKID NO. 1 PACING		CENTRIFUGE POLYMER FEED SKID NO. 1 LCP to CENTRIFUGE CONTROL PANEL (ETHERNET)
AI	I-4	FI-631A	CENTRIFUGE POLYMER FEED SKID NO. 1 RATE		CENTRIFUGE POLYMER FEED SKID NO. 1 LCP to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-4	PAH-632A	CENTRIFUGE POLYMER FEED SKID NO. 1 HIGH PRESSURE		CENTRIFUGE CONTROL PANEL to CENTRIFUGE POLYMER FEED SKID NO. 1 LCP (ETHERNET)
DO	I-4	HS-611D	CENTRIFUGE POLYMER FEED SKID NO. 2 LCP START/STOP		CENTRIFUGE POLYMER FEED SKID NO. 2 LCP to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-4	YI-611A	CENTRIFUGE POLYMER FEED SKID NO. 2 LCP RUNNING		CENTRIFUGE POLYMER FEED SKID NO. 2 LCP to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-4	GAI-611A	CENTRIFUGE POLYMER FEED SKID NO. 2 LCP COMMON ALARM		CENTRIFUGE POLYMER FEED SKID NO. 2 LCP to CENTRIFUGE CONTROL PANEL (ETHERNET)
AO	I-4	FI-630A	CENTRIFUGE POLYMER FEED SKID NO. 2 PACING		CENTRIFUGE CONTROL PANEL to CENTRIFUGE POLYMER FEED SKID NO. 2 LCP (ETHERNET)
AI	I-4	FI-631A	CENTRIFUGE POLYMER FEED SKID NO. 2 RATE		CENTRIFUGE POLYMER FEED SKID NO. 2 LCP to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-4	PAH-632A	CENTRIFUGE POLYMER FEED SKID NO. 2 HIGH PRESSURE		CENTRIFUGE CONTROL PANEL to CENTRIFUGE POLYMER FEED SKID NO. 2 LCP (ETHERNET)
DO	I-4	HS-611D	CENTRIFUGE POLYMER FEED SKID NO. 3 LCP START/STOP		CENTRIFUGE POLYMER FEED SKID NO. 3 LCP to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-4	YI-611A	CENTRIFUGE POLYMER FEED SKID NO. 3 LCP RUNNING		CENTRIFUGE POLYMER FEED SKID NO. 3 LCP to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-4	GAI-611A	CENTRIFUGE POLYMER FEED SKID NO. 3 LCP COMMON ALARM		CENTRIFUGE POLYMER FEED SKID NO. 3 LCP to CENTRIFUGE CONTROL PANEL (ETHERNET)
AO	I-4	FI-630A	CENTRIFUGE POLYMER FEED SKID NO. 3 PACING		CENTRIFUGE CONTROL PANEL to CENTRIFUGE POLYMER FEED SKID NO. 3 LCP (ETHERNET)

MOD TYPE	DRAWING NUMBER	TAG	MODULE/POINT DESCRIPTION	RANGE	INPUT FROM/OUTPUT TO
AI	I-4	FI-631A	CENTRIFUGE POLYMER FEED SKID NO. 3 RATE		CENTRIFUGE POLYMER FEED SKID NO. 3 LCP to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-4	PAH-632A	CENTRIFUGE POLYMER FEED SKID NO. 3 HIGH PRESSURE		CENTRIFUGE CONTROL PANEL to CENTRIFUGE POLYMER FEED SKID NO. 3 LCP (ETHERNET)
DO	I-5	HS-609A	WATER BOOSTER PUMP NO. 1 START/STOP		RTU-SH to WATER BOOSTER PUMP CONTROL PANEL (ETHERNET)
DI	I-5	YI-609A	WATER BOOSTER PUMP NO. 1 RUN		RTU-SH to WATER BOOSTER PUMP CONTROL PANEL (ETHERNET)
DI	I-5	GAI-609A	WATER BOOSTER PUMP NO. 1 ALARM		RTU-SH to WATER BOOSTER PUMP CONTROL PANEL (ETHERNET)
DI	I-6	PAH-609C	WATER BOOSTER PUMP NO. 1 HIGH PRESSURE		RTU-SH to WATER BOOSTER PUMP CONTROL PANEL (ETHERNET)
DO	I-5	HS-609A	WATER BOOSTER PUMP NO. 2 START/STOP		RTU-SH to WATER BOOSTER PUMP CONTROL PANEL (ETHERNET)
DI	I-5	YI-609A	WATER BOOSTER PUMP NO. 2 RUN		RTU-SH to WATER BOOSTER PUMP CONTROL PANEL (ETHERNET)
DI	I-5	GAI-609A	WATER BOOSTER PUMP NO. 2 ALARM		RTU-SH to WATER BOOSTER PUMP CONTROL PANEL (ETHERNET)
DI	I-6	PAH-609C	WATER BOOSTER PUMP NO. 2 HIGH PRESSURE		RTU-SH to WATER BOOSTER PUMP CONTROL PANEL (ETHERNET)
DO	I-5	HS-609A	WATER BOOSTER PUMP NO. 3 START/STOP		RTU-SH to WATER BOOSTER PUMP CONTROL PANEL (ETHERNET)
DI	I-5	YI-609A	WATER BOOSTER PUMP NO. 3 RUN		RTU-SH to WATER BOOSTER PUMP CONTROL PANEL (ETHERNET)
DI	I-5	GAI-609A	WATER BOOSTER PUMP NO. 3 ALARM		RTU-SH to WATER BOOSTER PUMP CONTROL PANEL (ETHERNET)
DI	I-6	PAH-609C	WATER BOOSTER PUMP NO. 3 HIGH PRESSURE		RTU-SH to WATER BOOSTER PUMP CONTROL PANEL (ETHERNET)
DI	I-5	YIA-640	CENTRIFUGE ROOM AIR FLOW ALARM		RTU-SH to VENTALATION MONITORING STATION (ETHERNET)
DI	I-7	YI-616A	SHUTTLE CONVEYOR NO. 1 IN AUTO		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	YI-616B	SHUTTLE CONVEYOR NO. 1 RUNNING FORWARD		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	YI-616C	SHUTTLE CONVEYOR NO. 1 RUNNING REVERSE		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	GA-616A	SHUTTLE CONVEYOR NO. 1 FAIL ALARM		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DO	I-7	YC-616A	SHUTTLE CONVEYOR NO. 1 CONTROL		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	YI-616A	SHUTTLE CONVEYOR NO. 2 IN AUTO		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	YI-616B	SHUTTLE CONVEYOR NO. 2 RUNNING FORWARD		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	YI-616C	SHUTTLE CONVEYOR NO. 2 RUNNING REVERSE		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	GA-616A	SHUTTLE CONVEYOR NO. 2 FAIL ALARM		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DO	I-7	YC-616A	SHUTTLE CONVEYOR NO. 2 CONTROL		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DO	I-7	ZC-618A	POSITION CONTROL NO. 1		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DO	I-7	ZC-618A	POSITION CONTROL NO. 2		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DO	I-7	ZC-618A	POSITION CONTROL NO. 3		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DO	I-7	ZC-618A	POSITION CONTROL NO. 4		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DO	I-7	ZC-618A	POSITION CONTROL NO. 5		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DO	I-7	ZC-618A	POSITION CONTROL NO. 6		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	ZI-618A	POSITION OPEN NO. 1		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	ZI-618A	POSITION OPEN NO. 2		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	ZI-618A	POSITION OPEN NO. 3		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	ZI-618A	POSITION OPEN NO. 4		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	ZI-618A	POSITION OPEN NO. 5		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	ZI-618A	POSITION OPEN NO. 6		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	ZI-618B	POSITION CLOSE NO. 1		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	ZI-618B	POSITION CLOSE NO. 2		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	ZI-618B	POSITION CLOSE NO. 3		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	ZI-618B	POSITION CLOSE NO. 4		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	ZI-618B	POSITION CLOSE NO. 5		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	ZI-618B	POSITION CLOSE NO. 6		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	YI-615A	LOAD OUT CONVEYOR NO. 1 IN AUTO		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	YI-615B	LOAD OUT CONVEYOR NO. 1 RUNNING FORWARD		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)

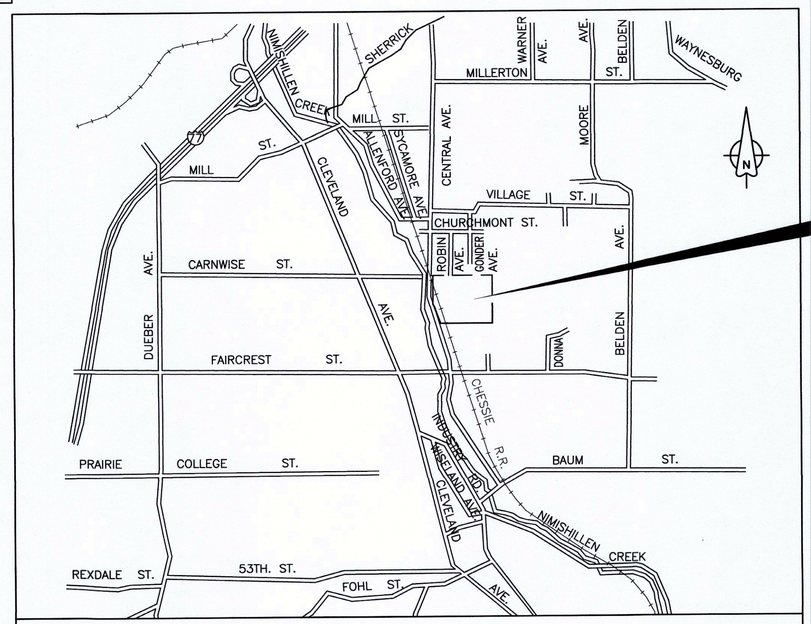
MOD TYPE	DRAWING NUMBER	TAG	MODULE/POINT DESCRIPTION	RANGE	INPUT FROM/OUTPUT TO
DI	I-7	YI-615C	LOAD OUT CONVEYOR NO. 1 RUNNING REVERSE		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	GA-615A	LOAD OUT CONVEYOR NO. 1 FAIL ALARM		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DO	I-7	YC-615A	LOAD OUT CONVEYOR NO. 1 CONTROL		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	YI-615A	LOAD OUT CONVEYOR NO. 2 IN AUTO		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	YI-615B	LOAD OUT CONVEYOR NO. 2 RUNNING FORWARD		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	YI-615C	LOAD OUT CONVEYOR NO. 2 RUNNING REVERSE		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	GA-615A	LOAD OUT CONVEYOR NO. 2 FAIL ALARM		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DO	I-7	YC-615A	LOAD OUT CONVEYOR NO. 2 CONTROL		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	YI-613A	PRESS CONVEYOR NO. 1 IN AUTO		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	YI-613B	PRESS CONVEYOR NO. 1 RUNNING FORWARD		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	YI-613C	PRESS CONVEYOR NO. 1 RUNNING REVERSE		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	GA-613A	PRESS CONVEYOR NO. 1 FAIL ALARM		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DO	I-7	YC-613A	PRESS CONVEYOR NO. 1 CONTROL		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	YI-613A	PRESS CONVEYOR NO. 2 IN AUTO		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	YI-613B	PRESS CONVEYOR NO. 2 RUNNING FORWARD		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	YI-613C	PRESS CONVEYOR NO. 2 RUNNING REVERSE		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	GA-613A	PRESS CONVEYOR NO. 2 FAIL ALARM		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DO	I-7	YC-613A	PRESS CONVEYOR NO. 2 CONTROL		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DO	I-7	ZC-617A	POSITION CONTROL NO. 1		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DO	I-7	ZC-617A	POSITION CONTROL NO. 2		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DO	I-7	ZC-617A	POSITION CONTROL NO. 3		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DO	I-7	ZC-617A	POSITION CONTROL NO. 4		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	ZI-617A	POSITION 1 NO. 1		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	ZI-617A	POSITION 1 NO. 2		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	ZI-617A	POSITION 1 NO. 3		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	ZI-617A	POSITION 1 NO. 4		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	ZI-617B	POSITION 2 NO. 1		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	ZI-617B	POSITION 2 NO. 2		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	ZI-617B	POSITION 2 NO. 3		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	ZI-617B	POSITION 2 NO. 4		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	ZI-617C	SPLIT POSITION NO. 1		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	ZI-617C	SPLIT POSITION NO. 2		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	ZI-617C	SPLIT POSITION NO. 3		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	ZI-617C	SPLIT POSITION NO. 4		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	YI-614A	DISCHARGE CONVEYOR NO. 1 IN AUTO		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	YI-614B	DISCHARGE CONVEYOR NO. 1 RUNNING FORWARD		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	YI-614C	DISCHARGE CONVEYOR NO. 1 RUNNING REVERSE		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	GA-614A	DISCHARGE CONVEYOR NO. 1 FAIL ALARM		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DO	I-7	YC-614A	DISCHARGE CONVEYOR NO. 1 CONTROL		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	YI-614A	DISCHARGE CONVEYOR NO. 2 IN AUTO		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	YI-614B	DISCHARGE CONVEYOR NO. 2 RUNNING FORWARD		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	YI-614C	DISCHARGE CONVEYOR NO. 2 RUNNING REVERSE		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	GA-614A	DISCHARGE CONVEYOR NO. 2 FAIL ALARM		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DO	I-7	YC-614A	DISCHARGE CONVEYOR NO. 2 CONTROL		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	LI-619A	SLIDE GATE CH-1A LEVEL NO. 1		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	LI-619A	SLIDE GATE CH-1A LEVEL NO. 2		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	LI-619A	SLIDE GATE CH-1A LEVEL NO. 3		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	LI-619A	SLIDE GATE CH-1A LEVEL NO. 4		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	LI-619A	SLIDE GATE CH-1A LEVEL NO. 5		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	LI-619A	SLIDE GATE CH-1A LEVEL NO. 6		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	LI-619A	SLIDE GATE CH-1A LEVEL NO. 7		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)

MOD TYPE	DRAWING NUMBER	TAG	MODULE/POINT DESCRIPTION	RANGE	INPUT FROM/OUTPUT TO
DI	I-7	LI-619A	SLIDE GATE CH-1A LEVEL NO. 8		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	LI-619A	SLIDE GATE CH-1A LEVEL NO. 9		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)
DI	I-7	LI-619A	SLIDE GATE CH-1A LEVEL NO. 10		RTU-SH to CENTRIFUGE CONTROL PANEL (ETHERNET)

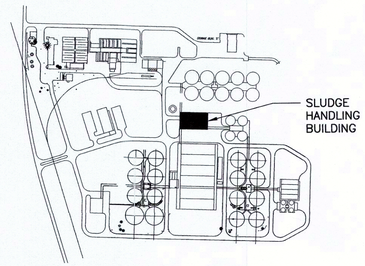
Appendix D: Project Drawings

CANTON WATER RECLAMATION FACILITY
SLUDGE PROCESSING MODIFICATIONS
CONTRACT NO. 27
CITY OF CANTON, STARK COUNTY, OHIO

MAY 2018



VICINITY MAP



CITY OF CANTON WATER RECLAMATION FACILITY
3530 CENTRAL AVENUE S.E.
CANTON, OHIO

LOCATION MAP

CITY COUNCIL

ALLEN SCHULMAN	PRESIDENT OF COUNCIL
JAMES O. BABCOCK	COUNCIL AT LARGE
COREY M. SMITH	COUNCIL AT LARGE
BILL SMUCKLER	COUNCIL AT LARGE
GREG HAWK	MEMBER
NATE CHESTER III	MEMBER
JASON SCAGLIONE	MEMBER
CHRIS SMITH	MEMBER
ROBERT FISHER	MEMBER
KEVIN D. HALL	MEMBER
JOHN MARIOL, II	MEMBER
EDMOND MACK	MEMBER
FRANK MORRIS, III	MEMBER

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ADMINISTRATION

THOMAS M. BERNABEI	MAYOR
JOHN M. HIGHMAN, JR.	DIRECTOR OF PUBLIC SERVICE
FONDA WILLIAMS	DEPUTY MAYOR
RICHARD A. MALLONN II	AUDITOR
KIM R. PEREZ	TREASURER
KRISTEN AYLWARD	LAW DIRECTOR
DAVID R. DOUGHERTY	CLERK OF COUNCIL
TRACY J. MILLS	WRF SUPERINTENDENT
MARK CROUSE	FINANCE DIRECTOR

APPROVALS

THOMAS M. BERNABEI — MAYOR — DATE 5/17/2018

JOHN M. HIGHMAN, JR. — DIRECTOR OF PUBLIC SERVICE — DATE 5/17/18

STATE OF OHIO — DAVID A. FRANK — 53268 — REGISTERED PROFESSIONAL ENGINEER

DAVID A FRANK, P.E., OH, 53268 — DATE 5/24/18

GENERAL DRAWINGS

SR. NO.	DWG. NO.	DRAWING NAME
01	G–1	TITLE SHEET
02	G–2	DRAWINGS INDEX
03	G–3	OVERALL SITE PLAN

DEMOLITION DRAWINGS

04	D–1	SLUDGE HANDLING BUILDING – FIRST FLOOR PLAN
05	D–2	SLUDGE HANDLING BUILDING BASEMENT FLOOR PLAN
06	D–3	SLUDGE HANDLING BUILDING – ELEVATIONS
07	D–4	SLUDGE HANDLING BUILDING – SECTIONS
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10	D–7	HVAC MODIFICATIONS
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CANTON WATER RECLAMATION FACILITY
SLUDGE PROCESSING MODIFICATIONS
CONTRACT NO. 27

ARCADIS PROJ. NO. AK000343.B002

NO.	DATE	ISSUED FOR	BY

DATE: MAY 2018
PROJECT NO.: AK000343.B002
FILE NAME: G–2
DESIGNED BY: DAF
DRAWN BY: TNB
CHECKED BY: JJW

SHEET TITLE

GENERAL

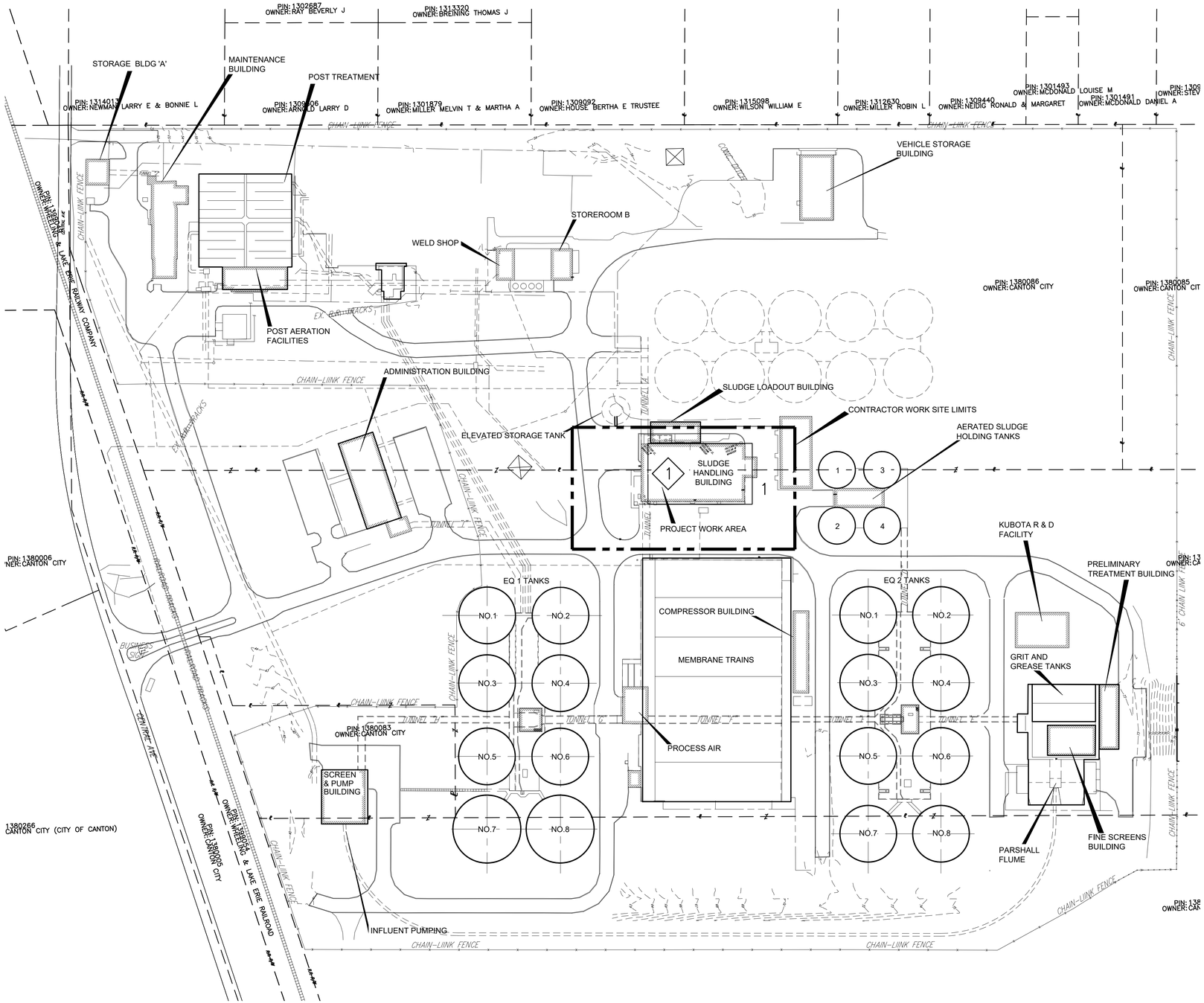
DRAWINGS INDEX

SCALE: AS SHOWN

G–2

SHEET 02 OF 61

User: YNI00655 Spec: AUS–NCSM0D File: I:\WATER\US\UB004316–01_CANTON WRF\E–DRAWINGS\SHEETS\GENERAL\G–2.DWG Scale: 1:1 SavedDate: 5/17/2018 Time: 15:00 Plot Date: Nimbargikar, Yoginath; 5/17/2018, 17:08 ; Layout: 02



SUMMARY OF WORK

(EXISTING TREATMENT FACILITIES SHALL REMAIN FULLY OPERATIONAL DURING CONSTRUCTION OF THE IMPROVEMENTS.)

1 REMOVE BELT FILTER PRESSES AND INSTALL CENTRIFUGES.

- DEMOLISH EXISTING MONORAILS AND REPLACE WITH NEW
- MODIFY PROCESS PIPING
- REPLACE POLYMER BLENDING UNITS
- MODIFY HVAC DUCTWORK
- INSTALL WATER BOOSTER SYSTEM

NOTES:

EXISTING EQUIPMENT, PIPING AND ELECTRICAL GEAR/WIRE RUNS THROUGHOUT SITE.

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ARCADIS PROJ. NO. AK000343.B002

NO.	DATE	ISSUED FOR	BY

DATE: MAY 2018
PROJECT NO.: AK000343.B002
FILE NAME: G-3
DESIGNED BY: DAF
DRAWN BY: TNB
CHECKED BY: JJW

SHEET TITLE

GENERAL

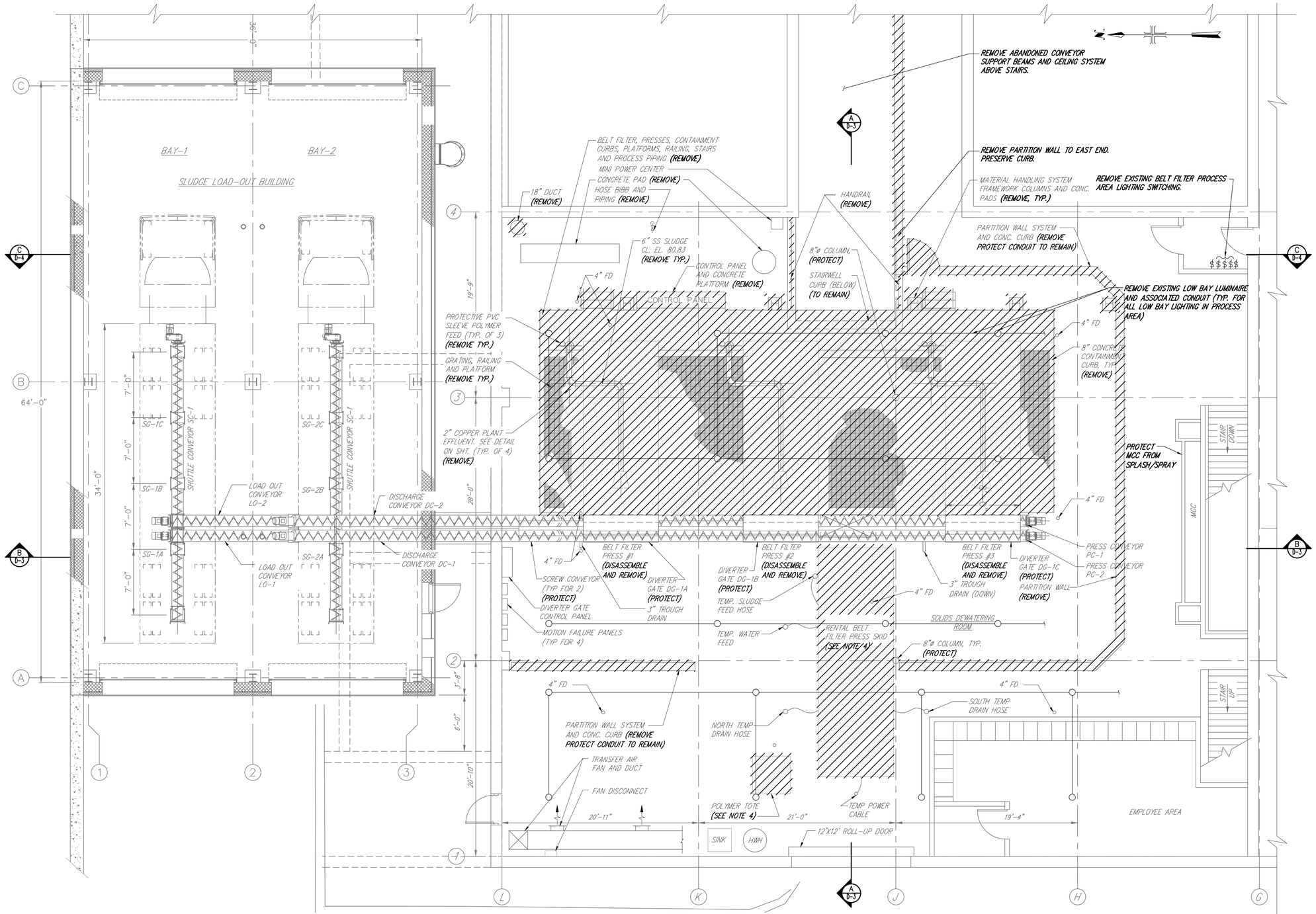
OVERALL SITE PLAN

SCALE: AS SHOWN

G-3

SHEET 03 OF 61

User:CRYMAN Spec:AUS-NCSMOD File:G:\PROJECT\AK000343.B002-CANTON SLUDGE\DRAWING\CADD\01_GENERAL\G-3 - STANDARD\G-3.DWG Scale:1:1/2 SavedDate:5/17/2018 Time:12:14 Plot Date: Rymon, Chris, 5/17/2018; 12:22 ; Layout:03



PARTIAL PLAN @ BFP FLOOR LEVEL

SCALE: 3/16" = 1'-0"

0 4' 8' 12'

NOTES:

1. REFER TO SPECIFICATION 01 14 16 FOR DEMOLITION/CONSTRUCTION SEQUENCE.
2. FRP DUCT AND MONORAIL NOT SHOWN FOR CLARITY.
3. UPON COMPLETION OF DEMOLITION, CLEAN ALL GLAZED TILE BLOCK AND GROUT.
4. ASSIST RENTAL BELT FILTER PRESS (BFP) OWNER WITH REMOVAL OF SKID FROM BUILDING WHEN DIRECTED BY OWNER. REMOVE TEMPORARY POWER AND PIPING CONNECTIONS BACK TO THEIR SOURCE AND CAP, PLUG OR BLIND FLANGE.
5. CONTINUITY OF LIGHTING CIRCUITING BEYOND PROJECT AREA SHALL BE MAINTAINED DURING AND AFTER DEMOLITION WORK IS COMPLETE.

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ARCADIS PROJ. NO. AK000343.B002

NO.	DATE	ISSUED FOR	BY

DATE: MAY 2018
PROJECT NO.: AK000343.B002
FILE NAME: D–1
DESIGNED BY: DAF
DRAWN BY: TNB
CHECKED BY: JJW

SHEET TITLE

DEMOLITION

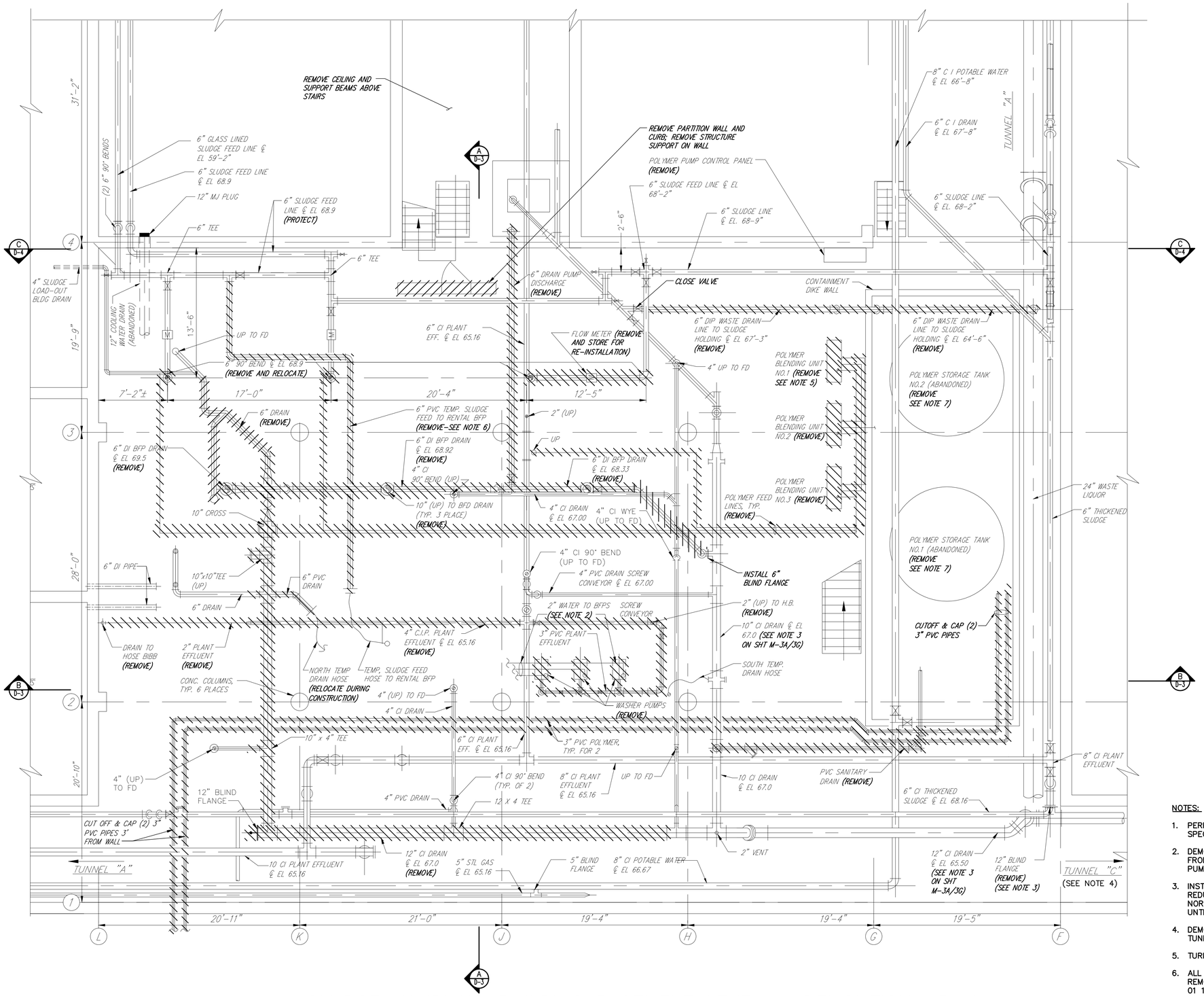
SLUDGE HANDLING BUILDING – FIRST FLOOR PLAN

SCALE: AS SHOWN

D–1

SHEET 04 OF 61

User:CRYMAN Spec:AUS–NCSMOD File:G:\PROJECT\AK000343.B002–CANTON SLUDGE\DRAWING\CADD\02_DEMO\D–1 – STANDARD\D–1.DWG Scale:1:1/2 SavedDate:5/17/2018 Time:13:51 Plot Date: Ryman, Chris; 5/17/2018; 14:13 ; Layout:04



SLUDGE HANDLING BUILDING BASEMENT LEVEL – DEMOLITION PLAN

SCALE: 3/16" = 1'-0"

0 4' 8' 12'

NOTES:

1. PERFORM DEMOLITION FOLLOWING SEQUENCING DEFINED IN SPECIFICATION SECTION 01 14 16.
2. DEMOLISH BOOSTED PLANT EFFLUENT SUPPLY PIPING FROM EACH BELT FILTER PRESS TO EACH PUMP, PUMPING NOT SHOWN FOR CLARITY.
3. INSTALL PVC FLANGE 90 DEG BEND (UP) AND 12" x 6" REDUCER. INSTALL PVC PIPING TO REROUTE RENTAL BFP NORTH TEMP DRAIN TO THIS 6" DRAIN CONNECTION UNTIL RENTAL IS REMOVED.
4. DEMOLISH 12" DRAIN PIPING LOCATION TO SOUTH IN TUNNEL 'C', SEE SHT D-4.
5. TURN OVER POLYMER BLENDING UNIT NO. 1 TO CITY.
6. ALL PIPING AND HOSE SERVING RENTAL BFP TO BE REMOVED AND TURNED OVER TO CITY; FOLLOW SECTION 01 14 16.
7. CLEAN OUT RESIDUAL POLYMER (ASSUME 1' DEPTH) AND PUMP INTO PLANT DRAIN SYSTEM PRIOR TO DEMOLITION AND REMOVAL OF TANKS, REMOVE ALL CONNECTED PIPING (NOT SHOWN FOR CLARITY).

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CONTRACT NO. 27

ARCADIS PROJ. NO. AK000343.B002

NO.	DATE	ISSUED FOR	BY

DATE: MAY 2018
PROJECT NO.: AK000343.B002
FILE NAME: D-2
DESIGNED BY: DAF
DRAWN BY: TNB
CHECKED BY: JJW

SHEET TITLE

DEMOLITION

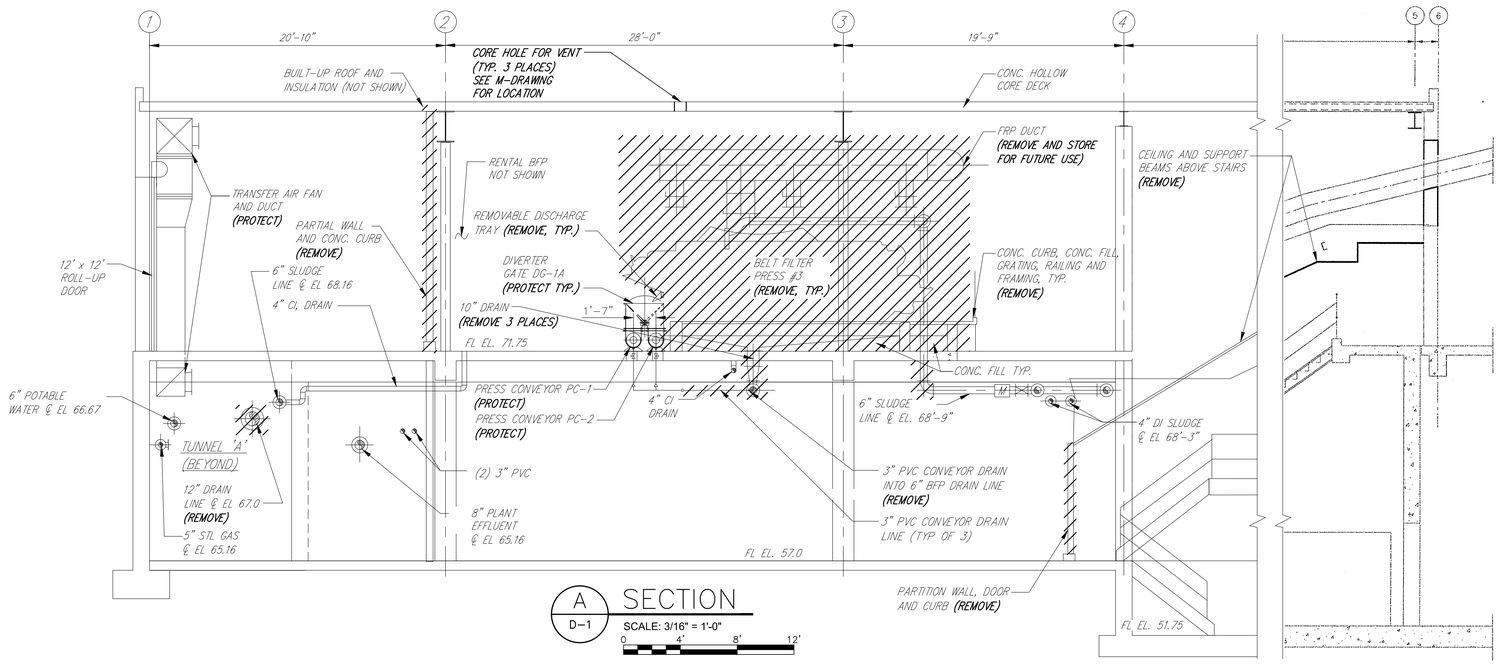
SLUDGE HANDLING BUILDING BASEMENT FLOOR PLAN

SCALE: AS SHOWN

D-2

SHEET 05 OF 61

User:CRYMAN Spec:AUS-NCSMOD File:G:\PROJECT\AK000343.B002-CANTON SLUDGE\DRAWING\CADD\02_DEMO\D-2 - STANDARD\D-2.DWG Scale:1:1 SavedDate:5/17/2018 Time:13:15 Plot Date: Ryman, Chris; 5/17/2018; 13:15 ; Layout:05



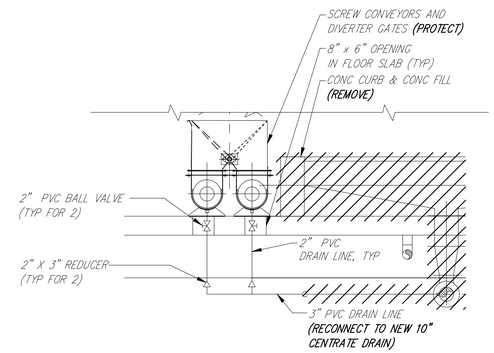
A D-1 SECTION

SCALE: 3/16" = 1'-0"

0 4' 8' 12'

NOTES:

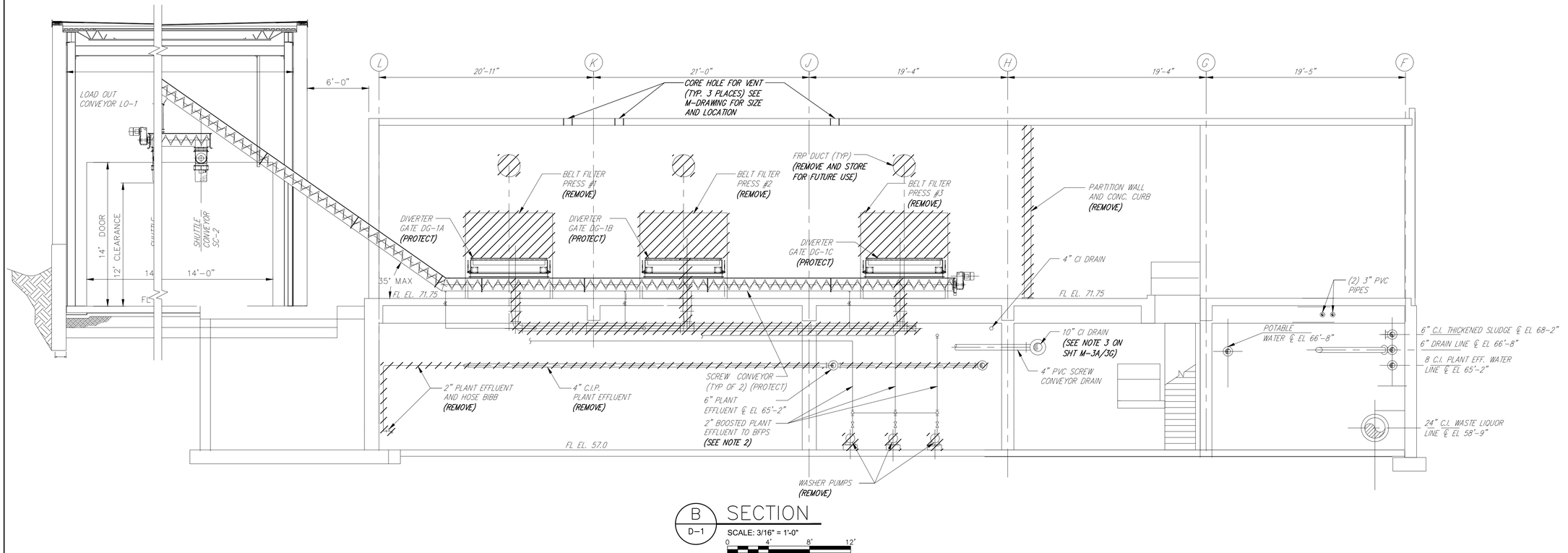
1. NOT ALL PIPING SHOWN FOR CLARITY.
2. DEMOLISH BOOSTED PLANT EFFLUENT SUPPLY PIPING FROM EACH BELT FILTER PRESS TO EACH PUMP, HATCH NOT SHOWN FOR CLARITY.
3. FRP DUCT AND MONORAIL SYSTEM PARTIALLY EXCLUDED FOR CLARITY. REFER TO D-6, D-7 AND D-8 FOR FULL EXTENTS.



CONVEYOR DRAIN LINE DETAIL

SCALE: 3/8" = 1'-0"

0 2' 4' 6'



B D-1 SECTION

SCALE: 3/16" = 1'-0"

0 4' 8' 12'

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CANTON WATER RECLAMATION FACILITY SLUDGE PROCESSING MODIFICATIONS CONTRACT NO. 27

ARCADIS PROJ. NO. AK000343.B002

NO.	DATE	ISSUED FOR	BY

DATE:	MAY 2018
PROJECT NO.:	AK000343.B002
FILE NAME:	D-3
DESIGNED BY:	DAF
DRAWN BY:	TNB
CHECKED BY:	JJW

SHEET TITLE

DEMOLITION

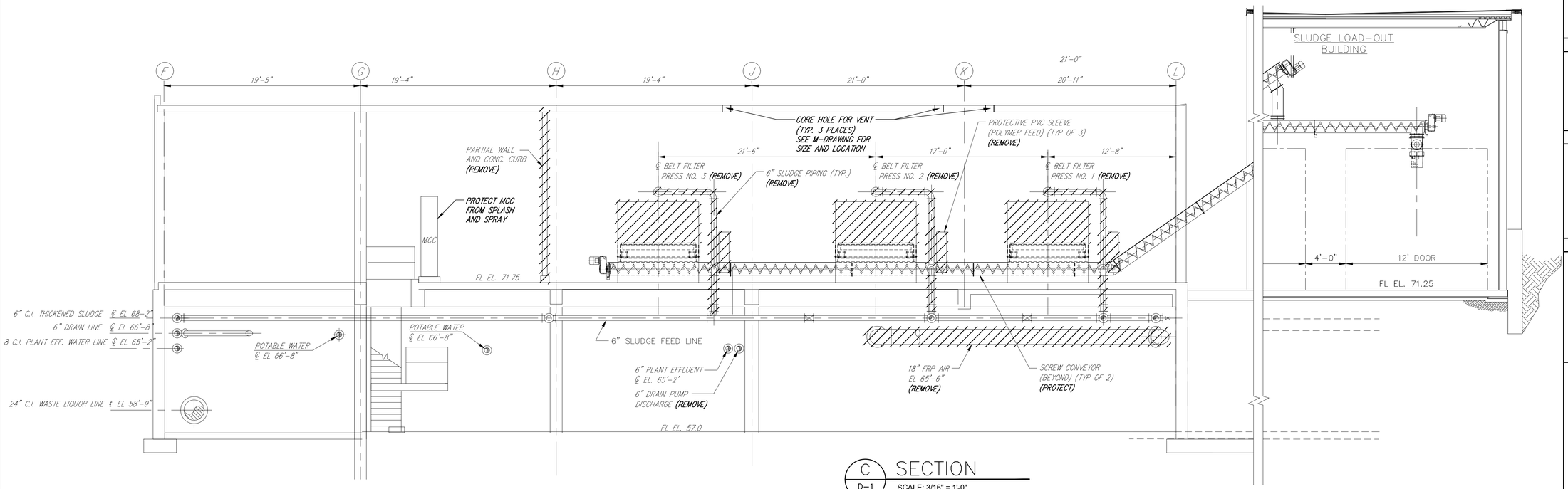
SLUDGE HANDLING BUILDING – ELEVATIONS

SCALE: AS SHOWN

D-3

SHEET 06 OF 61

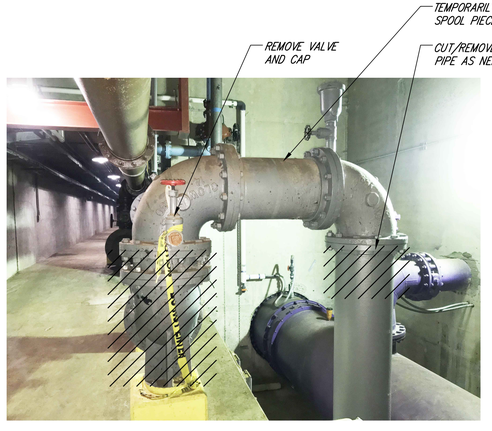
User: YN00655 Spec: AUS-NCSMOD File:I:\WATER\US\JB004316-01_CANTON WRF\E-DRAWINGS\SHEETS\DEMOLISH\D-3.DWG Scale:1:1/2 SavedDate:5/17/2018 Time:17:53 Plot Date: Nimbargikar, Yoginath; 5/17/2018 18:51 ; Layout:06



C / D-1 SECTION

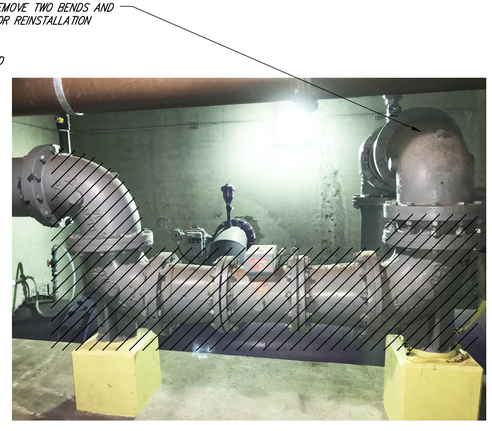
SCALE: 3/16" = 1'-0"

0 4' 8' 12'



14" DRAIN – SOUTH ELEVATION

SCALE: NTS

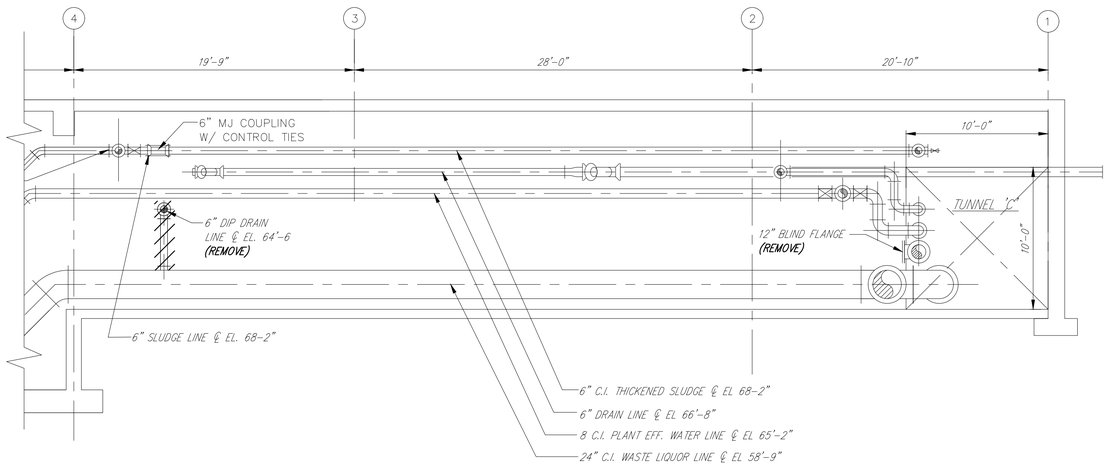


14" DRAIN – WEST ELEVATION

SCALE: NTS

NOTE:

1. CLEAN PIPE INTERIOR SEE NOTE 2 ON SHT. M-5A



BASEMENT SOUTH ELEVATION

SCALE: 3/16" = 1'-0"

0 4' 8' 12'

NOTES:

1. NOT ALL PIPING SHOWN FOR CLARITY.
2. FRP DUCT AND MONORAIL NOT SHOWN FOR CLARITY. REFER TO D-6, D-7 AND D-8 FOR FULL EXTENTS OF DEMOLITION.
3. EX. STRUCTURAL STEEL FRAMING ABOVE BFP'S NOT SHOWN. REFER TO SHT. D-8 FOR ASSOCIATED DEMOLITION WORK.

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SLUDGE PROCESSING MODIFICATIONS
CONTRACT NO. 27

ARCADIS PROJ. NO. AK000343.B002

NO.	DATE	ISSUED FOR	BY

DATE: MAY 2018
PROJECT NO.: AK000343.B002
FILE NAME: D-4
DESIGNED BY: DAF
DRAWN BY: TNB
CHECKED BY: JJW

SHEET TITLE

DEMOLITION

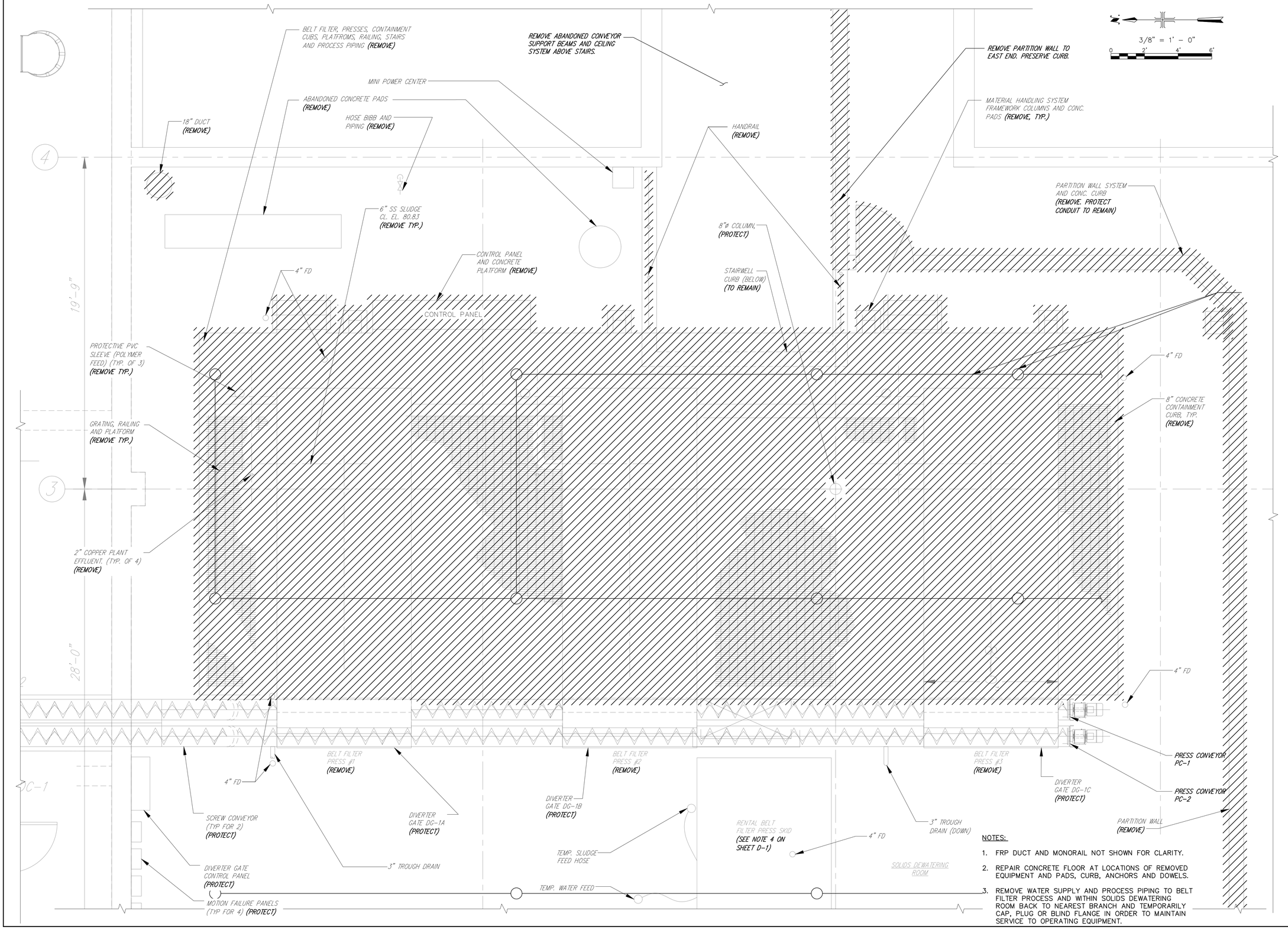
SLUDGE HANDLING BUILDING – SECTIONS

SCALE: AS SHOWN

D-4

SHEET 07 OF 61

User:YNI00655 Spec:AUS-NCSMOD File:I:\WATER\US\JB004316-01_CANTON WRF\E-DRAWINGS\SHEETS\DEMOLISH\D-4.DWG Scale:1:1/2 Saved Date:5/17/2018 Time:12:39 Plot Date: Nimbargikar, Yoginath; 5/17/2018; 14:26 ; Layout:07



NOTES:

1. FRP DUCT AND MONORAIL NOT SHOWN FOR CLARITY.
2. REPAIR CONCRETE FLOOR AT LOCATIONS OF REMOVED EQUIPMENT AND PADS, CURB, ANCHORS AND DOWELS.
3. REMOVE WATER SUPPLY AND PROCESS PIPING TO BELT FILTER PROCESS AND WITHIN SOLIDS DEWATERING ROOM BACK TO NEAREST BRANCH AND TEMPORARILY CAP, PLUG OR BLIND FLANGE IN ORDER TO MAINTAIN SERVICE TO OPERATING EQUIPMENT.

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ARCADIS PROJ. NO. AK000343.B002

NO.	DATE	ISSUED FOR	BY

DATE:	MAY 2018
PROJECT NO.:	AK000343.B002
FILE NAME:	D-5
DESIGNED BY:	DAF
DRAWN BY:	TNB
CHECKED BY:	JJW

SHEET TITLE

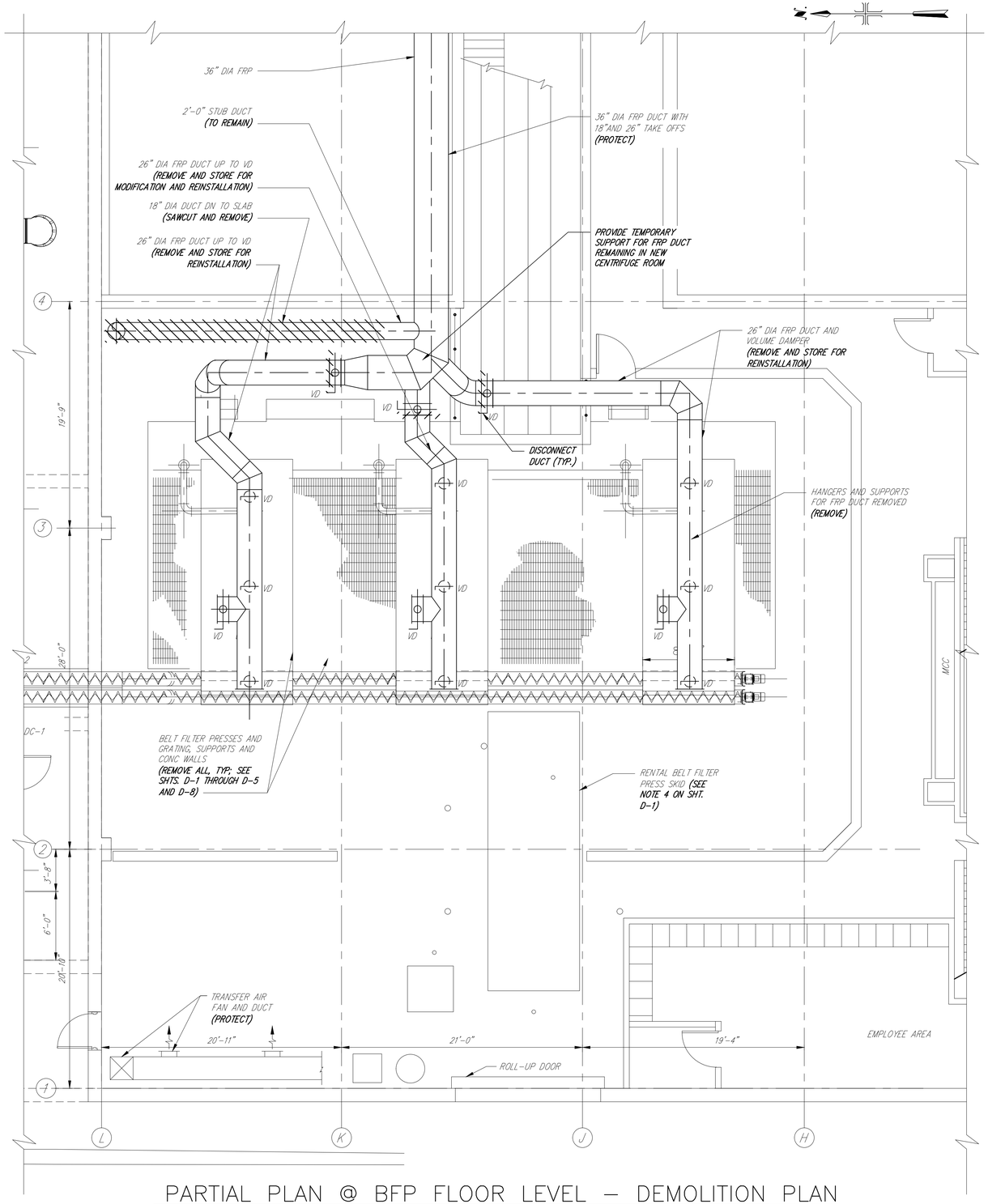
DEMOLITION

SLUDGE HANDLING BUILDING - BELT FILTER PRESS PLAN

SCALE: AS SHOWN

D-5

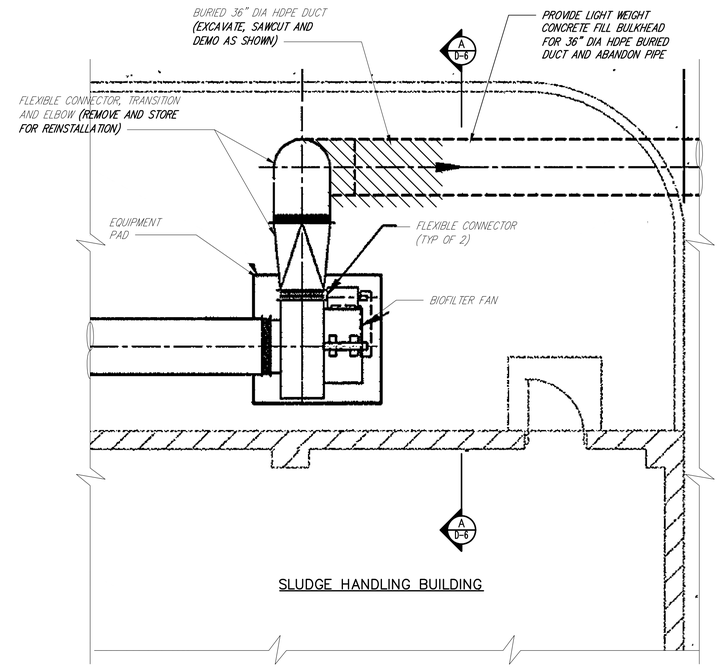
SHEET 08 OF 61



PARTIAL PLAN @ BFP FLOOR LEVEL – DEMOLITION PLAN

SCALE: 3/16" = 1'-0"

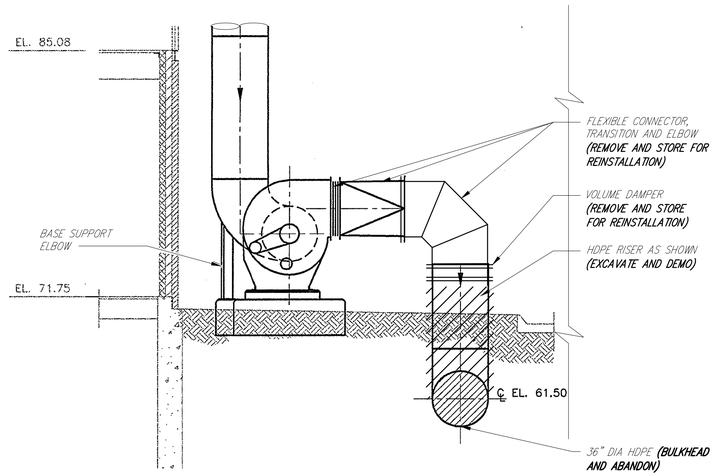
0 4" 8" 12"



PARTIAL PLAN AT BIOFILTER FAN

SCALE: 1/□" = 1'-0"

0 2' 4' 8'



A D-6 SECTION

SCALE: 1/□" = 1'-0"

0 2' 4' 8'

NOTE:

1. PROVIDE TEMPORARY DISCHARGE HOOD AND REBALANCE FAN TO 11,000 CFM.

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CONTRACT NO. 27

ARCADIS PROJ. NO. AK000343.B002

NO.	DATE	ISSUED FOR	BY

DATE: MAY 2018
PROJECT NO.: AK000343.B002
FILE NAME: D-6
DESIGNED BY: DJO
DRAWN BY: TNB
CHECKED BY: JJW

SHEET TITLE

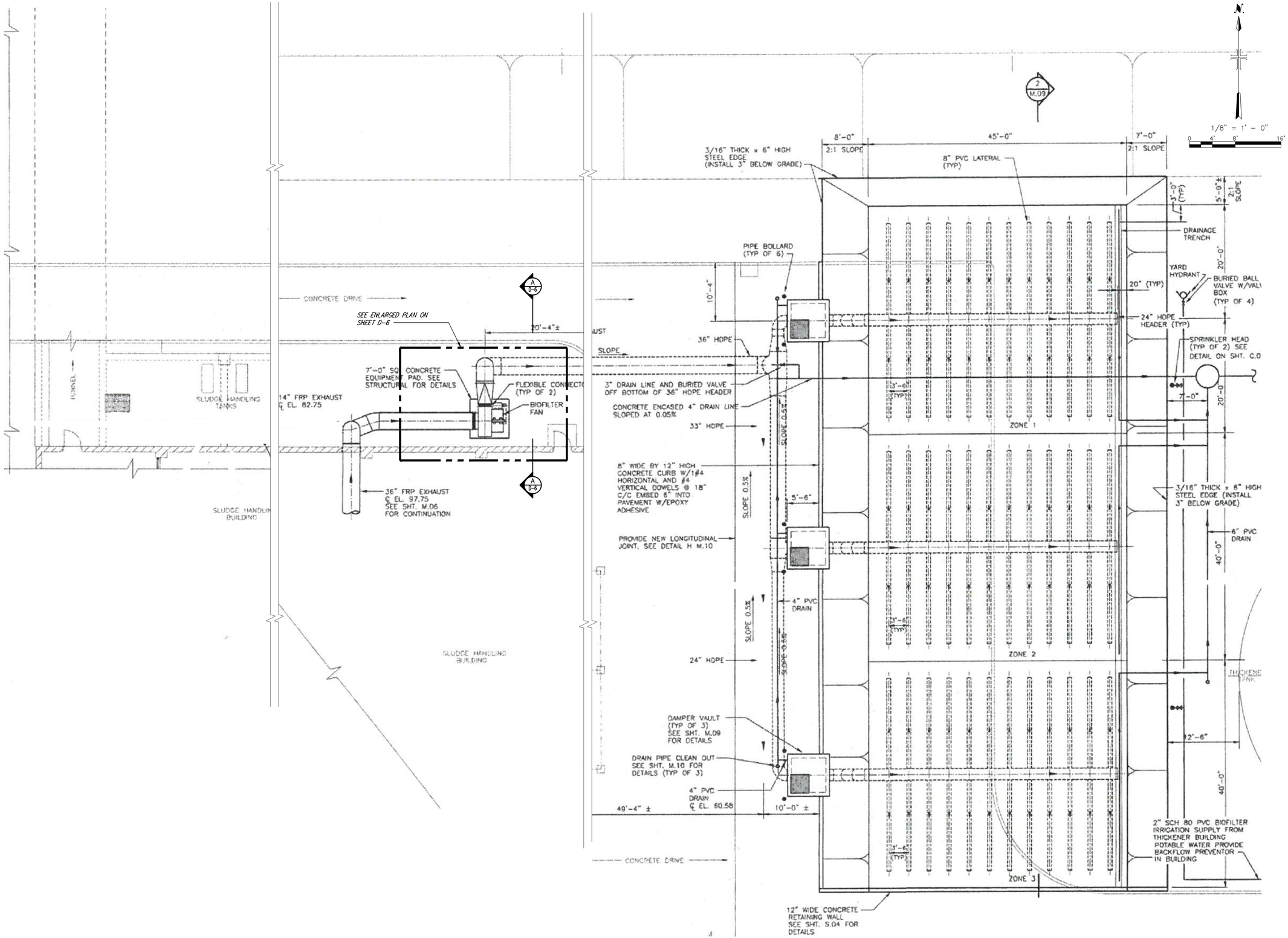
DEMOLITION

SLUDGE DEWATERING BUILDING HVAC MODIFICATIONS

SCALE: AS SHOWN

D-6

SHEET 09 OF 61



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SLUDGE PROCESSING MODIFICATIONS
CONTRACT NO. 27

ARCADIS PROJ. NO. AK000343.B002

NO.	DATE	ISSUED FOR	BY

DATE:	MAY 2018
PROJECT NO.:	AK000343.B002
FILE NAME:	D-7
DESIGNED BY:	DAF
DRAWN BY:	TNB
CHECKED BY:	JJW

SHEET TITLE

DEMOLITION

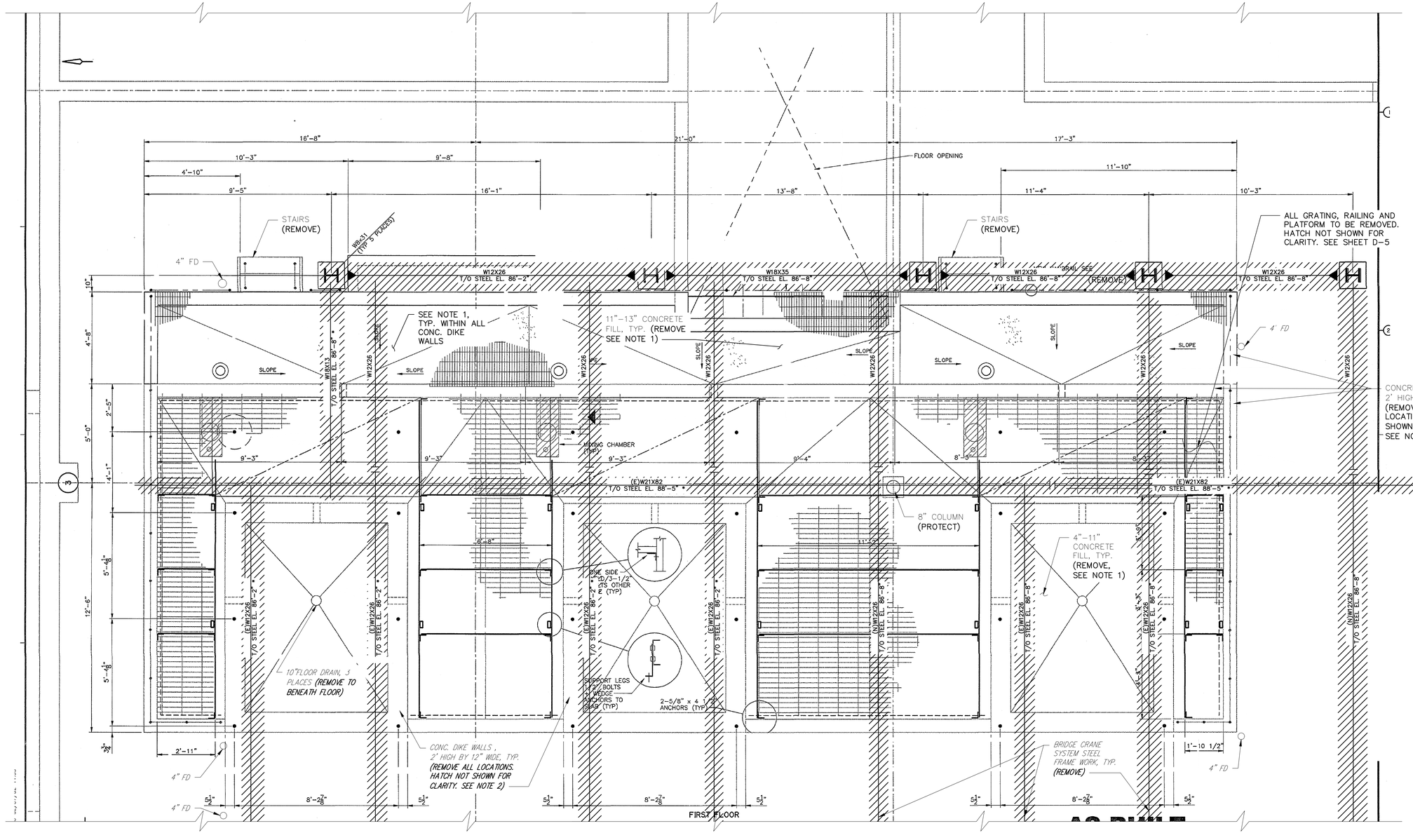
HVAC MODIFICATIONS

SCALE: AS SHOWN

D-7

SHEET 10 OF 61

User:SPI00654 Spec:AUS-NCSMOD File:I:\WATER\US\UB000316-01_CANTON WRF\E-DRAWINGS\SHEETS\DEMOLISH\D-7.DWG Scale:1:1/2 SavedDate:4/18/2018 Time:15:41 Plot Date: Nimbargikar, Yognath; 5/17/2018; 14:38 ; Layout:10



SLUDGE DEWATERING BUILDING – BFP PLATFORM, DIKE WALLS AND BRIDGE CRANE

SCALE: 3/8" = 1'-0"

0 2' 4' 6'

NOTES:

1. REMOVE ALL CONCRETE FILL TO FINISH FLOOR.
2. BURN OFF ANY REMAINING DOWELS, ANCHOR BOLTS OR REINFORCING STEEL TO 1 INCH BELOW SURROUNDING SURFACE.

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ARCADIS PROJ. NO. AK000343.B002

NO.	DATE	ISSUED FOR	BY

DATE: MAY 2018
PROJECT NO.: AK000343.B002
FILE NAME: D-8
DESIGNED BY: DAF
DRAWN BY: TNB
CHECKED BY: JJW

SHEET TITLE

DEMOLITION

SLUDGE DEWATERING BUILDING – BFP PLATFORM, DIKE WALLS AND BRIDGE CRANE

SCALE: AS SHOWN

D-8

SHEET 11 OF 61

A. STRUCTURAL STEEL NOTES:

1. MATERIAL
   WIDE FLANGE SHAPES: ASTM A992.
   S SHAPES CHANNELS AND HP SHAPES: ASTM A572 GR 50.
   ANGLES, PLATES, AND BARS: ASTM A36.
   PIPE: ASTM A53 GR B.
   HOLLOW STRUCTURAL SECTIONS (HSS): ASTM A1085.

2. WELDING
   WELDING SHALL CONFORM TO AWS D1.1, STRUCTURAL WELDING CODE – STEEL.
   ELECTRODES: E70XX.

3. BOLTED CONNECTIONS
   BOLTS – 3/4ø ASTM A325 TYPE 1, WITH ASTM A563 C HEAVY HEX NUTS AND F436 WASHERS UNLESS OTHERWISE NOTED.
   HOLES – 13/16"ø FOR 3/4"ø BOLTS UNLESS OTHERWISE NOTED.
   SLOTTED HOLES – 13/16" X 1 7/8" FOR 3/4"ø BOLTS ONLY WHERE NOTED.
   BOLTS DESIGNATED SC ARE SLIP CRITICAL AND SHALL BE INSTALLED AS PER RCSC SPECIFICATION WITH A CLASS A SURFACE CONDITION.
   ALL OTHER BOLTS SHALL BE PRE–TENSIOINED AND SHALL BE INSTALLED AS PER RCSC SPECIFICATION.

4. ADHESIVE ANCHORS
   CONCRETE – HILTI RE500–V3 OR HILTI HY200–SD SYSTEM OR EQUAL.
   SOLID OR HOLLOW MASONRY – HILTI HY 70 SYSTEM OR EQUAL.
   THREADED RODS SHALL BE ASTM F593 (AISI 304 CW) STAINLESS.

5. PAINT
   ALL STRUCTURAL STEEL SHALL BE PRIME AND FINISH PAINTED AS PER SPECIFICATION SECTION 09 91 00.
   MONORAIL TRACK GIRDERS SHALL BE 'OSHA SAFETY YELLOW' WITH MAXIMUM CAPACITY STENCILED IN BLACK ON BOTH SIDES IN 5 INCH HIGH BLOCK LETTERING. NO PAINT ON WHEEL CONTACT SURFACE OF MONORAIL TRACK.
   NO PAINT WITHIN 2 INCHES OF FIELD WELDS OR HOLES FOR SLIP CRITICAL CONNECTIONS.

B. CONCRETE NOTES:

1. DETAILS, WORKMANSHIP, AND GENERAL PROCEDURE SHALL CONFORM TO ACI 318, ACI 315, ACI 301, ACI 350, ACI SP66 DETAILING MANUAL, AND CRSI MANUAL OF STANDARD PRACTICE, UNLESS OTHERWISE NOTED.

2. MINIMUM COMPRESSIVE STRENGTH AT 28 DAYS – 4,500 PSI.

3. BAR REINFORCING – ASTM A615 GRADE 60.

4. WELDED WIRE FABRIC REINFORCING – ASTM A185.

5. ALL LAP SPLICES SHALL BE CLASS B OR AS SHOWN.

6. PROVIDE 3/4" X 3/4" CHAMFER ON ALL EXPOSED CORNERS.

7. CONCRETE COVER OVER REINFORCING (CAST IN PLACE):

CONCRETE CAST AGAINST EARTH	3"
CONCRETE EXPOSED TO EARTH OR WEATHER:	
#6 BARS AND LARGER	2"
#5 BARS AND SMALLER	1 1/2"
CONCRETE NOT EXPOSED TO EARTH OR WEATHER:	
SLAB, JOIST AND WALL REINFORCING	3/4"
BEAM AND COLUMN PRIMARY REINFORCEMENT, STIRRUPS AND TIES	1 1/2"

8. COAT ALL EXPOSED SAWCUT CONCRETE SURFACES WITH 2 COATS SIKAGARD 62 OR EQUAL.

9. PROVIDE WWF 4 X 4 – W9 X W9 IN ALL FILL CONCRETE.

10. PULTRUDED CARBON FIBER REINFORCED POLYMER (CFRP) LAMINATE FOR STRENGTHENING EXISTING CONCRETE BEAMS SHALL BE SIKA CARBODUR S1012 BONDED TO EXISTING CONCRETE BEAMS WITH SIKADUR 30 EPOXY RESIN. INSTALLATION SHALL BE IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS. EXISTING BEAMS REQUIRING STRENGTHENING ARE SHOWN ON THE DRAWINGS. THIS WORK IS TO BE DONE AFTER THE CENTRIFUGES ARE IN THEIR FINAL POSITION.

C. ALUMINUM NOTES:

1. MATERIAL AND ALLOY:
   ALL SHAPES, EXTRUSIONS, PLATES AND BARS SHALL BE 6061–T6.
   PIPE RAILING SHALL BE SCHEDULE 40, 6061–T6, 6063–T5, OR 6063–T6.
   RAILING POSTS SHALL BE SCHEDULE 80, 6061–T6. SPACE RAIL POSTS 4'–0" MAXIMUM.

2. BOLTS
   ALL BOLTS ASTM F593, AISI 304–CW STAINLESS; 3/4"ø UNLESS NOTED OTHERWISE.
   ALL HOLES 13/16"ø UNLESS NOTED OTHERWISE.

4. BAR GRATING:
   1 1/2" X 3/16" ALUMINUM, TYPE GIA–150 BY McNICOLS OR EQUAL.
   BEARING BAR SPACING – 1 3/16"
   CROSS BAR SPACING – 4".

D. CENTRIFUGE INSTALLATION:

1. CONTRACTOR SHALL SUBMIT AN INSTALLATION PLAN DEFINING THE PROPOSED PROCEDURE FOR BRINGING THE CENTRIFUGES INTO THE BUILDING AND SETTING THEM IN THE FINAL POSITION. IT IS THE CONTRACTOR'S RESPONSIBILITY TO TAKE ALL MEASURES TO AVOID OVERLOADING THE EXISTING STRUCTURE DURING INSTALLATION. PLAN SHALL INCLUDE DRAWINGS AND CALCULATIONS AS NECESSARY, PREPARED BY, SIGNED AND SEALED BY A LICENSED PROFESSIONAL ENGINEER REGISTERED TO PRACTICE IN THE SAME STATE AS THE SITE.

LEGEND

UNDISTURBED SOIL
ROCK
SELECT BACKFILL
BAR GRATING
STEEL
CHECKERED PLATE
BRICK MASONRY
CONCRETE MASONRY
CONCRETE
GROUT
RIGID INSULATION
BATT INSULATION

ABBREVIATIONS

A.B.	ANCHOR BOLT	I.D.	INSIDE DIAMETER
ADJ.	ADJUSTABLE	I.F.	INSIDE FACE
ADD'L	ADDITIONAL	INV	INVERT
AFF	ABOVE FINISHED FLOOR		
AL	ALUMINUM		
ALT	ALTERNATE	JT	JOINT
ALUM.	ALUMINUM		
APPROX	APPROXIMATE	K.	KIP (1000 POUNDS)
ARCH	ARCHITECTURAL	K.O.	KNOCK OUT
B/	BOTTOM OF, BACK OF		
B / B	BACK TO BACK	L	ANGLE (STRUCTURAL SHAPE)
BAL	BALANCE	LB	POUND
BETW	BETWEEN	LG.	LONG
BITUM.	BITUMINOUS	L.L.	LIVE LOAD
B.L.	BUILDING LINE	LLH	LONG LEG HORIZONTAL
BLDG	BUILDING	LLV	LONG LEG VERTICAL
BLK	BLOCK	LLBB	LONG LEGS BACK TO BACK
BM	BEAM	LLO	LONG LEGS OUTSTANDING
BOT	BOTTOM	LOC	LOCATION
B PL	BASE PLATE	LONG.	LONGITUDINAL
BRG	BEARING	L.P.	LOW POINT
BUR	BUILT UP ROOF	L.W.	LONG WAY, LIGHT WEIGHT
BSMT.	BASEMENT		
		MAS	MASONRY
C	CHANNEL STRUCTURAL SHAPE	MAX	MAXIMUM
CANT'L	CANTILEVER	MECH	MECHANICAL
C.J.	CONSTRUCTION JOINT	MFR	MANUFACTURE, MANUFACTURER
	CONTROL JOINT	M.H.	MANHOLE
CLR	CLEAR	MID	MIDDLE
℄	CENTERLINE	MIN	MINIMUM
C.M.U.	CONCRETE MASONRY UNIT	MK.	MARK
COL	COLUMN	MO	MASONRY OPENING
COMP	COMPRESSIBLE	N	NORTH
CONC	CONCRETE	NA	NOT APPLICABLE
CONN	CONNECTION	N.F.	NEAR FACE
CONST	CONSTRUCTION	NO.	NUMBER
CONT	CONTINUOUS	N.T.S.	NOT TO SCALE
CSTG	CASTING		
C/C	CENTER TO CENTER	O.C.	ON CENTER
CTR	CENTER	O.D.	OUTSIDE DIAMETER
		O.F.	OUTSIDE FACE
DET	DETAIL	OH.	OVERHEAD
DFT	DRY FILM THICKNESS	OPNG	OPENING
DIA	DIAMETER	OPP	OPPOSITE
DIAG	DIAGONAL		
DIM	DIMENSION	P.C.O.	PILE CUT OFF
DIST.	DISTANCE	ℙ	PLATE
DL	DEAD LOAD	P.S.F.	POUNDS PER SQUARE FOOT
DN	DOWN	PVC	POLYVINYL CHLORIDE
do	DITTO		
DP	DEEP	R	RADIUS, RISER
DWG	DRAWING	R.D.	ROOF DRAIN
DWL	DOWEL	REINF	REINFORCEMENT
		REQD	REQUIRED
E	EAST	RM	ROOM
EA	EACH	R.O.	ROUGH OPENING
E.F.	EACH FACE		
E.J.	EXPANSION JOINT	S	SOUTH
EL	ELEVATION	SCHED.	SCHEDULE
ELEC	ELECTRICAL	SECT	SECTION
EMB	EMBEDMENT, EMBEDDED	SF	SQUARE FEET
ENCL	ENCLOSURE	SHT	SHEET
EQ	EQUAL	SIM	SIMILAR
EQP	EQUIPMENT	SL	SLAB
E.S.	EACH SIDE	SLV	SHORT LEG VERTICAL
E.W.	EACH WAY	SLBB	SHORT LEGS BACK TO BACK
E.W. T&B	EACH WAY TOP & BOTTOM	SLO	SHORT LEGS OUTSTANDING
EXIST	EXISTING	SP	SPIRAL
EXP	EXPANSION	SPA.	SPACES OR SPACING
EXT	EXTERIOR	SPEC	SPECIFICATION
		SQ	SQUARE
F.B.	FLOOR BEAM	SUP.	SUPPORT
F.D.	FLOOR DRAIN	S.STL.	STAINLESS STEEL
FDN	FOUNDATION	STD	STANDARD
FE	FIRE EXTINGUISHER	STIR	STIRRUP
F.F.	FAR FACE	STL	STEEL
FIN	FINISH	STR	STRUCTURAL
FL	FLOOR	S.W.	SHORT WAY
FRP	FIBERGLASS REINFORCED PLASTIC	SYM.	SYMMETRICAL
FT	FOOT		
FTG	FOOTING		
		T&B	TOP AND BOTTOM
GA	GAGE	TEMP.	TEMPORARY
GALV	GALVANIZE	THK.	THICK
G.B.	GRADE BEAM	TOC	TOP OF CONCRETE
GR	GRADE	TOM	TOP OF MASONRY
GRD.	GROUND	TOS	TOP OF STEEL
GRTG	GRATING	THK	THICK
GYP BD	GYPSUM BOARD	T/	TOP OF
		TR	TREAD
H	HIGH	TYP	TYPICAL
HGT	HEIGHT		
HOR	HORIZONTAL	U.O.N.	UNLESS OTHERWISE NOTED
H.P.	HIGH POINT		
HR.	HANDRAIL	VERT	VERTICAL
H.S.	HIGH STRENGTH		
HSS	HOLLOW STRUCTURAL SECTION	W	WIDE FLANGE STRUCTURAL SHAPE, WIDTH, WEST
HT.	HEIGHT		
HVAC	HEATING, VENTILATING & AIR CONDITIONING	W/	WITH
		W/O	WITHOUT
		WP	WORK POINT
INSUL.	INSULATION	WT.	WEIGHT
INT.	INTERIOR	WSE	WATER SURFACE ELEVATION

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ARCADIS U.S., INC.

CONSULTANTS

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Matthew A. Palte
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REGISTERED PROFESSIONAL ENGINEER
5-2-2018

CITY OF CANTON

CANTON WATER RECLAMATION FACILITY SLUDGE PROCESSING MODIFICATIONS CONTRACT NO. 27

ARCADIS PROJ. NO. AK000343.B002

NO.	DATE	ISSUED FOR	BY

DATE:	MAY 2018
PROJECT NO.:	AK000343.B002
FILE NAME:	S–001
DESIGNED BY:	DiCORSO
DRAWN BY:	DiCORSO
CHECKED BY:	PALTE

SHEET TITLE

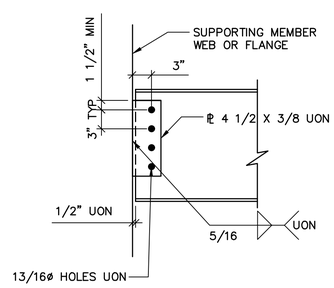
STRUCTURAL

GENERAL NOTES ABBREVIATIONS & TYPICAL DETAILS

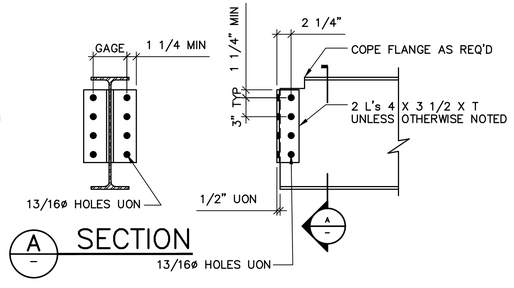
SCALE: NONE

S–1

SHEET 12 OF 61



SINGLE PLATE CONNECTION



DOUBLE ANGLE CONNECTION

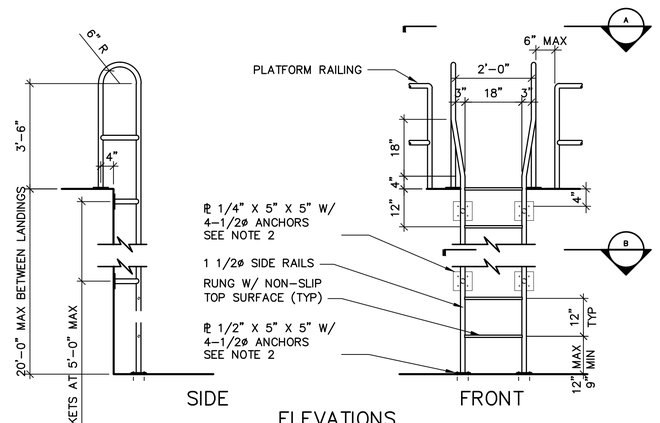
BEAM CONNECTION SCHEDULE

SECTION	N ROWS BOLTS	ANGLE T	REMARKS
C6	2	1/4	ONE ANGLE UON
W8	2	1/4	
W10	2	1/4	
S12	3	1/4	SC CONNECTION W/ SLOTTED HOLES AS SHOWN

NOTES:
1. PROVIDE "N" ROWS 3/4"ø A325 BOLTS. SEE TABLE.
2. ALL BOLTS SHALL BE PRE-TENSIONED.
3. CONNECTIONS SHALL BE SLIP CRITICAL WHERE NOTED 'SC'.
4. PROVIDE SLOTTED HOLES WHERE SHOWN.
5. SEE GENERAL NOTES FOR ADDITIONAL REQUIREMENTS.

TYPICAL BOLTED BEAM CONNECTIONS

1"=1'-0"



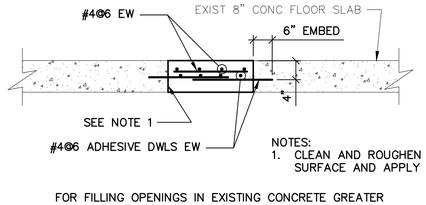
ELEVATIONS

NOTES:
1. DETAILS ARE FOR GENERAL CONFIGURATION ONLY. CONTRACTOR SHALL SUBMIT DETAILED SHOP FABRICATION DRAWINGS SHOWING CONFORMANCE WITH OSHA AND ALL APPLICABLE LAWS AND REGULATIONS.
2. COORDINATE ANCHOR TYPES WITH THE SUPPORTING STRUCTURE. USE BE MACHINE BOLTS FOR STEEL, AND ADHESIVE OR EXPANSION BOLTS FOR CONCRETE OR MASONRY.

LADDER DETAILS

STEEL OR ALUMINUM

1/2"=1'-0"

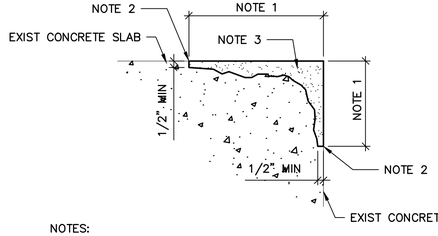


NOTES:
1. CLEAN AND ROUGHEN EXISTING CONC SURFACE AND APPLY BONDING AGENT.

FOR FILLING OPENINGS IN EXISTING CONCRETE GREATER THAN 12 INCHES BUT LESS THAN 20 INCHES

TYP CONC INFILL DETAIL

1/2"=1'-0"



NOTES:

1. REMOVE ALL DETERIORATED CONCRETE TO SOUND CONCRETE. CHIP CONCRETE SUBSTRATE TO OBTAIN A SURFACE PROFILE OF 1/8 INCH IN DEPTH WITH A NEW FRACTURED AGGREGATE SURFACE.

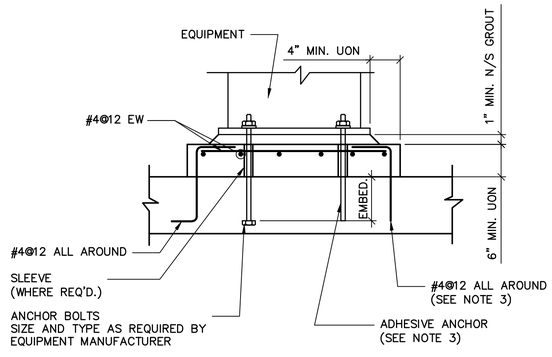
2. SAWCUT EXISTING CONCRETE AS REQUIRED 1 INCH OUTSIDE SPALLED AREA, TO A DEPTH OF 1/2 INCH.

3. COAT EXISTING EXPOSED REINFORCING WITH ANTI-CORROSION COATING AND APPLY NEW REPAIR MORTAR IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS.

4. FOR COST ESTIMATING PURPOSES, ASSUME EACH AREA OF REPAIR IS A MINIMUM OF 1 SQUARE FOOT.

REPAIR OF SPALLED CONCRETE

(NTS)



NOTES:
1. PROVIDE SUPPORT PAD FOR ALL EQUIPMENT UON.
2. COORDINATE LOCATION AND SIZE OF PAD WITH OTHER DISCIPLINES' DRAWINGS AND WITH EQUIPMENT MANUFACTURERS' DRAWINGS.
3. FOR EXISTING SLABS, PROVIDE ADHESIVE ANCHORAGE SYSTEM IN CONFORMANCE WITH EQUIPMENT MANUFACTURERS' REQUIREMENTS.

TYPICAL EQUIPMENT PAD DETAIL

NOT TO SCALE

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PROFESSIONAL ENGINEER
5-2-2018

CITY OF CANTON

CANTON WATER RECLAMATION FACILITY SLUDGE PROCESSING MODIFICATIONS CONTRACT NO. 27

ARCADIS PROJ. NO. AK000343.B002

NO.	DATE	ISSUED FOR	BY

DATE: MAY 2018
PROJECT NO.: AK000343.B002
FILE NAME: S-002
DESIGNED BY: DiCORSO
DRAWN BY: DiCORSO
CHECKED BY: PALTE

SHEET TITLE

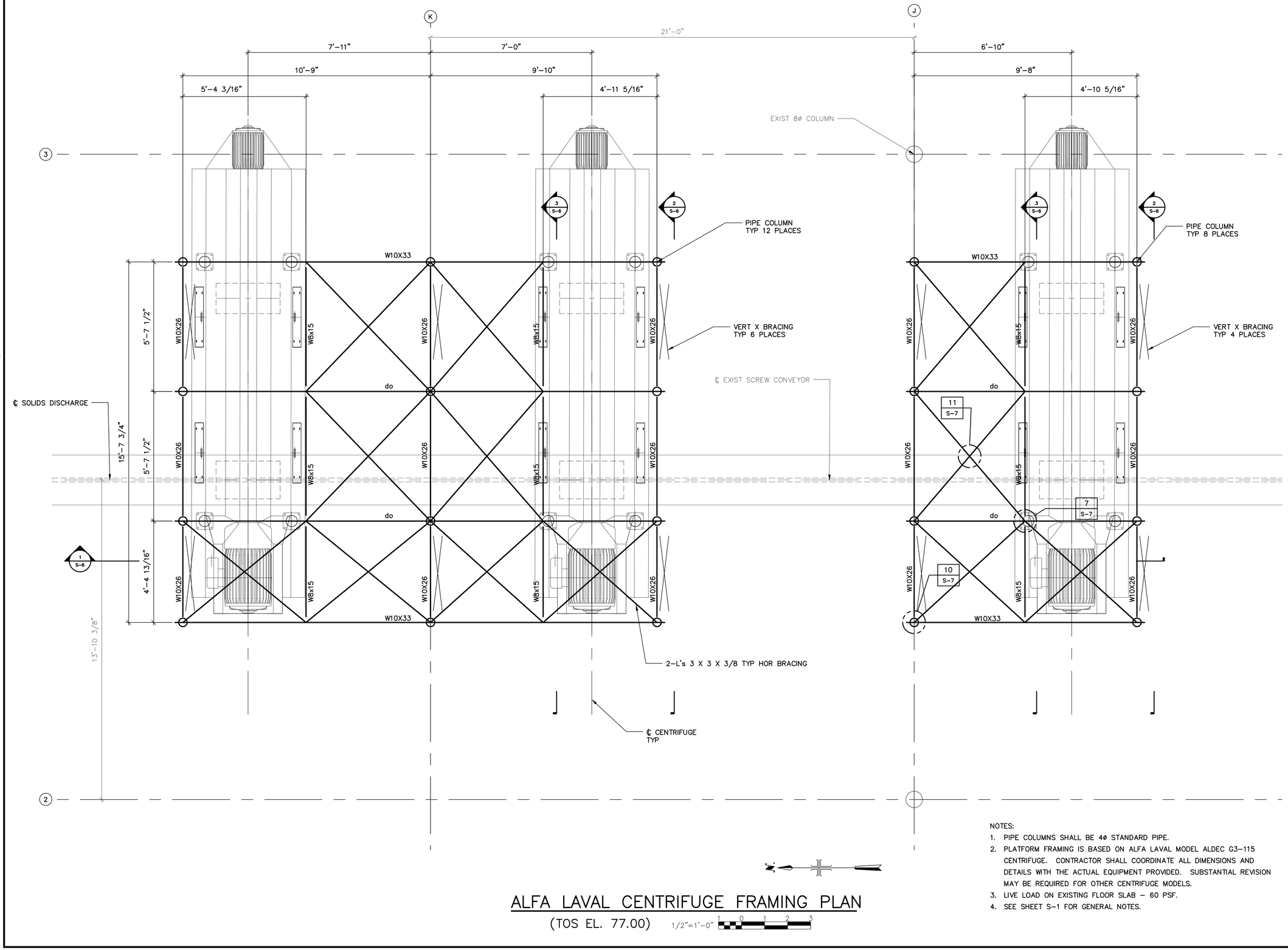
STRUCTURAL

TYPICAL DETAILS

SCALE: AS SHOWN

S-2

SHEET 13 OF 61



ALFA LAVAL CENTRIFUGE FRAMING PLAN

(TOS EL. 77.00) 1/2"=1'-0"

NOTES:

1. PIPE COLUMNS SHALL BE 4ø STANDARD PIPE.
2. PLATFORM FRAMING IS BASED ON ALFA LAVAL MODEL ALDEC G3-115 CENTRIFUGE. CONTRACTOR SHALL COORDINATE ALL DIMENSIONS AND DETAILS WITH THE ACTUAL EQUIPMENT PROVIDED. SUBSTANTIAL REVISION MAY BE REQUIRED FOR OTHER CENTRIFUGE MODELS.
3. LIVE LOAD ON EXISTING FLOOR SLAB – 60 PSF.
4. SEE SHEET S-1 FOR GENERAL NOTES.

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5-2-2018

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CANTON WATER RECLAMATION FACILITY SLUDGE PROCESSING MODIFICATIONS CONTRACT NO. 27

ARCADIS PROJ. NO. AK000343.B002

NO.	DATE	ISSUED FOR	BY

DATE:	MAY 2018
PROJECT NO.:	AK000343.B002
FILE NAME:	S-101A
DESIGNED BY:	DiCORSO
DRAWN BY:	DiCORSO
CHECKED BY:	PALTE

SHEET TITLE

STRUCTURAL

SLUDGE HANDLING BUILDING

FIRST FLOOR PLAN

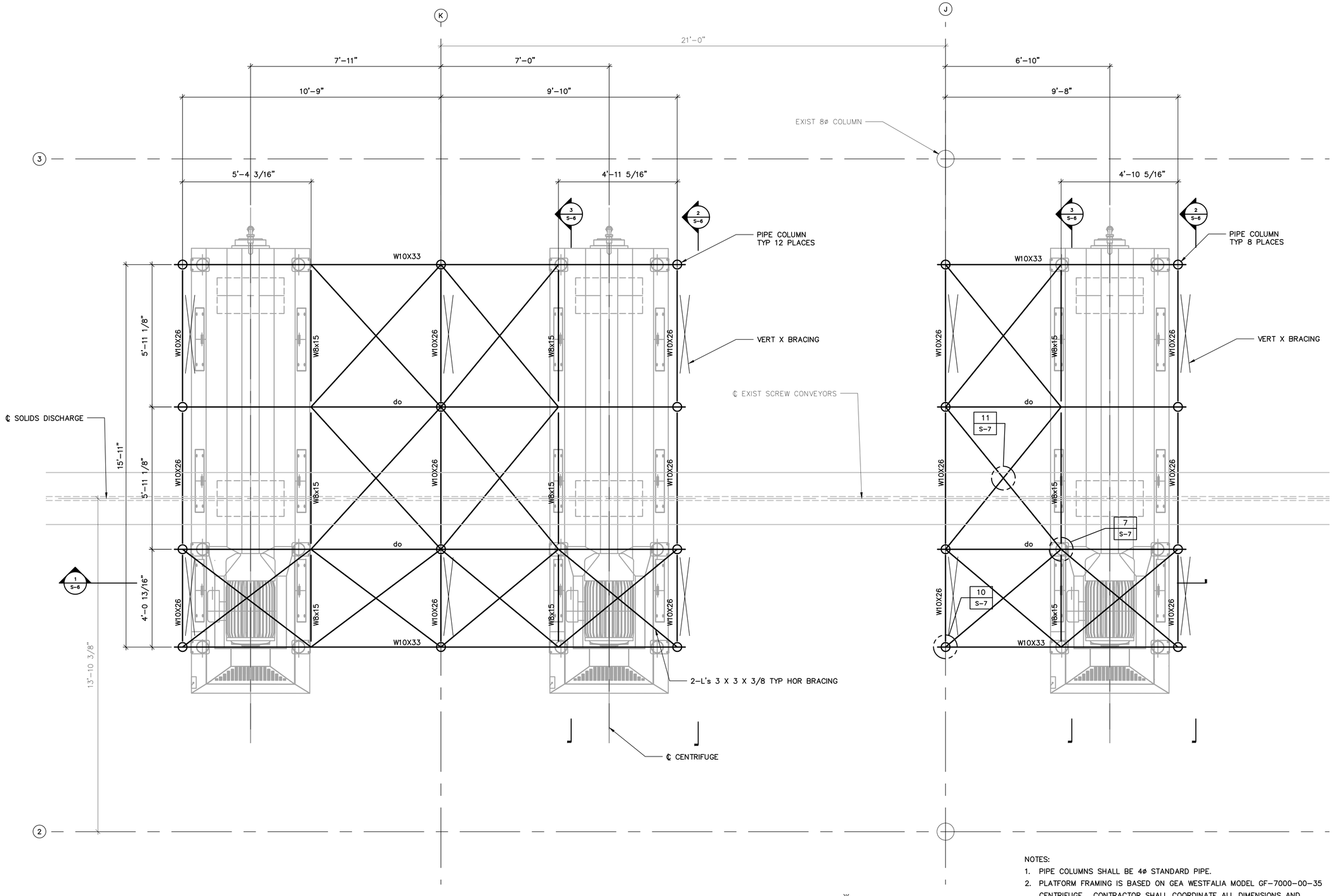
ALFA LAVAL

SCALE: 1/2" = 1'-0"

S-3A

SHEET 14 OF 61

User:DiCORSO Spec:AUS-NCSMOD File:G:\PROJECTS\AK000343.R001CANTON\CADD\STRUCT\S-101A.DWG Scale:1:1 SavedDate:4/20/2018 Time:07:34 Plot Date: DiCorso, Paul; 5/10/2018; 09:33 ; Layout:14



NOTES:

1. PIPE COLUMNS SHALL BE 4ø STANDARD PIPE.
2. PLATFORM FRAMING IS BASED ON GEA WESTFALIA MODEL GF-7000-00-35 CENTRIFUGE. CONTRACTOR SHALL COORDINATE ALL DIMENSIONS AND DETAILS WITH THE ACTUAL EQUIPMENT PROVIDED. SUBSTANTIAL REVISION MAY BE REQUIRED FOR OTHER CENTRIFUGE MODELS.
3. LIVE LOAD ON EXISTING FLOOR SLAB – 60 PSF.
4. SEE SHEET S-1 FOR GENERAL NOTES.

GEA CENTRIFUGE FRAMING PLAN

(TOS EL. 77.00) 1/2"=1'-0"

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5-2-2018

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CANTON WATER RECLAMATION FACILITY
SLUDGE PROCESSING MODIFICATIONS
CONTRACT NO. 27

ARCADIS PROJ. NO. AK000343.B002

NO.	DATE	ISSUED FOR	BY

DATE: MAY 2018
PROJECT NO.: AK000343.B002
FILE NAME: S-101
DESIGNED BY: DiCORSO
DRAWN BY: DiCORSO
CHECKED BY: PALTE

SHEET TITLE

STRUCTURAL

SLUDGE HANDLING BUILDING

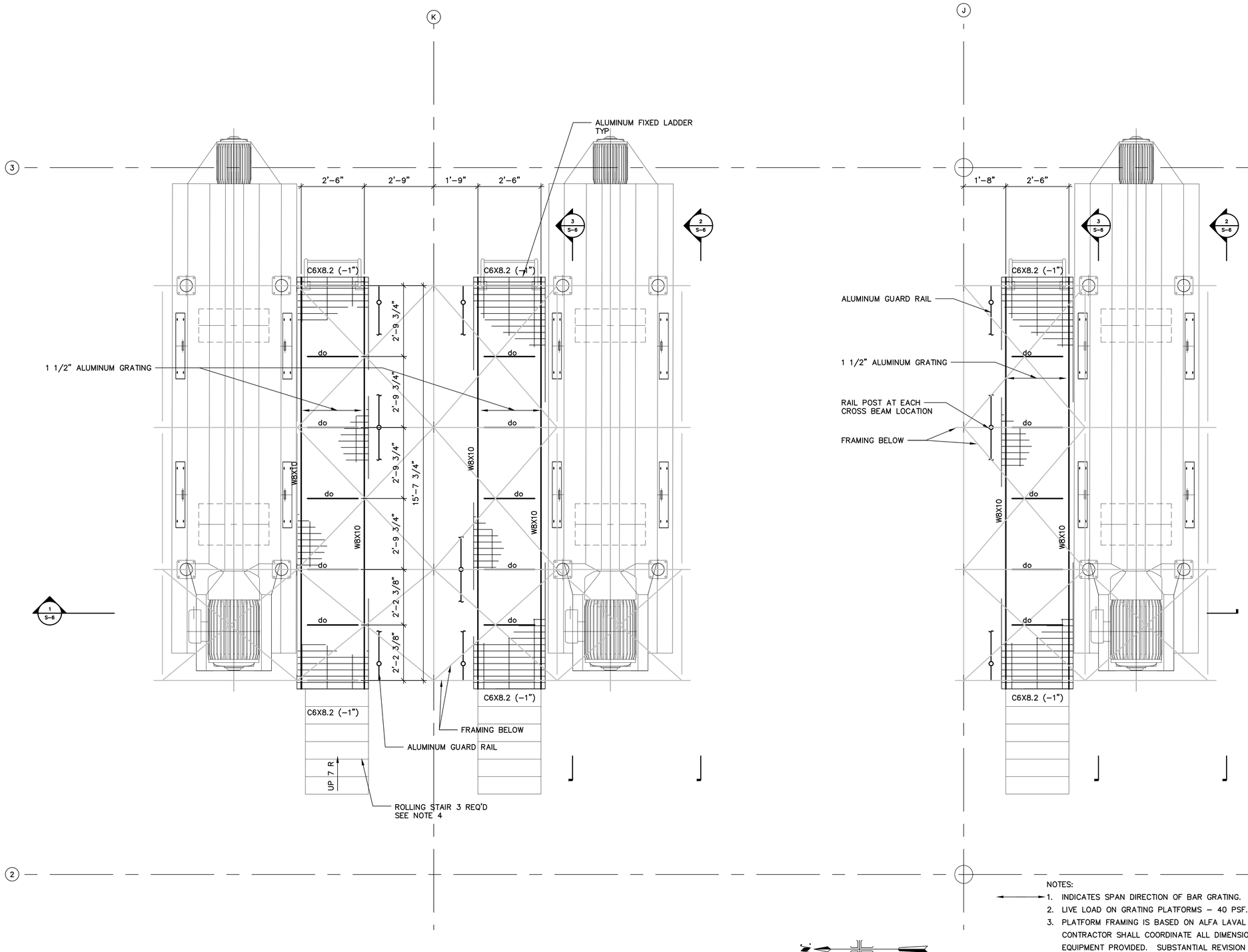
FIRST FLOOR PLAN

GEA

SCALE: 1/2" = 1'-0"

S-3G

SHEET 15 OF 61



ALFA LAVAL CENTRIFUGE ACCESS PLATFORM FRAMING PLAN

(TOS EL. 77.66)

1/2"=1'–0"

NOTES:

1. INDICATES SPAN DIRECTION OF BAR GRATING.
2. LIVE LOAD ON GRATING PLATFORMS – 40 PSF.
3. PLATFORM FRAMING IS BASED ON ALFA LAVAL MODEL ALDEC G3–115 CENTRIFUGE. CONTRACTOR SHALL COORDINATE ALL DIMENSIONS AND DETAILS WITH THE ACTUAL EQUIPMENT PROVIDED. SUBSTANTIAL REVISION MAY BE REQUIRED FOR OTHER CENTRIFUGE MODELS.
4. ROLLING STAIR SHALL BE MODEL NO. RWSR107246–XR WITH PERFORATED STEEL TREADS, 70 INCH PLATFORM HEIGHT AND STEP LOCK, BY TRI–ARC, AVAILABLE THROUGH GRAINGER, OR EQUAL. COMPLY WITH ALL APPLICABLE OSHA AND ANSI STANDARDS.
5. SEE SHEET S–1 FOR GENERAL NOTES.

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LEGAL ENTITY:
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REGISTERED PROFESSIONAL ENGINEER
5-2-2018

CITY OF CANTON

CANTON WATER RECLAMATION FACILITY SLUDGE PROCESSING MODIFICATIONS CONTRACT NO. 27

ARCADIS PROJ. NO. AK000343.B002

NO.	DATE	ISSUED FOR	BY

DATE:	MAY 2018
PROJECT NO.:	AK000343.B002
FILE NAME:	S–102A
DESIGNED BY:	DiCORSO
DRAWN BY:	DiCORSO
CHECKED BY:	PALTE

SHEET TITLE

STRUCTURAL

SLUDGE HANDLING BUILDING

FIRST FLOOR PLAN

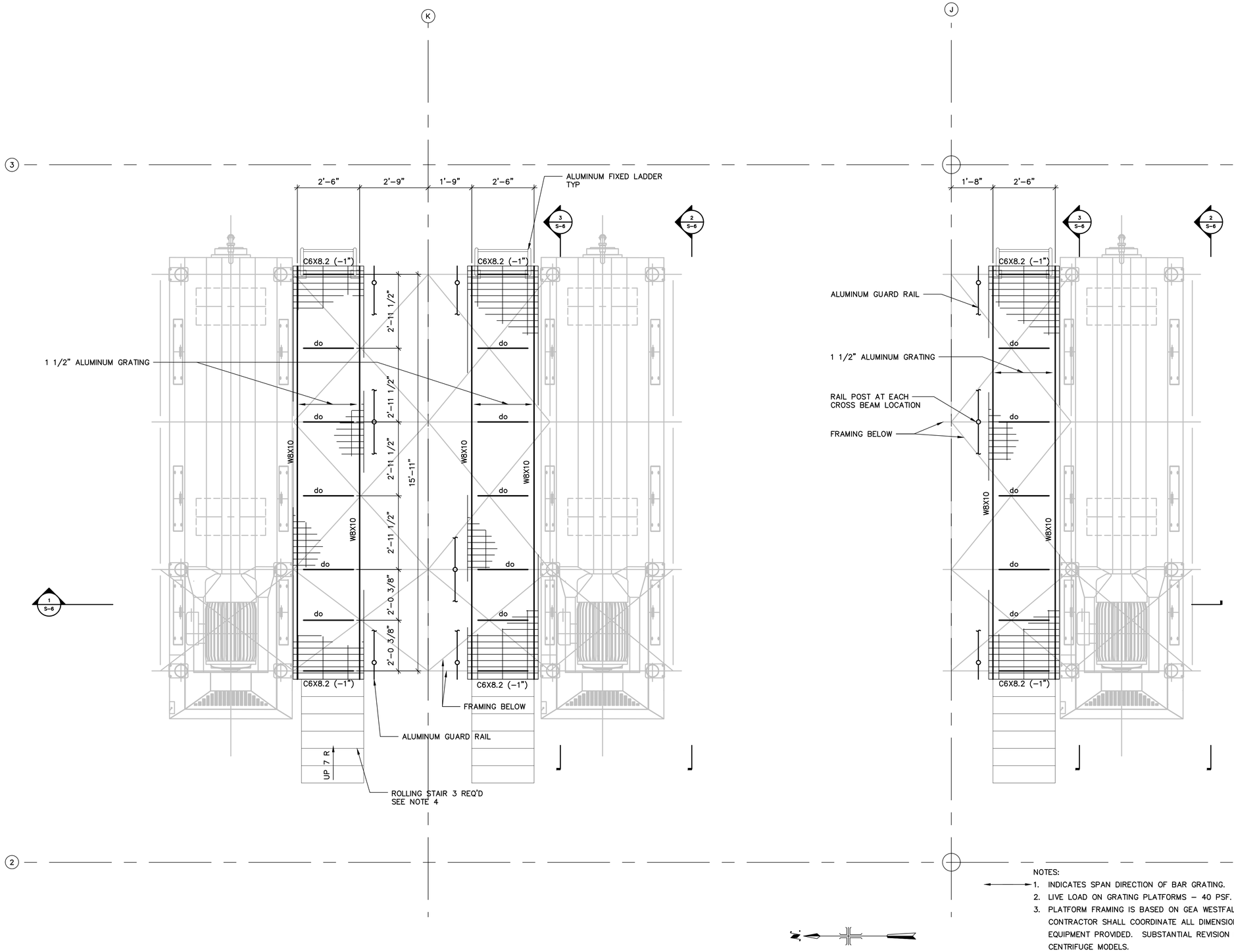
ALFA LAVAL

SCALE: 1/2" = 1'–0"

S–4A

SHEET 16 OF 61

User:DiCORSO Spec:AUS–NCSMOD File:G:\PROJECTS\AK000343.R001CANTON\CADD\STRUCT\S–102A.DWG Scale:1:1 SavedDate:5/10/2018 Time:07:10 Plot Date: DiCorso, Paul: 5/10/2018; 09:33 ; Layout:16



GEA CENTRIFUGE ACCESS PLATFORM FRAMING PLAN

(TOS EL. 77.66)

1/2"=1'-0"

NOTES:

1. INDICATES SPAN DIRECTION OF BAR GRATING.
2. LIVE LOAD ON GRATING PLATFORMS – 40 PSF.
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5. SEE SHEET S-1 FOR GENERAL NOTES.

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5-2-2018

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ARCADIS PROJ. NO. AK000343.B002

NO.	DATE	ISSUED FOR	BY

DATE:	MAY 2018
PROJECT NO.:	AK000343.B002
FILE NAME:	S-102
DESIGNED BY:	DiCORSO
DRAWN BY:	DiCORSO
CHECKED BY:	PALTE

SHEET TITLE

STRUCTURAL

SLUDGE HANDLING BUILDING

FIRST FLOOR PLAN

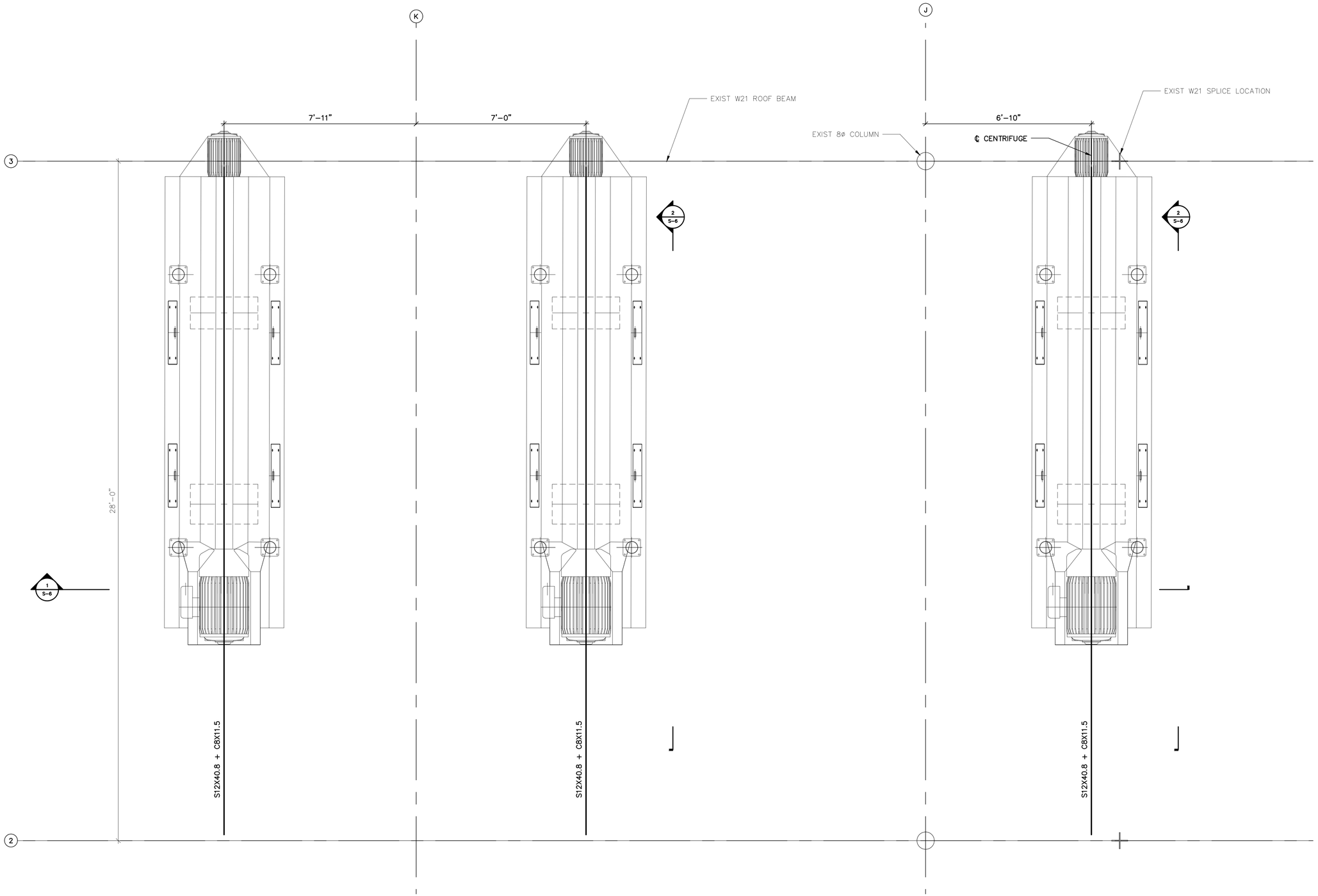
GEA

SCALE: 1/2" = 1'-0"

S-4G

SHEET 17 OF 61

User:DICORSO Spec:AUS-NCSMOD File:G:\PROJECTS\AK000343.R001CANTON\CADD\STRUCT\S-102.DWG Scale:1:1 SavedDate:5/10/2018 Time:07:09 Plot Date: DiCorso, Paul; 5/10/2018; 09:33 ; Layout:17



MONORAIL FRAMING PLAN (ALFA LAVAL SHOWN)

(TOS EL. 88.25)

1/2"=1'-0"

NOTES:
MONORAIL BEAMS RATED FOR A 4 TON HAND CHAIN OPERATED HOIST AND TROLLEY WITH NO IMPACT.
SEE SHEET S–1 FOR GENERAL NOTES.

ARCADIS

LEGAL ENTITY:
ARCADIS U.S., INC.

CONSULTANTS

SUB CONSULTANTS

SEALS

STATE OF OHIO
Matthew A. Palte
#E–68671
REGISTERED PROFESSIONAL ENGINEER
5-2-2018

CITY OF CANTON

CANTON WATER RECLAMATION FACILITY SLUDGE PROCESSING MODIFICATIONS CONTRACT NO. 27

ARCADIS PROJ. NO. AK000343.B002

NO.	DATE	ISSUED FOR	BY

DATE: MAY 2018
PROJECT NO.: AK000343.B002
FILE NAME: S–103A
DESIGNED BY: DiCORSO
DRAWN BY: DiCORSO
CHECKED BY: PALTE

SHEET TITLE

STRUCTURAL

SLUDGE HANDLING BUILDING

ROOF PLAN

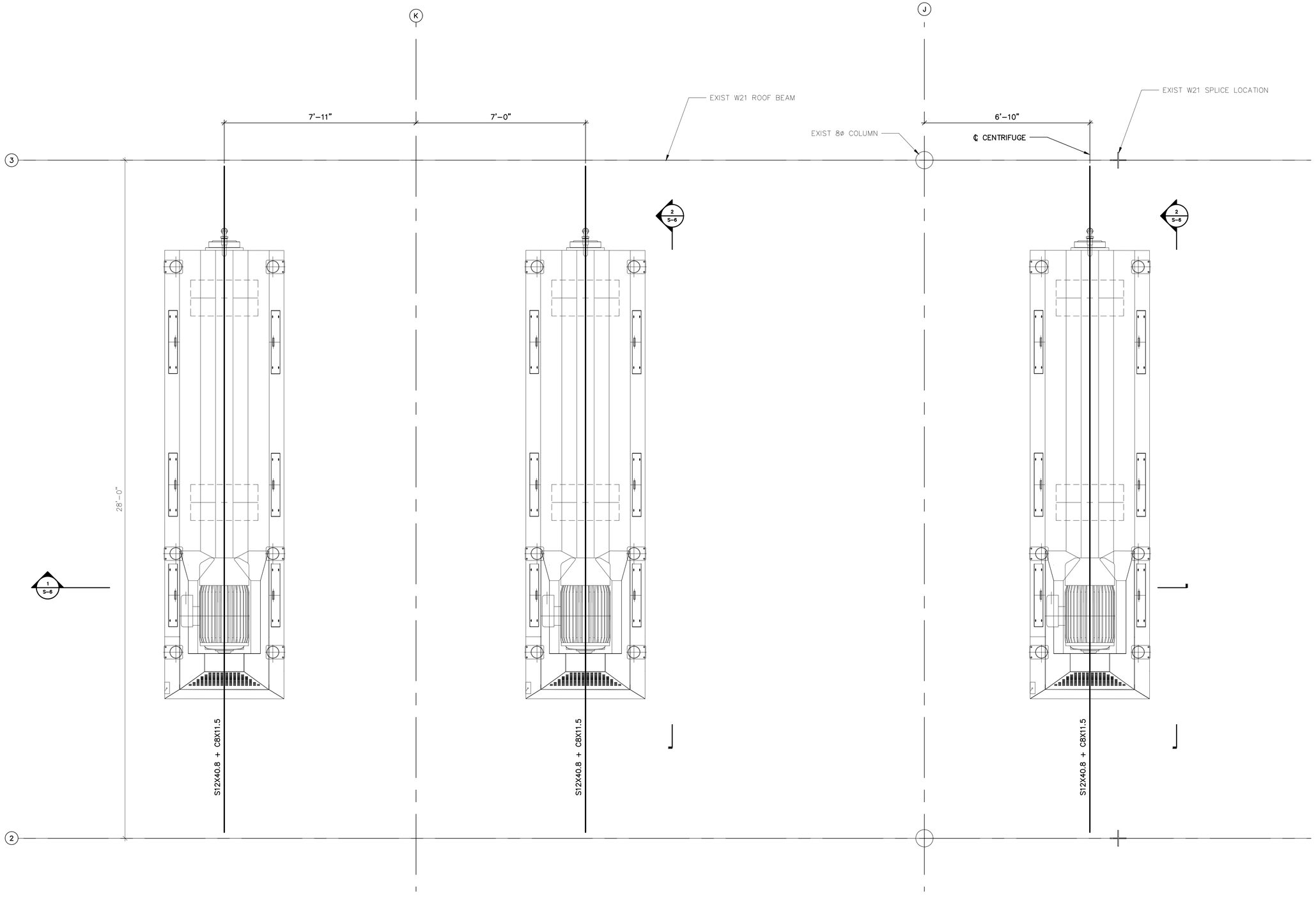
ALFA LAVAL

SCALE: 1/2" = 1'–0"

S–5A

SHEET 18 OF 61

User:DICORSO Spec:AUS-NCSMOD File:G:\PROJECTS\AK000343.R001CANTON\CADD\STRUCT\S-103A.DWG Scale:1:1 SavedDate:4/20/2018 Time:07:37 Plot Date: DiCorso, Paul; 5/10/2018; 09:34 ; Layout:18



MONORAIL FRAMING PLAN (GEA SHOWN)

(TOS EL. 88.25) 1/2"=1'-0"

NOTES:
MONORAIL BEAMS RATED FOR A 4 TON HAND CHAIN OPERATED HOIST AND TROLLEY WITH NO IMPACT.
SEE SHEET S-1 FOR GENERAL NOTES.

ARCADIS

LEGAL ENTITY:
ARCADIS U.S., INC.

CONSULTANTS

SUB CONSULTANTS

SEALS

STATE OF OHIO
Matthew A. Palte
#E-68671
REGISTERED PROFESSIONAL ENGINEER
5-2-2018

CITY OF CANTON

CANTON WATER RECLAMATION FACILITY
SLUDGE PROCESSING MODIFICATIONS
CONTRACT NO. 27

ARCADIS PROJ. NO. AK000343.B002

NO.	DATE	ISSUED FOR	BY

DATE: MAY 2018
PROJECT NO.: AK000343.B002
FILE NAME: S-103
DESIGNED BY: DiCORSO
DRAWN BY: DiCORSO
CHECKED BY: PALTE

SHEET TITLE

STRUCTURAL

SLUDGE HANDLING BUILDING

ROOF PLAN

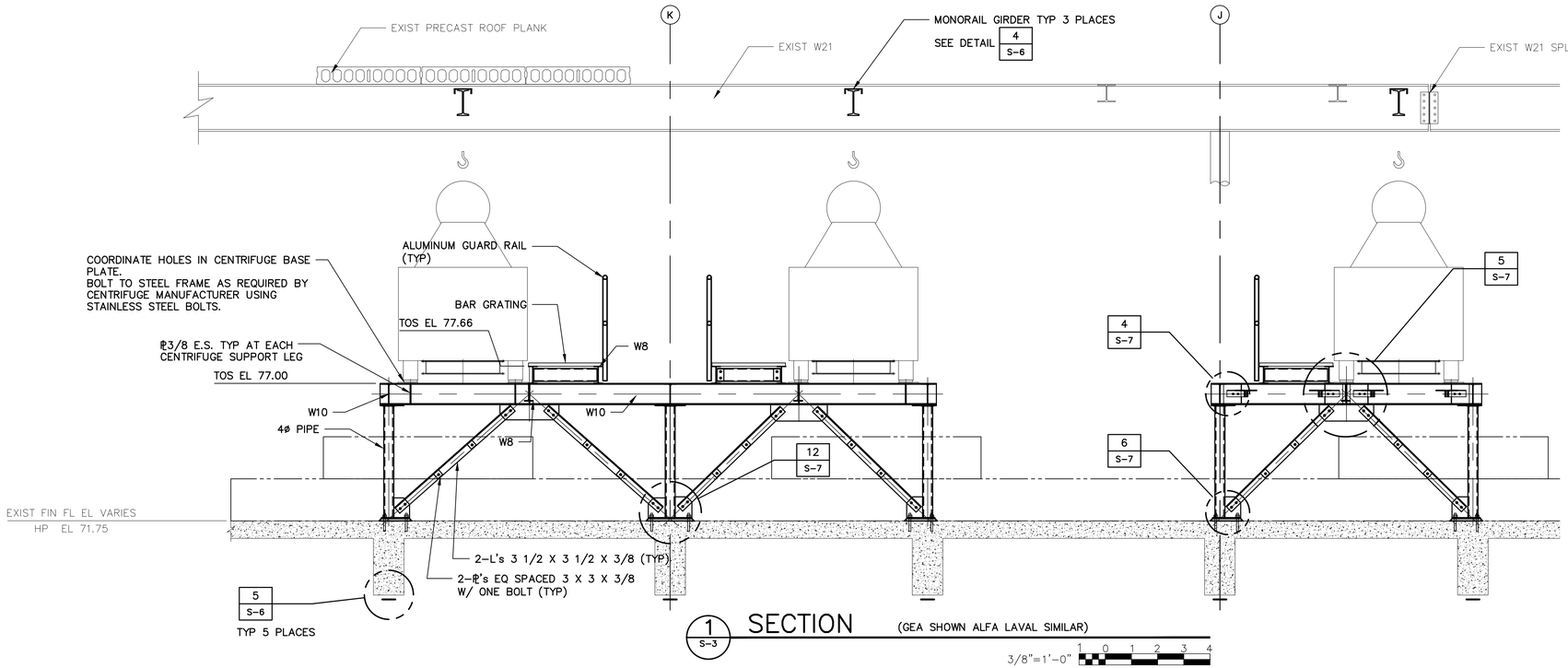
GEA

SCALE: 1/2" = 1'-0"

S-5G

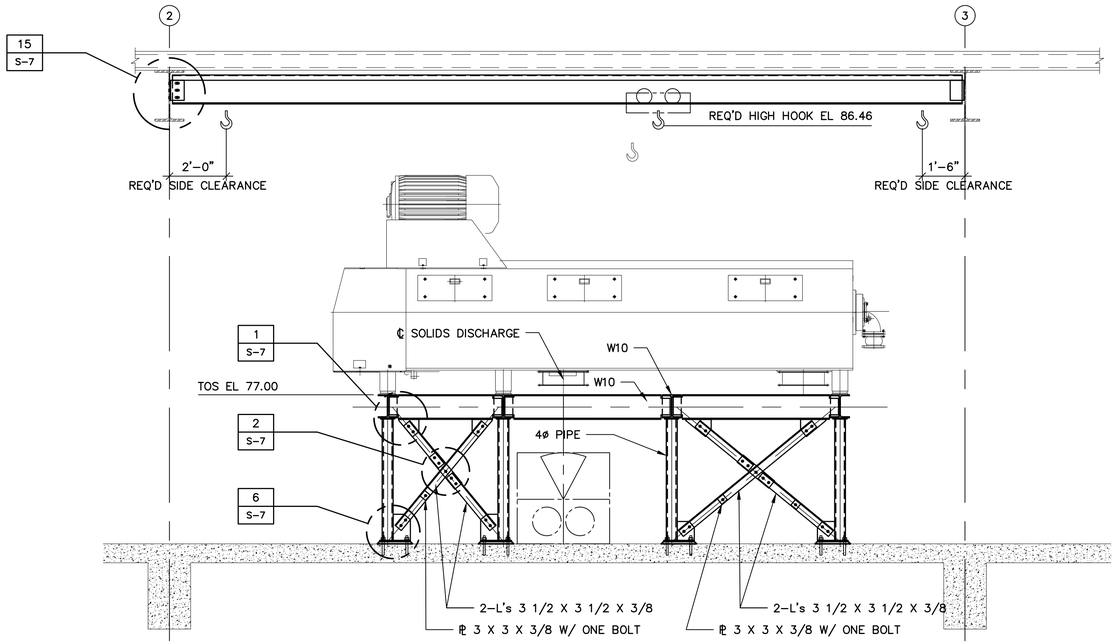
SHEET 19 OF 61

User:DiCORSO Spec: AUS-NCSMOD File: G:\PROJECTS\AK000343.R001CANTON\CADD\STRUCT\S-103.DWG Scale:1:1 Saved Date: 4/20/2018 Time:07:36 Plot Date: DiCorso, Paul; 5/10/2018; 09:34 - Layout:19



1 S-3 SECTION (GEA SHOWN ALFA LAVAL SIMILAR)

3/8"=1'-0"

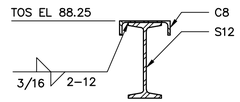


2 S-3 SECTION (GEA SHOWN ALFA LAVAL SIMILAR)

3/8"=1'-0"

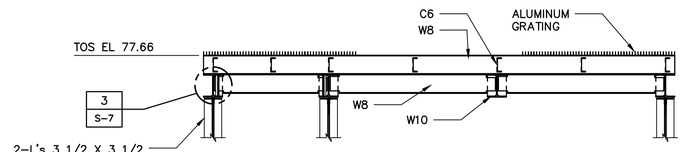
5 S-6 DETAIL (TYP 5 PLACES)

1"=1'-0"



4 S-6 DETAIL

1"=1'-0"



3 S-3 SECTION

3/8"=1'-0"

NOTES:
MONORAIL BEAMS RATED FOR A 4 TON HAND CHAIN OPERATED HOIST AND TROLLEY WITH NO IMPACT.
SEE SHEET S-1 FOR GENERAL NOTES.

ARCADIS

LEGAL ENTITY:
ARCADIS U.S., INC.

CONSULTANTS

SUB CONSULTANTS

SEALS

STATE OF OHIO
Matthew A. Palte
#E-68671
REGISTERED PROFESSIONAL ENGINEER
5-2-2018

CITY OF CANTON

CANTON WATER RECLAMATION FACILITY SLUDGE PROCESSING MODIFICATIONS CONTRACT NO. 27

ARCADIS PROJ. NO. AK000343.B002

NO.	DATE	ISSUED FOR	BY

DATE:	MAY 2018
PROJECT NO.:	AK000343.B002
FILE NAME:	S-104
DESIGNED BY:	DiCORSO
DRAWN BY:	DiCORSO
CHECKED BY:	PALTE

SHEET TITLE

STRUCTURAL

SLUDGE HANDLING BUILDING

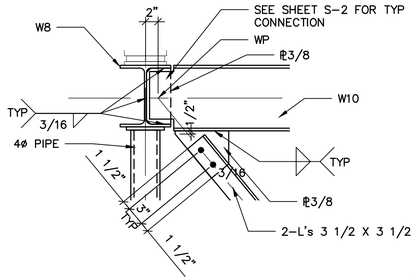
SECTIONS & DETAILS

SCALE: AS SHOWN

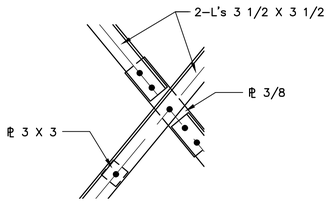
S-6

SHEET 20 OF 61

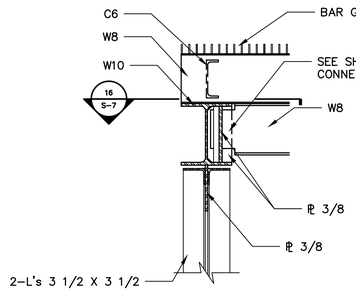
User:DiCORSO Spec:AUS-NCSMOD File:G:\PROJECTS\AK000343.R001CANTON\CADD\STRUCT\S-104.DWG Scale:1:1 SavedDate:4/20/2018 Time:07:37 Plot Date: DiCorso, Paul; 5/10/2018; 09:34 - Layout:20



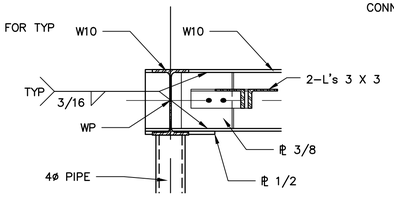
1 S-6 DETAIL
1"=1'-0"



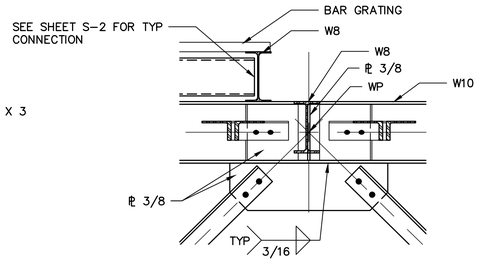
2 S-6 DETAIL
1"=1'-0"



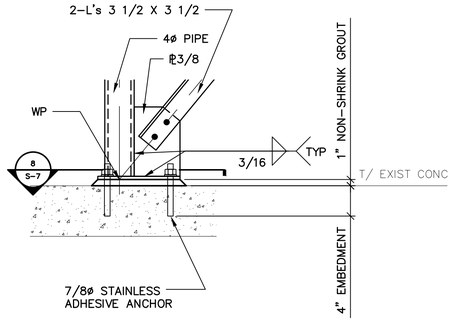
3 S-6 DETAIL
1"=1'-0"



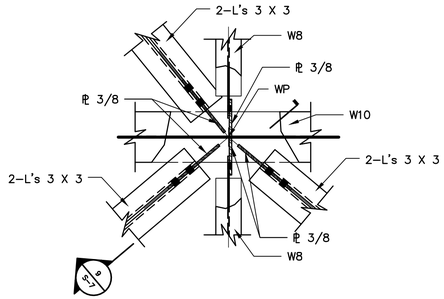
4 S-6 DETAIL
1"=1'-0"



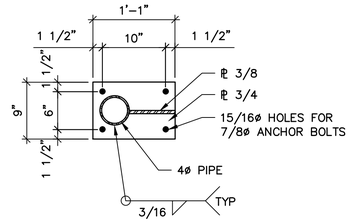
5 S-6 DETAIL
1"=1'-0"



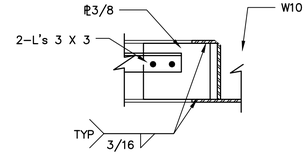
6 S-6 DETAIL
SEE NOTE 1
1"=1'-0"



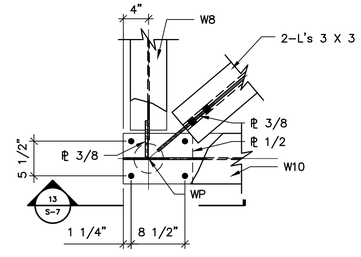
7 S-3 DETAIL
1"=1'-0"



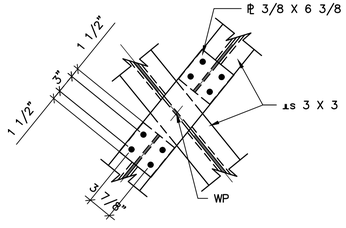
8 S-7 SECTION
1"=1'-0"



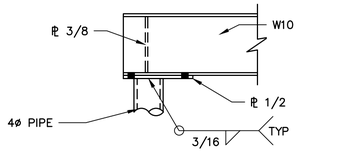
9 S-7 SECTION
1"=1'-0"



10 S-3 DETAIL
1"=1'-0"



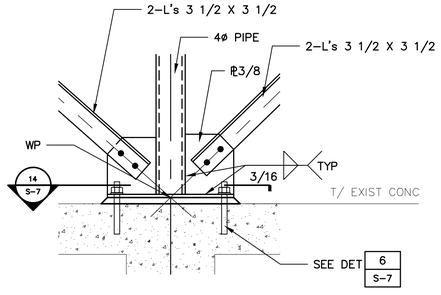
11 S-3 DETAIL
1"=1'-0"



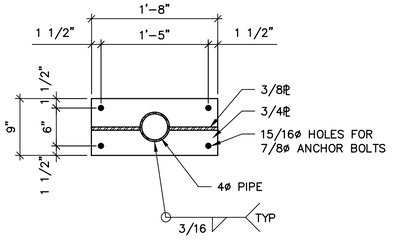
13 S-7 SECTION
1"=1'-0"

NOTES:

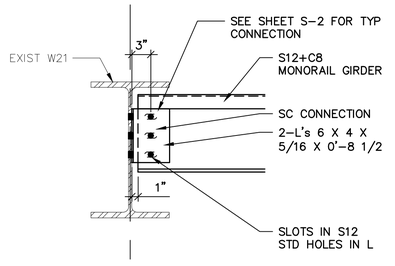
1. COLUMN SHALL BE FINISHED TO BEAR ON BASE PLATE. IF FINISHING IS REQUIRED ON THE BASE PLATE TO PROVIDE A SATISFACTORY BEARING SURFACE FOR THE COLUMN, THE THICKNESS SHOWN REPRESENTS THE REQUIRED THICKNESS AFTER FINISHING. THE BOTTOM OF THE BASE PLATE SUPPORTED ON GROUT DOES NOT REQUIRE FINISHING.
2. SEE SHEET S-1 FOR GENERAL NOTES.



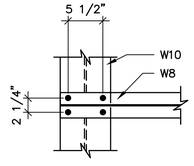
12 S-6 DETAIL
SEE NOTE 1
1"=1'-0"



14 S-7 SECTION
1"=1'-0"



15 S-6 DETAIL
1"=1'-0"



16 S-7 SECTION
1"=1'-0"

ARCADIS
LEGAL ENTITY:
ARCADIS U.S., INC.

CONSULTANTS

SUB CONSULTANTS

SEALS

CITY OF CANTON

CANTON WATER RECLAMATION FACILITY
SLUDGE PROCESSING MODIFICATIONS
CONTRACT NO. 27

ARCADIS PROJ. NO. AK000343.B002

NO.	DATE	ISSUED FOR	BY

DATE:	MAY 2018
PROJECT NO.:	AK000343.B002
FILE NAME:	S-105
DESIGNED BY:	DiCORSO
DRAWN BY:	DiCORSO
CHECKED BY:	PALTE

SHEET TITLE

STRUCTURAL

SLUDGE HANDLING BUILDING

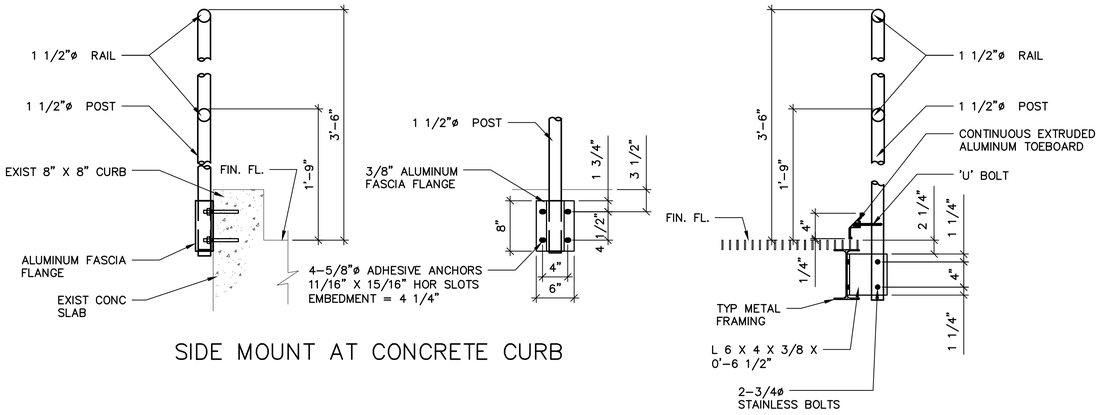
SECTIONS & DETAILS

SCALE: AS SHOWN

S-7

SHEET 21 OF 61

User:DiCORSO Spec: AUS--NCSM0D File:G:\PROJECTS\AK000343.R0001CANTON\CADD\STRUCT\S-105.DWG Scale:1:1 SavedDate:4/20/2018 Time:07:38 Plot Date: DiCorso, Paul; 5/10/2018; 09:34 - Layout:21

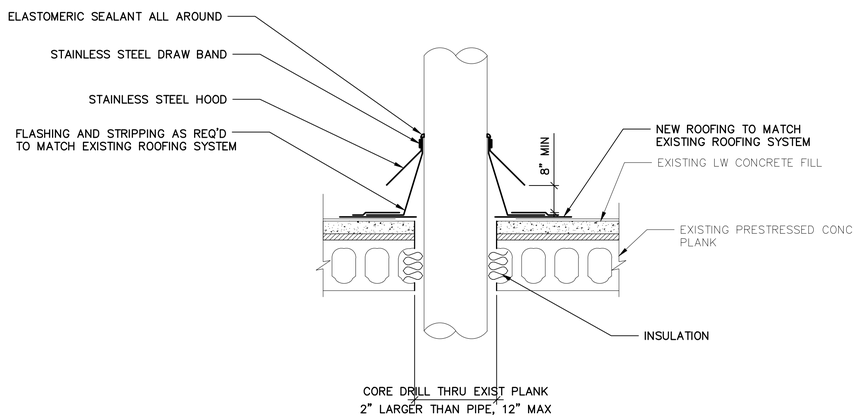


SIDE MOUNT AT CONCRETE CURB

SIDE MOUNT AT METAL FRAMING

RAIL POST CONNECTION DETAILS

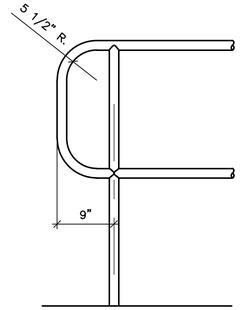
1"=1'-0"



FOR OPENINGS LESS THAN 12 INCHES DIAMETER

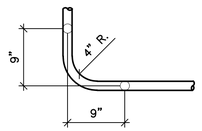
TYP ROOF PENETRATION DETAIL

1"=1'-0"



TYPICAL RAILING END

1"=1'-0"



TYPICAL CORNER PLAN

1"=1'-0"

LEGAL ENTITY:
ARCADIS U.S., INC.

CONSULTANTS

SUB CONSULTANTS

SEALS

STATE OF OHIO
Matthew A. Palte
#E-68671
REGISTERED PROFESSIONAL ENGINEER
5-2-2018

CITY OF CANTON

CANTON WATER RECLAMATION FACILITY SLUDGE PROCESSING MODIFICATIONS CONTRACT NO. 27

ARCADIS PROJ. NO. AK000343.B002

NO.	DATE	ISSUED FOR	BY

DATE: MAY 2018
PROJECT NO.: AK000343.B002
FILE NAME: S-003
DESIGNED BY: DiCORSO
DRAWN BY: DiCORSO
CHECKED BY: PALTE

SHEET TITLE

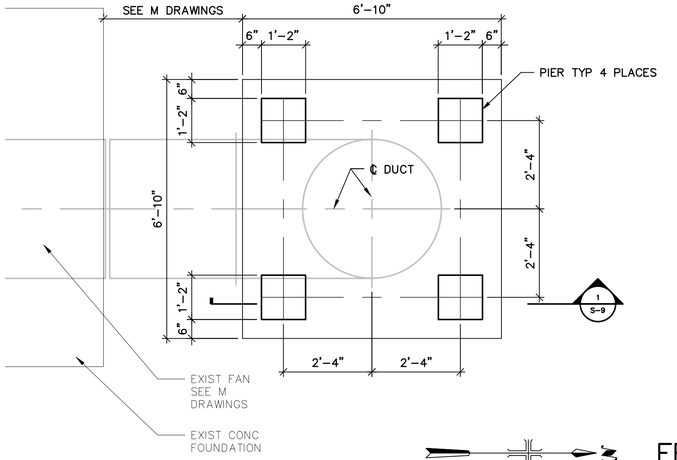
STRUCTURAL

TYPICAL DETAILS

SCALE: AS SHOWN

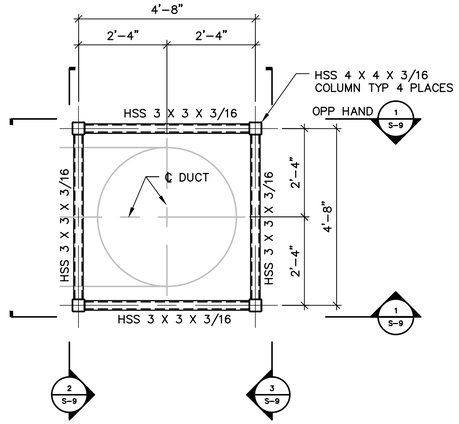
S-8

SHEET 22 OF 61



FOUNDATION PLAN

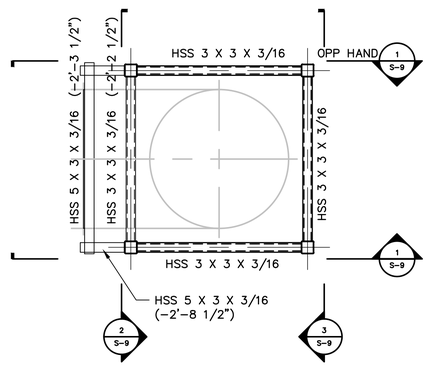
1/2"=1'-0"



FRAMING PLAN

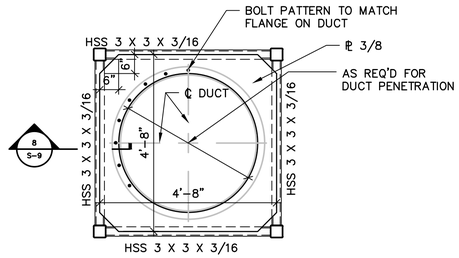
(TOS EL 72.58) 1/2"=1'-0"

(TOS EL 80.00)



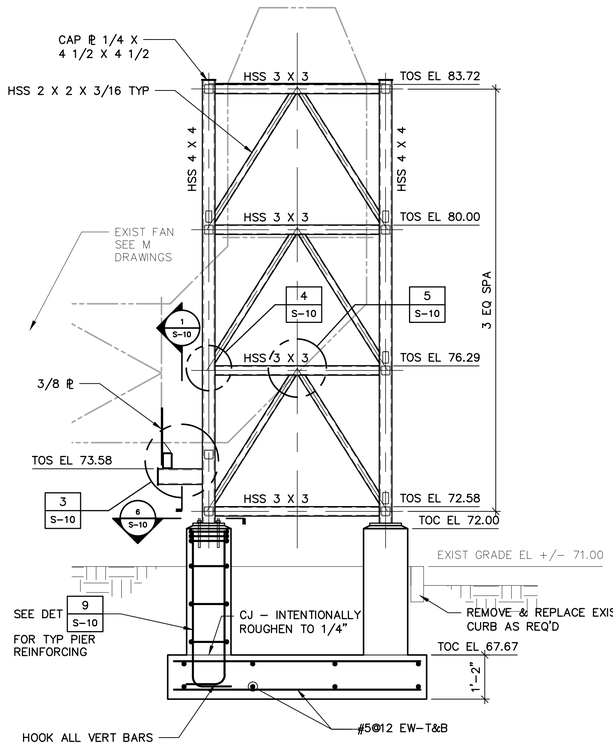
FRAMING PLAN

(TOS EL 76.29) 1/2"=1'-0"



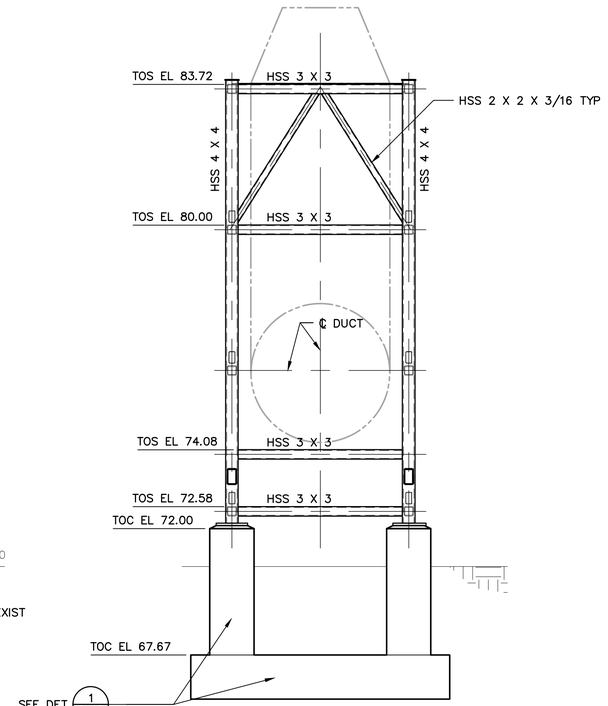
FRAMING PLAN

(TOS EL 83.72) 1/2"=1'-0"



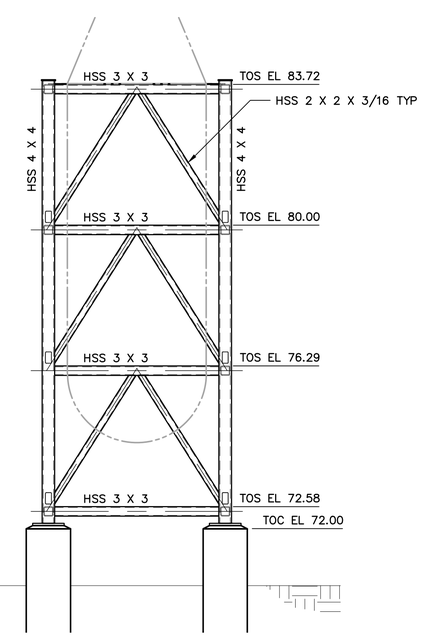
SECTION

1/2"=1'-0"



SECTION

1/2"=1'-0"



SECTION

1/2"=1'-0"

SEE SHEET S-1 FOR GENERAL NOTES.

ARCADIS

LEGAL ENTITY:
ARCADIS U.S., INC.

CONSULTANTS

SUB CONSULTANTS

SEALS

STATE OF OHIO
Matthew A. Palte
#E-68671
REGISTERED PROFESSIONAL ENGINEER
5-2-2018

CITY OF CANTON

CANTON WATER RECLAMATION FACILITY SLUDGE PROCESSING MODIFICATIONS CONTRACT NO. 27

ARCADIS PROJ. NO. AK000343.B002

NO.	DATE	ISSUED FOR	BY

DATE:	MAY 2018
PROJECT NO.:	AK000343.B002
FILE NAME:	S-201
DESIGNED BY:	DiCORSO
DRAWN BY:	DiCORSO
CHECKED BY:	PALTE

SHEET TITLE

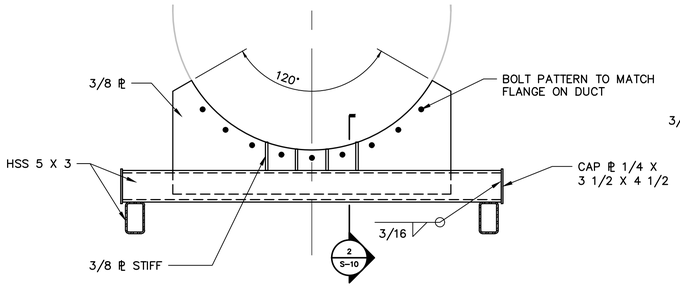
STRUCTURAL

DUCT SUPPORT PLANS, SECTIONS & DETAILS

SCALE: AS SHOWN

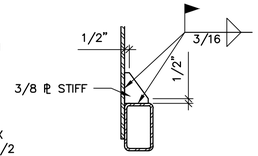
S-9

SHEET 23 OF 61



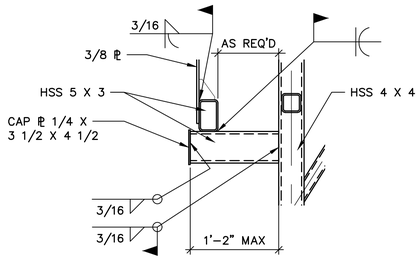
1 S-9 SECTION

1"=1'-0"



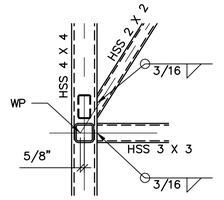
2 S-10 SECTION

1 1/2"=1'-0"



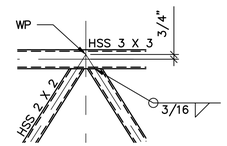
3 S-9 DETAIL

1"=1'-0"



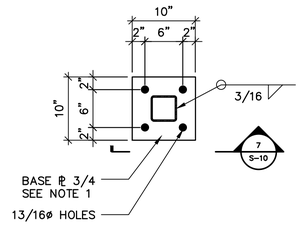
4 S-9 DETAIL

1"=1'-0"



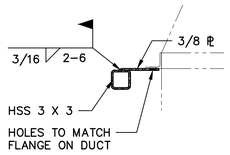
5 S-9 DETAIL

1"=1'-0"



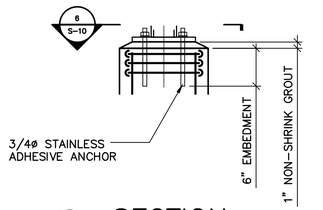
6 S-9 SECTION

1"=1'-0"



8 S-9 SECTION

1"=1'-0"



7 S-10 SECTION

1"=1'-0"

9 S-9 DETAIL TYPICAL PIER

NTS

10 S-10 SECTION

1"=1'-0"

NOTES:

1. COLUMN SHALL BE FINISHED TO BEAR ON BASE PLATE. IF FINISHING IS REQUIRED ON THE BASE PLATE TO PROVIDE A SATISFACTORY BEARING SURFACE FOR THE COLUMN, THE THICKNESS SHOWN REPRESENTS THE REQUIRED THICKNESS AFTER FINISHING. THE BOTTOM OF THE BASE PLATE SUPPORTED ON GROUT DOES NOT REQUIRE FINISHING.
2. SEE SHEET S-1 FOR GENERAL NOTES.

ARCADIS

LEGAL ENTITY:
ARCADIS U.S., INC.

CONSULTANTS

SUB CONSULTANTS

SEALS

STATE OF OHIO
Matthew A. Palte
#E-68671
REGISTERED PROFESSIONAL ENGINEER
5-2-2018

CITY OF CANTON

CANTON WATER RECLAMATION FACILITY
SLUDGE PROCESSING MODIFICATIONS
CONTRACT NO. 27

ARCADIS PROJ. NO. AK000343.B002

NO.	DATE	ISSUED FOR	BY

DATE: MAY 2018
PROJECT NO.: AK000343.B002
FILE NAME: S-202
DESIGNED BY: DiCORSO
DRAWN BY: DiCORSO
CHECKED BY: PALTE

SHEET TITLE

STRUCTURAL

DUCT SUPPORT SECTIONS & DETAILS

SCALE: AS SHOWN

S-10

SHEET 24 OF 61

PIPING AND APPURTENANCES LEGEND

- FLANGED JOINT
- MECHANICAL JOINT/RESTRAINED JOINT
- WELDED JOINT
- BELL AND SPIGOT JOINT
- GROOVED OR SHOULDERED END JOINT
- BLIND FLANGE
- MECHANICAL JOINT/ RESTRAINED JOINT PLUG
- FLARE END
- EXPANSION COUPLING
- HARNESSED EXPANSION COUPLING
- FLANGE COUPLING ADAPTER
- HARNESSED FLANGE COUPLING ADAPTER
- FLEXIBLE COUPLING
- HARNESSED FLEXIBLE COUPLING
- MAGNETIC FLOW METER
- INSULATED PIPE
- TURN UP
- TURN DOWN
- REDUCER/INCREASER
- RECTANGULAR TO ROUND TRANSITION PIECE
- BLIND FLANGE
- QUICK CONNECT ADAPTER (MALE)
- QUICK CONNECT ADAPTER (FEMALE)
- STRAINER
- UNION
- FLAME ARRESTER
- DRIP TRAP
- SEDIMENT TRAP
- STATIC MIXER
- DOPPLER TYPE FLOWMETER
- MAGNETIC FLOWMETER
- TEMPERATURE REGULATING VALVE
- THREE WAY VALVE
- NEEDLE VALVE
- TEMPERATURE GAUGE
- PRESSURE GAUGE
- INLINE PRESSURE GAUGE
- FLOW TOTALIZER
- ROTAMETER
- HOSE REEL

- PRESSURE SWITCH
- PRESSURE SWITCH/GAUGE WITH DIAPHRAGM SEAL
- THERMAL SHUTOFF VALVE
- ANTI-SIPHON VALVE
- PULSATION DAMPENER
- THERMAL MASS FLOWMETER
- CALIBRATION CHAMBER
- FLEXIBLE HOSE CONNECTION
- RUPTURE DISC
- MOTORIZED OPERATOR
- PNEUMATIC OPERATOR
- DIFFERENTIAL PRESSURE GAUGE WITH DIAPHRAGM SEAL
- PRESSURE GAUGE WITH DIAPHRAGM SEAL
- DIFFERENTIAL PRESSURE GAUGE
- PIPE FLOW
- OPEN CHANNEL FLOW
- AIR FLOW
- WATER SURFACE ELEVATION

PIPE SUPPORT LEGEND

- STANCHION SADDLE PIPE SUPPORT
- FLOOR BRACED STANCHION SADDLE PIPE SUPPORT
- WALL BRACED STANCHION SADDLE PIPE SUPPORT
- TRAPEZE PIPE SUPPORT
- CLEVIS HANGER PIPE SUPPORT
- WALL-MOUNTED CLEVIS HANGER PIPE SUPPORT
- CONCRETE PIPE SUPPORT
- WALL BRACKET PIPE SUPPORT
- WALL BRACKET TRAPEZE PIPE SUPPORT
- STACKED RACK PIPE SUPPORT
- BEAM PIPE SUPPORT

MATERIALS LEGEND

EXISTING	PROPOSED	
		CONCRETE
		GROUT
		BRICK
		CONCRETE MASONRY UNIT
		INSULATION
		GLASS
		STEEL
		GRATING
		CHECKERED PLATE
		RAILING

EXISTING	PROPOSED	
		UNDISTURBED SOIL
		GENERAL FILL
		SELECT BACKFILL
		SUBBASE
		MUDMAT
		ROCK
		DUMPED ROCK FILL
		DEMOLITION

SCHEMATIC EQUIPMENT LEGEND

- SUBMERSIBLE PUMP
- CENTRIFUGAL PUMP / CENTRIFUGAL FAN
- PROGRESSING CAVITY PUMP
- METERING PUMP
- COMPRESSOR
- ROTARY POSITIVE DISPLACEMENT BLOWER
- SLUICE/SLIDE GATE
- WEIR GATE

VALVE LEGEND

AR	AIR RELEASE VALVE
AV	AIR AND VACUUM VALVE
BA	BALL VALVE
BD	BUTTERFLY DAMPER
BU	BUTTERFLY VALVE
CV	CHECK VALVE
CV	BALL CHECK VALVE
CS	CURB STOP
ED	ELLIPTIC
EP	ECCENTRIC PLUG VALVE
FH	FIRE HYDRANT
GA	GATE VALVE
GL	GLOBE VALVE
KG	KNIFE GATE VALVE
PRV	PRESSURE REDUCING VALVE
PR	PRESSURE RELIEF VALVE
RO	ROTAMETER
SV	SOLENOID VALVE
TE	TELESCOPIING VALVE
YH	YARD HYDRANT
HB	HOSE BIBB

GENERAL NOTES:

1. THIS DRAWING SERVES AS A COMPREHENSIVE STANDARD. NOT ALL LEGENDS, SYMBOLS, AND ABBREVIATIONS ITEMS ARE NECESSARILY USED ON THIS PROJECT.
2. CONTRACTOR SHALL VERIFY ALL DIMENSIONS AND CONDITIONS IN FIELD BEFORE AND DURING CONSTRUCTION.
3. TYPICAL RAILING DETAILS FOR ALL RAILING AND HANDRAILS SHOWN ON THE MECHANICAL DRAWINGS ARE ON ARCHITECTURAL SHEETS.

GENERAL, CIVIL, AND MECHANICAL ABBREVIATIONS

AB	ANCHOR BOLT
ABAN	ABANDONED
ADD'L	ADDITIONAL
ADJ	ADJUSTABLE
AH	ACCESS HATCH
ALUM	ALUMINUM
ALT	ALTERNATE
AT	AERATION TANK
BF	BLIND FLANGE
BITUM	BITUMINOUS
BL	BASELINE
BLDG	BUILDING
BMK	BENCH MARK
BM	BEAM
BOP	BOTTOM OF PIPE
BOT	BOTTOM
BRG	BEARING
BRP	BUILDING REFERENCE POINT
℄	CENTERLINE
C/C	CENTER TO CENTER
CB	CATCH BASIN
CFB	CHEMICAL FEED BANK
CHH	COMMUNICATION HANDHOLE
CJ	CONSTRUCTION JOINT
CL.	CLEAR
CMH	COMMUNICATION MANHOLE
CO	CLEANOUT
COL	COLUMN
CONC	CONCRETE
CONT	CONTINUED
CPLG	COUPLING
CY	CUBIC YARD(S)
DET	DETAIL
DIP	DUCTILE IRON PIPE
DIA	DIAMETER
DISCH	DISCHARGE
DMH	DROP MANHOLE
DN	DOWN
DWL	DOWELS
EA	EACH
EF	EACH FACE
EFF	EFFLUENT
EJ	EXPANSION JOINT
EL	ELEVATION
ELEC	ELECTRIC
EMH	ELECTRICAL MANHOLE
EQ	EQUAL
EW	EACH WAY
EX	EXISTING
FCA	FLANGED COUPLING ADAPTER
FD	FLOOR DRAIN
FDN	FOUNDATION
FDND	FOUNDATION DRAIN
FF	FAR FACE
FIN	FINISHED
FL	FLUSHING
FLEX	FLEXIBLE
FLG	FLANGE
FLR	FLOOR
FM	FLOWMETER
FS	FLOW SWITCH
FTG	FOOTING
FT	FEET
GA	GAGE OR GAUGE
GALV	GALVANIZED
GE	GROOVED END JOINT
GRD	GROUND
GRAT	GRATING
HB	HOSE BIBB
HORIZ	HORIZONTAL
HP	HIGH POINT
ID	INSIDE DIAMETER
IF	INSIDE FACE
IN, "	INCHES
INF	INFLUENT
INV	INVERT
JST	JOIST
JT	JOINT
K	KIP (1000 POUNDS)
KSF	KIPS PER SQUARE FOOT
LG	LONG
LLH	LONG LEG HORIZONTAL
LLV	LONG LEG VERTICAL
LR	LONG RADIUS
LSH	LEVEL SWITCH HIGH
LSLL	LEVEL SWITCH LOW LOW
MAS	MASONRY
MAX	MAXIMUM
MCC	MOTOR CONTROL CENTER
MFR	MANUFACTURER
MGD	MILLION GALLONS PER DAY
MH	MANHOLE
MIN	MINIMUM
MJ	MECHANICAL JOINT
MO	MASONRY OPENING
MS	MICROSCREENS
NC	NORMALLY CLOSED
NF	NEAR FACE
NO	NORMALLY OPEN
NO.	NUMBER
OC	ON CENTER
OD	OUTSIDE DIAMETER
OF	OUTSIDE FACE
OPNG	OPENING
OPP	OPPOSITE
PC	POINT OF CURVATURE
PE	PLAIN END
PFS	PROCESS FLOW SCHEMATIC
PI	POINT OF INTERSECTION
ℙ	PLATE OR PROPERTY LINE
PSF	POUNDS PER SQUARE FOOT
PSI	POUNDS PER SQUARE INCH
PT	POINT OF TANGENCY
R	RISER
RED	REDUCER
REINF	REINFORCEMENT OR REINFORCE
REQ'D	REQUIRED
RJ	RESTRAINED JOINT
RM	ROOM
ROW	RIGHT OF WAY
SC	SECONDARY CLARIFIER
SCM	STREAMING CURRENT MONITOR
SHT	SHEET
SPA	SPACING
SR	SHORT RADIUS
SS	STAINLESS STEEL
STD	STANDARD
STL	STEEL
STRUC	STRUCTURAL
T	TREAD
T/	TOP OF
T&B	TOP AND BOTTOM
TF	TRICKLING FILTER
THK	THICK
TYP	TYPICAL
UON	UNLESS OTHERWISE NOTED
USG	UNITED STATES STANDARD GAC
VERT	VERTICAL
W/	WITH
WP	WORK POINT
WS	WATER STOP
WWF	WELDED WIRE FABRIC

BURIED AND EXPOSED PIPING FLOW STREAM ABBREVIATIONS

ALP	AIR LOW PRESSURE
ATI	AERATION TANK INFLUENT
FM	FORCE MAIN
ML	MIXED LIQUOR
MSI	MICROSCREEN INFLUENT
MSE	MICROSCREEN EFFLUENT
PE	PLANT EFFLUENT
PLD	PLANT DRAIN
PLDR	PLANT DRAIN RETURN
PLI	PLANT INFLUENT
PRE	PRIMARY EFFLUENT
PW	POTABLE WATER
RAS	RETURN ACTIVATED SLUDGE
SAN	SANITARY WASTE
SCE	SECONDARY CLARIFIER EFFLUENT
SCI	SECONDARY CLARIFIER INFLUENT
SCUM	SCUM
TFB	TRICKLING FILTER BYPASS
TFE	TRICKLING FILTER EFFLUENT
TFI	TRICKLING FILTER INFLUENT
WAS	WASTE ACTIVATED SLUDGE

VALVE DESIGNATIONS

AR	AIR RELEASE VALVE
AV	AIR AND VACUUM VALVE
BV	BALL VALVE
BFP	BACKFLOW PREVENTER ASSEMBLY
BPV	BACK PRESSURE VALVE
BU	BUTTERFLY VALVE
CAV	COMBINATION VACUUM RELIEF AND AIR RELEASE VALVE
CS	CURB STOP
CV	CHECK VALVE/BALL CHECK VALVE
DV	DIAPHRAGM VALVE
ED	ELLIPTIC DIAPHRAGM
EP	ECCENTRIC PLUG VALVE
FH	FIRE HYDRANT
GA	GATE VALVE
GL	GLOBE VALVE
KG	KNIFE GATE
MU	MUD VALVE
PQV	PRESSURE REGULATING VALVE
PRV	PRESSURE REDUCING VALVE
PR	PRESSURE RELIEF VALVE
PV	ECCENTRIC PLUG VALVE
RO	ROTAMETER
RPZ	REDUCED PRESSURE ZONE
SV	SOLENOID VALVE
TE	TELESCOPING VALVE
WH	WALL HYDRANT
YH	YARD HYDRANT

ARCADIS

LEGAL ENTITY:
ARCADIS U.S., INC.

CONSULTANTS

SUB CONSULTANTS

SEALS

STATE OF OHIO · DAVID A. FRANK · 53268 · REGISTERED PROFESSIONAL ENGINEER

CITY OF CANTON

CANTON WATER RECLAMATION FACILITY SLUDGE PROCESSING MODIFICATIONS CONTRACT NO. 27

ARCADIS PROJ. NO. AK000343.B002

NO.	DATE	ISSUED FOR	BY

DATE: MAY 2018
PROJECT NO.: AK000343.B002
FILE NAME: M-1
DESIGNED BY: DAF
DRAWN BY: TNB
CHECKED BY: JJW

SHEET TITLE

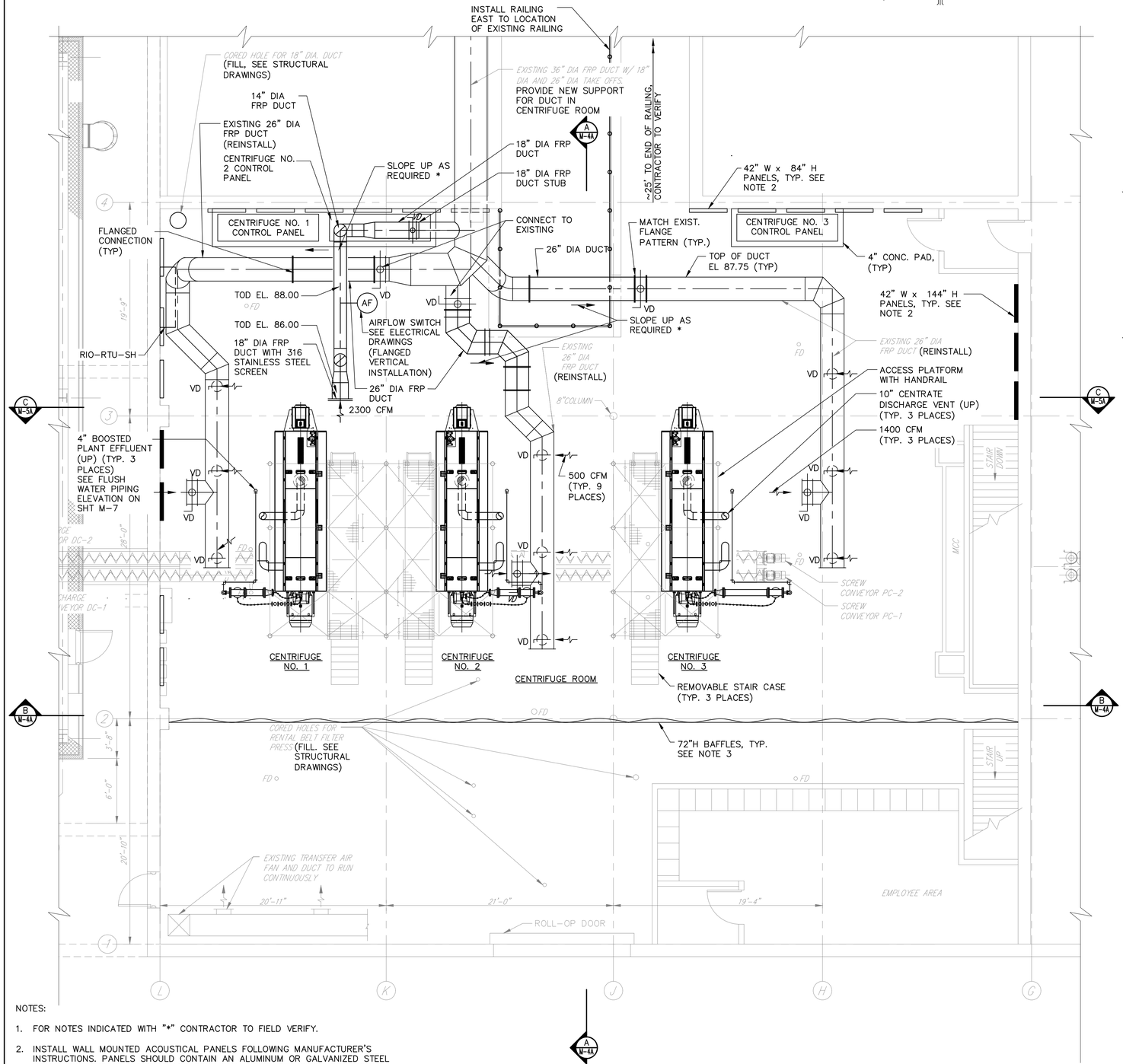
MECHANICAL

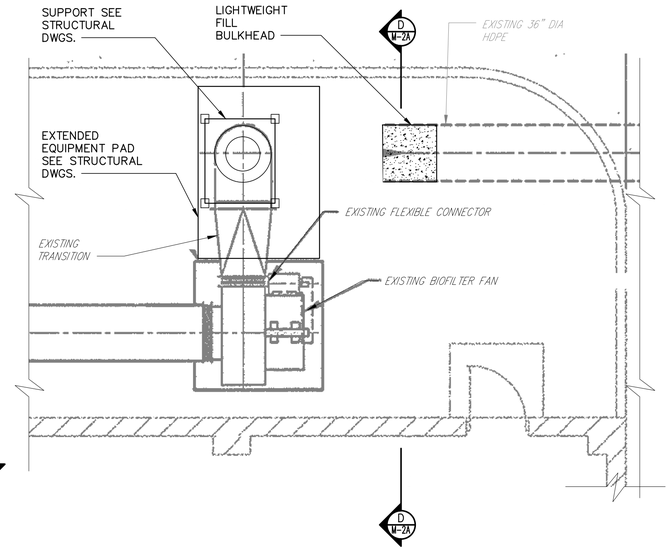
LEGENDS, SYMBOLS, AND ABBREVIATIONS

SCALE: NONE

M-1

SHEET 25 OF 61

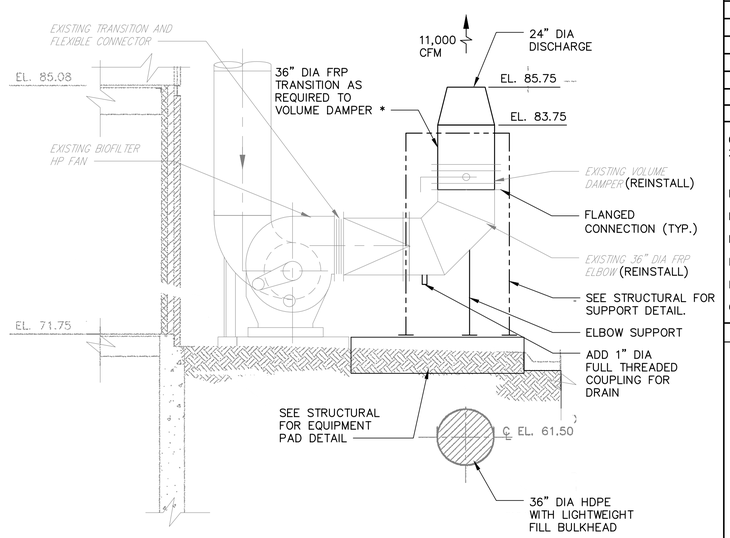




PARTIAL PLAN AT BIOFILTER FAN

SCALE: 1/4" = 1'-0"

0 2' 4' 8'



D SECTION
M-2A

SCALE: 1/4" = 1'-0"

0 2' 4' 8'

NOTE:
1. FIELD VERIFY SIZE OF EXISTING DUCT AND FLANGE PATTERN.

NOTES:

1. FOR NOTES INDICATED WITH "*" CONTRACTOR TO FIELD VERIFY.
2. INSTALL WALL MOUNTED ACOUSTICAL PANELS FOLLOWING MANUFACTURER'S INSTRUCTIONS. PANELS SHOULD CONTAIN AN ALUMINUM OR GALVANIZED STEEL FRAME SUPPORTING A FIBERGLASS CORE WITH NOISE REDUCTION COEFFICIENT VALUE OF MINIMUM 1 MANUFACTURED BY KINETICS NOISE CONTROL (MODEL KNP (2" THICK)), OR MPC INC. (MODEL SW-200-2-1/4" THICK), OR EQUAL.
3. INSTALL CEILING-MOUNTED ACOUSTICAL BAFFLES FOLLOWING MANUFACTURER'S INSTRUCTIONS; HANGING VERTICALLY FROM EXISTING BEAMS. BAFFLES TO CONTAIN A FIBERGLASS CORE ENCASED IN A VINYL FILM COVER MANUFACTURED BY KINETICS NOISE CONTROL (KB-803-2" THICK), (MODEL B-500, 2-1/2" THICK), OR EQUAL. COORDINATE INDIVIDUAL BAFFLE LENGTHS WITH MONORAILS AND POSTS.

PARTIAL PLAN @ CENTRIFUGE FLOOR LEVEL

SCALE: 3/16" = 1'-0"

0 4' 8' 12'

ARCADIS

LEGAL ENTITY:
ARCADIS U.S., INC.

CONSULTANTS

SUB CONSULTANTS

SEALS

STATE OF OHIO
DAVID A. FRANK
53268
REGISTERED
PROFESSIONAL ENGINEER

CITY OF CANTON

CANTON WATER RECLAMATION FACILITY SLUDGE PROCESSING MODIFICATIONS CONTRACT NO. 27

ARCADIS PROJ. NO. AK000343.B002

NO.	DATE	ISSUED FOR	BY

DATE:	MAY 2018
PROJECT NO.:	AK000343.B002
FILE NAME:	M-2A
DESIGNED BY:	DAF
DRAWN BY:	TNB
CHECKED BY:	JJW

SHEET TITLE

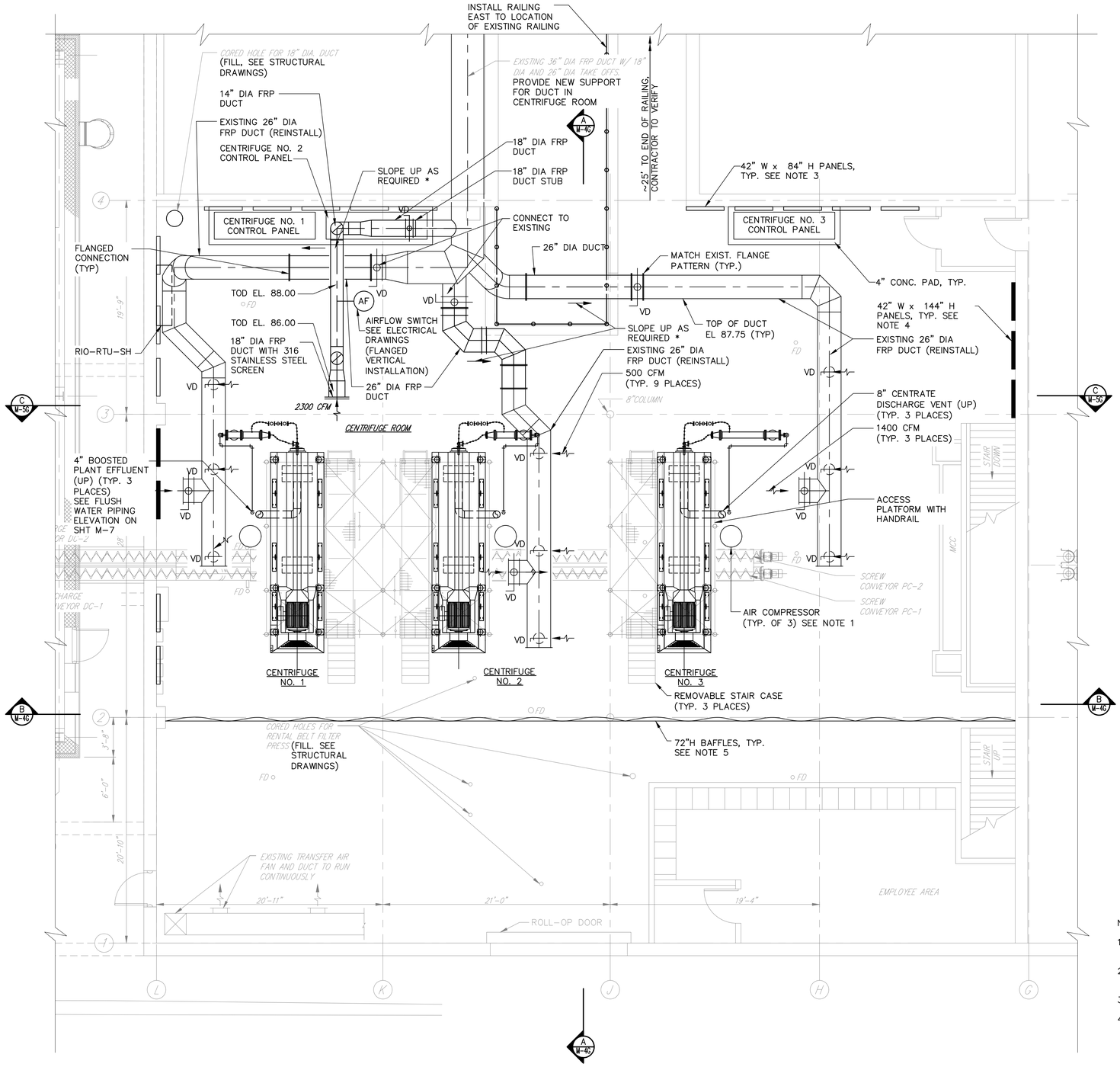
MECHANICAL

SLUDGE HANDLING BUILDING – FLOOR PLAN, ALFA LAVAL

SCALE: AS SHOWN

M-2A

SHEET 26 OF 61



PARTIAL PLAN @ CENTRIFUGE FLOOR LEVEL

SCALE: 3/16" = 1'-0"

0 4' 8' 12'

NOTES:

1. GEA UNITS REQUIRE AIR COMPRESSORS FOR LUBRICATION SYSTEM. PROVIDE UNIT REQUESTED BY MANUFACTURER.
2. CONNECT FLEXIBLE POLYMER TUBING TO PORT ON MANUFACTURER PROVIDED 90° BEND.
3. REFER TO SHEET M-2A FOR BIOFILTER FAN WORK.
4. INSTALL WALL MOUNTED ACOUSTICAL PANELS FOLLOWING MANUFACTURER'S INSTRUCTIONS. PANELS SHOULD CONTAIN AN ALUMINUM OR GALVANIZED STEEL FRAME SUPPORTING A FIBERGLASS CORE WITH NOISE REDUCTION COEFFICIENT VALUE OF MINIMUM 1 MANUFACTURED BY KINETICS NOISE CONTROL (MODEL KNP (2" THICK)), OR MPC INC. (MODEL SW-200-2-1/4" THICK), OR EQUAL.
5. INSTALL CEILING-MOUNTED ACOUSTICAL BAFFLES FOLLOWING MANUFACTURER'S INSTRUCTIONS; HANGING VERTICALLY FROM EXISTING BEAMS. BAFFLES TO CONTAIN A FIBERGLASS CORE ENCASED IN A VINYL FILM COVER MANUFACTURED BY KINETICS NOISE CONTROL (KB-803-2" THICK), (MODEL B-500, 2-1/2" THICK), OR EQUAL. COORDINATE INDIVIDUAL BAFFLE LENGTHS WITH MONORAILS AND POSTS.

ARCADIS

LEGAL ENTITY:
ARCADIS U.S., INC.

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SUB CONSULTANTS

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STATE OF OHIO
DAVID A. FRANK
53268
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PROFESSIONAL ENGINEER

CITY OF CANTON

CANTON WATER RECLAMATION FACILITY
SLUDGE PROCESSING MODIFICATIONS
CONTRACT NO. 27

ARCADIS PROJ. NO. AK000343.B002

NO.	DATE	ISSUED FOR	BY

DATE: MAY 2018
PROJECT NO.: AK000343.B002
FILE NAME: M-2G
DESIGNED BY: DAF
DRAWN BY: TNB
CHECKED BY: JJW

SHEET TITLE

MECHANICAL

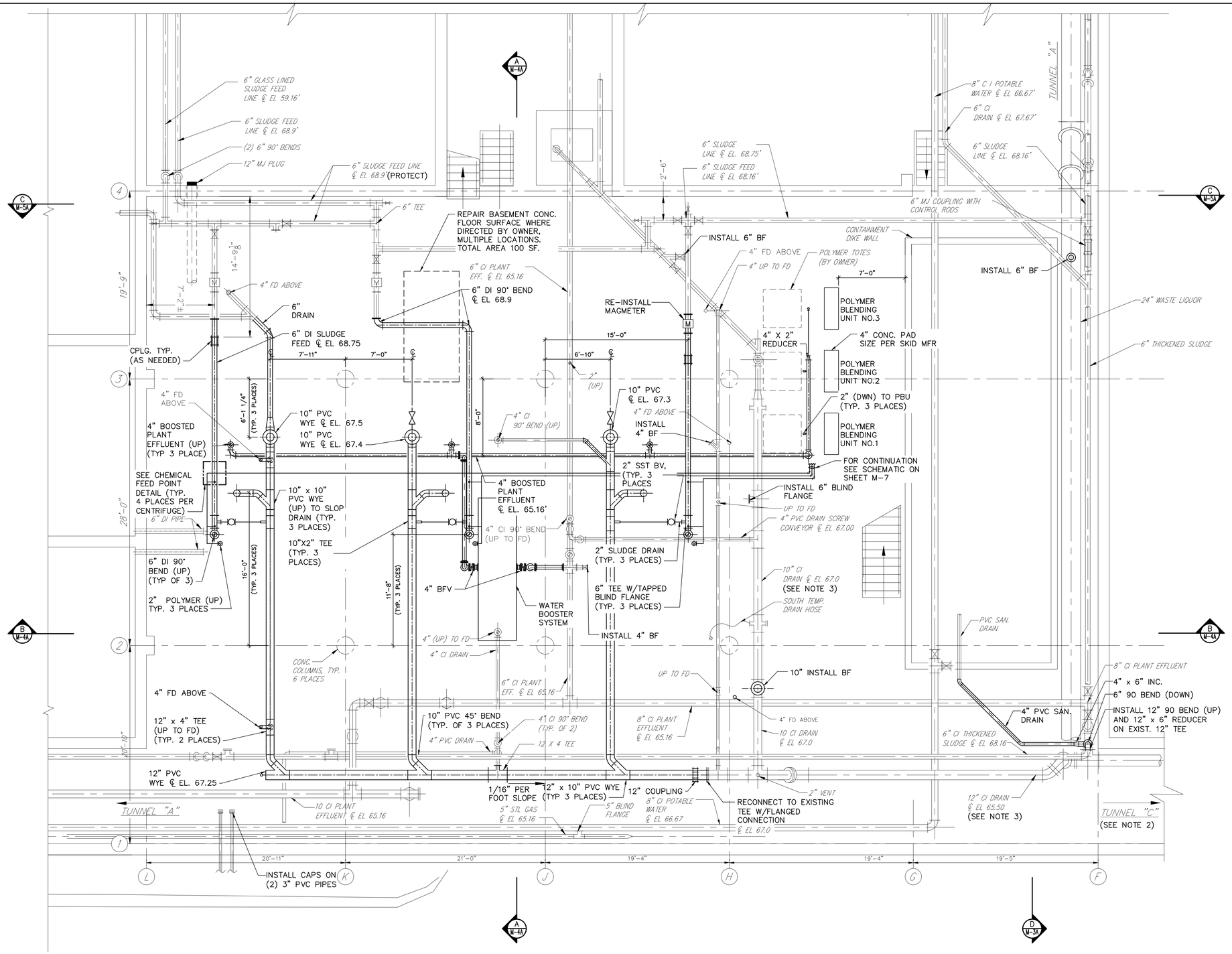
SLUDGE HANDLING BUILDING - FLOOR PLAN, GEA

SCALE: AS SHOWN

M-2G

SHEET 27 OF 61

User: YNI09655 Spec: AUS-NCSMOD File: I:\WATER\US\UB004316-01_CANTON WRF\E-DRAWINGS\SHEETS\MECHANICAL\M-2G.DWG Scale: 1:1/2 SavedDate: 5/16/2018 Time: 19:05 Plot Date: Nimbargikar, Yoginath: 5/16/2018; 19:07 ; Layout: 27



SLUDGE HANDLING BUILDING BASEMENT LEVEL – FLOOR PLAN

SCALE: 3/16" = 1'-0"

0 4' 8' 12'

NOTES:

1. INSTALL SST CLEVIS HANGERS, AS NEEDED, SUCH THAT PROPOSED DRAIN PIPING HAS A MINIMUM SLOPE OF 1/16" PER FOOT.
2. MODIFY 14" DRAIN PIPING LOCATED SOUTH IN TUNNEL "C" SEE DETAIL ON SHEET M-5A.
3. FLUSH AND CLEAN DEPOSITS IN EX. 10", 12" AND 14" DRAIN PIPING.

ARCADIS

LEGAL ENTITY:
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STATE OF OHIO
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CANTON WATER RECLAMATION FACILITY
SLUDGE PROCESSING MODIFICATIONS
CONTRACT NO. 27

ARCADIS PROJ. NO. AK000343.B002

NO.	DATE	ISSUED FOR	BY

DATE:	MAY 2018
PROJECT NO.:	AK000343.B002
FILE NAME:	M-3A
DESIGNED BY:	DAF
DRAWN BY:	TNB
CHECKED BY:	JJW

SHEET TITLE

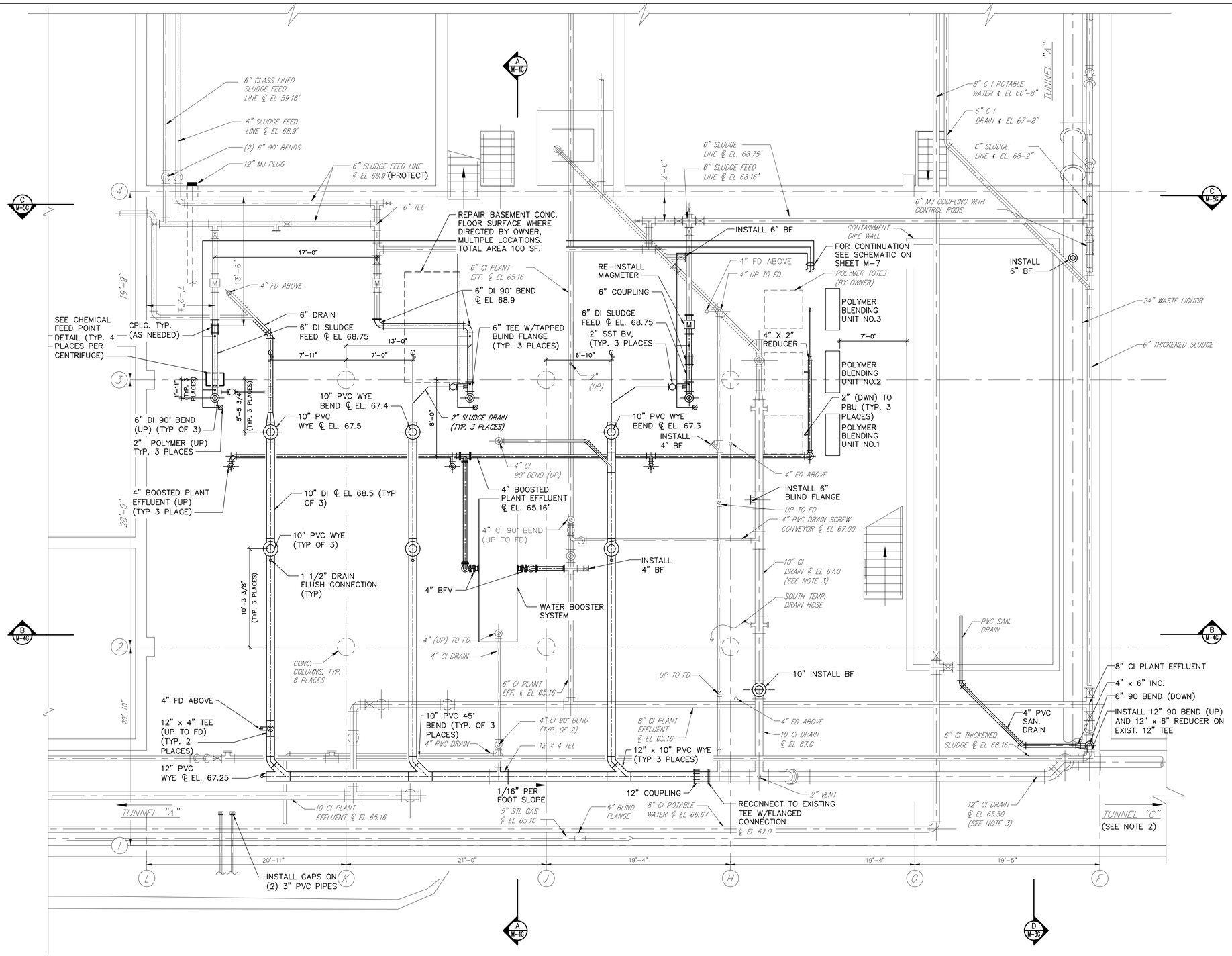
MECHANICAL

SLUDGE HANDLING BUILDING – BASEMENT FLOOR PLAN, ALFA LAVAL

SCALE: AS SHOWN

M-3A

SHEET 28 OF 61



SLUDGE HANDLING BUILDING BASEMENT LEVEL – FLOOR PLAN

SCALE: 3/16" = 1'-0"

0 4' 8' 12'

NOTES:

1. INSTALL SST CLEVIS HANGERS, AS NEEDED, SUCH THAT PROPOSED DRAIN PIPING HAS A MINIMUM SLOPE OF 1/16" PER FOOT.
2. MODIFY 14" DRAIN PIPING LOCATED SOUTH IN TUNNEL "C" SEE DETAIL ON SHEET M-5A.
3. FLUSH AND CLEAN DEPOSITS IN EX. 10", 12" AND 14" DRAIN PIPING

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CANTON WATER RECLAMATION FACILITY
SLUDGE PROCESSING MODIFICATIONS
CONTRACT NO. 27

ARCADIS PROJ. NO. AK000343.B002

NO.	DATE	ISSUED FOR	BY

DATE: MAY 2018
PROJECT NO.: AK000343.B002
FILE NAME: M-3G
DESIGNED BY: DAF
DRAWN BY: TNB
CHECKED BY: JJW

SHEET TITLE

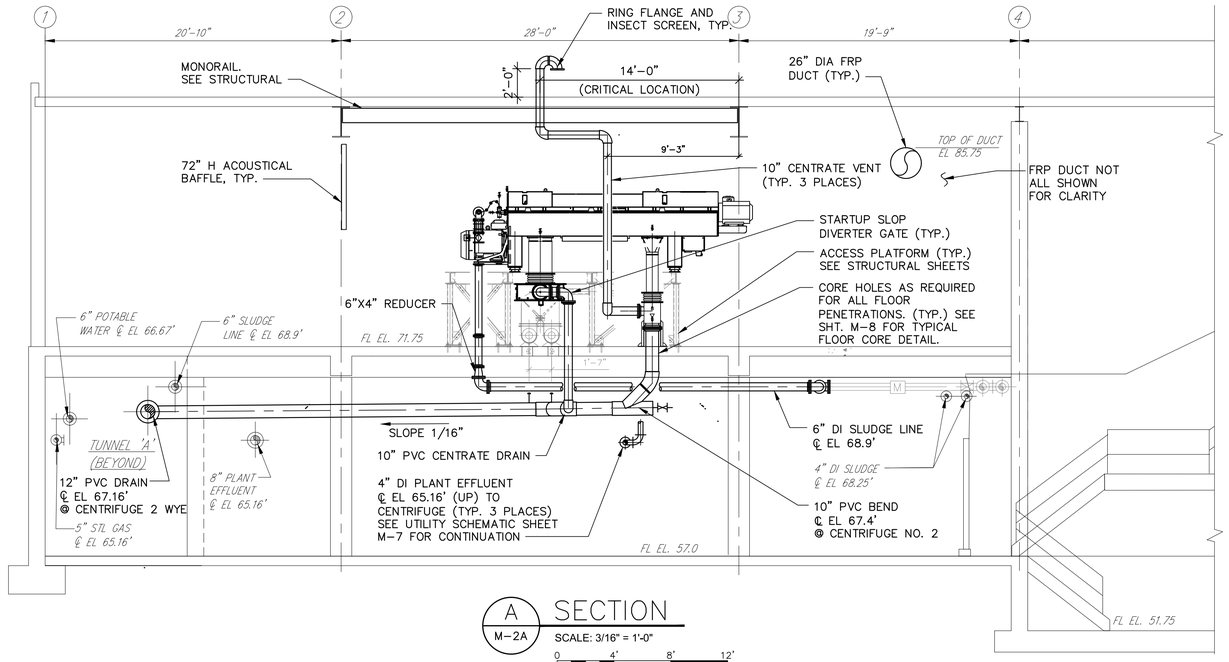
MECHANICAL

SLUDGE HANDLING BUILDING – BASEMENT FLOOR PLAN, GEA

SCALE: AS SHOWN

M-3G

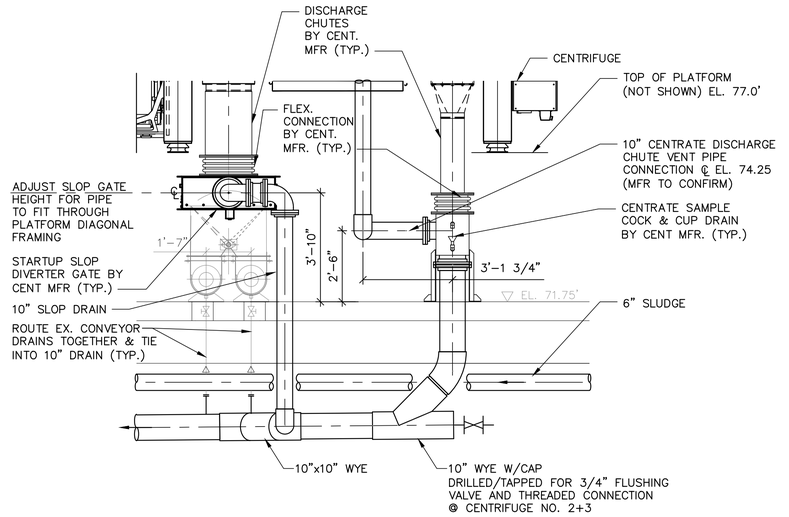
SHEET 29 OF 61



A M-2A **SECTION**

SCALE: 3/16" = 1'-0"

0 4' 8' 12'



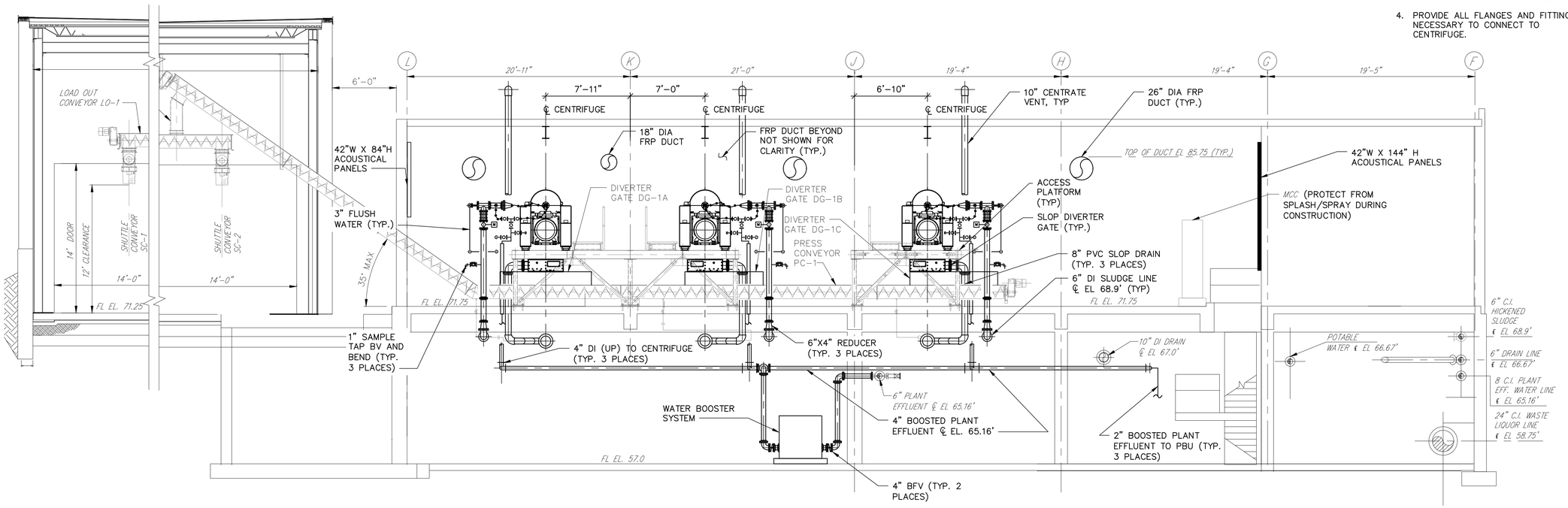
DRAIN DETAILS

SCALE: 3/8" = 1'-0"

0 2' 4' 6'

NOTES:

1. DESIGN/INSTALL ELEVATION OF CENTRATE DISCHARGE CHUTE SO VENT PIPE FITS THROUGH ACCESS PLATFORM FRAMING.
2. CENTRATE DISCHARGE CHUTE AND SLOP GATE TO BE SUPPORTED FROM FLOOR, WITH FLEXIBLE CONNECTIONS TO CENTRIFUGE.
3. PLATFORM NOT SHOWN FOR CLARITY.
4. PROVIDE ALL FLANGES AND FITTINGS NECESSARY TO CONNECT TO CENTRIFUGE.



B M-2A **SECTION**

SCALE: 3/16" = 1'-0"

0 4' 8' 12'

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CANTON WATER RECLAMATION FACILITY SLUDGE PROCESSING MODIFICATIONS CONTRACT NO. 27

ARCADIS PROJ. NO. AK000343.B002

NO.	DATE	ISSUED FOR	BY

DATE:	MAY 2018
PROJECT NO.:	AK000343.B002
FILE NAME:	M-4A
DESIGNED BY:	DAF
DRAWN BY:	TNB
CHECKED BY:	JJW

SHEET TITLE

MECHANICAL

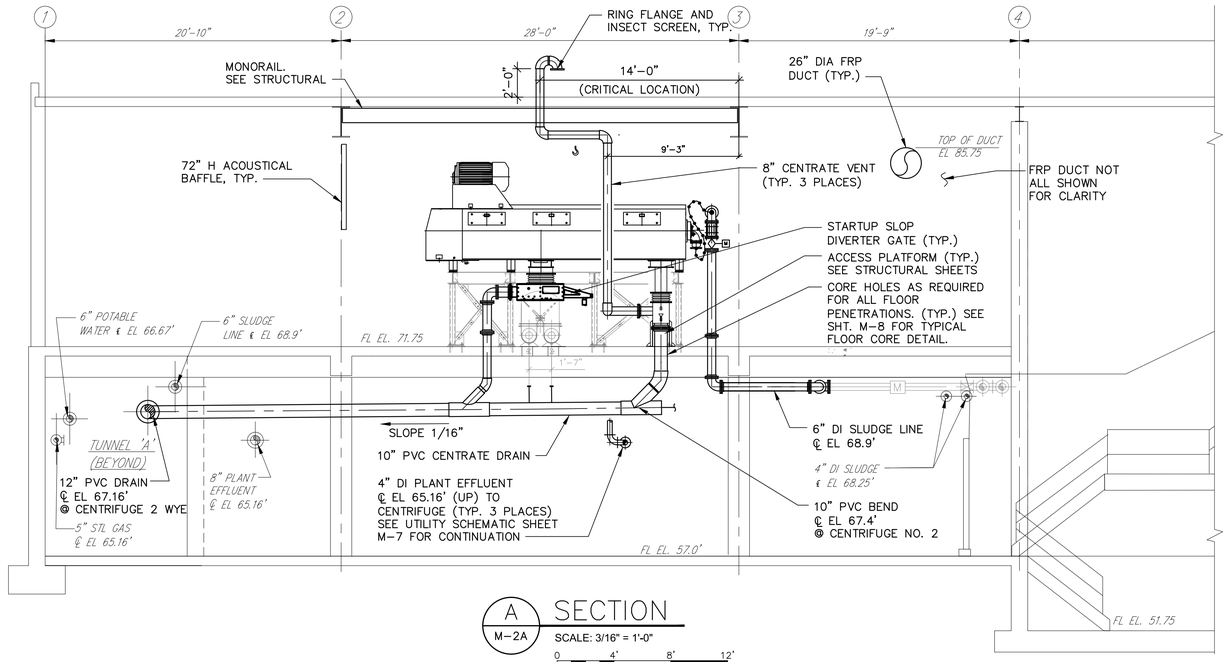
SLUDGE HANDLING BUILDING – SECTIONS, ALFA LAVAL

SCALE: AS SHOWN

M-4A

SHEET 30 OF 61

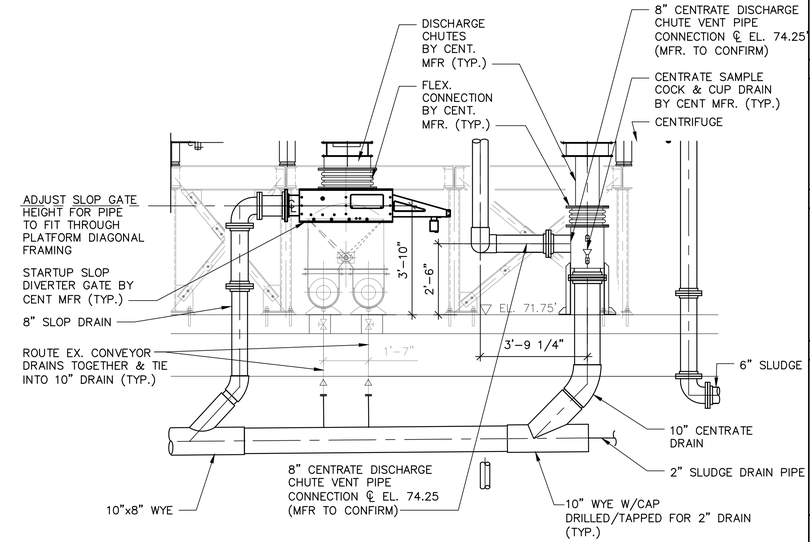
User: YN00655 Spec: AUS-NCSMOD File: I:\WATER\US\UB004316-01_CANTON WRF\E-DRAWINGS\SHEETS\MECHANICAL\M-44.DWG Scale:1:1/2 SavedDate:5/22/2018 Time:12:34 Plot Date: Nimbargikar, Yoginath: 5/22/2018; 12:38 ; Layout:30



A M-2A **SECTION**

SCALE: 3/16" = 1'-0"

0 4' 8' 12'



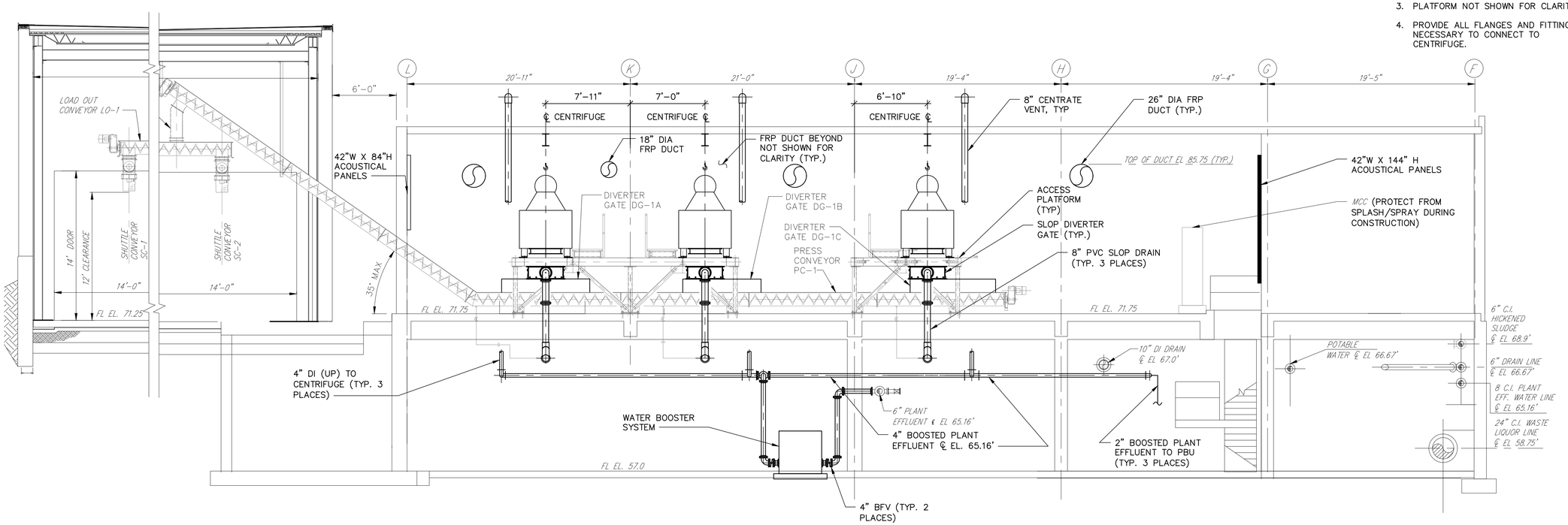
DRAIN DETAILS

SCALE: 3/8" = 1'-0"

0 2' 4' 6'

NOTES:

1. DESIGN/INSTALL ELEVATION OF CENTRATE DISCHARGE CHUTE SO VENT PIPE FITS THROUGH ACCESS PLATFORM FRAMING.
2. CENTRATE DISCHARGE CHUTE AND SLOP GATE TO BE SUPPORTED FROM FLOOR, WITH FLEXIBLE CONNECTIONS TO CENTRIFUGE.
3. PLATFORM NOT SHOWN FOR CLARITY.
4. PROVIDE ALL FLANGES AND FITTINGS NECESSARY TO CONNECT TO CENTRIFUGE.



B M-2A **SECTION**

SCALE: 3/16" = 1'-0"

0 4' 8' 12'

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LEGAL ENTITY:
ARCADIS U.S., INC.

CONSULTANTS

SUB CONSULTANTS

SEALS

STATE OF OHIO
DAVID A. FRANK
53268
REGISTERED
PROFESSIONAL ENGINEER

CITY OF CANTON

CANTON WATER RECLAMATION FACILITY SLUDGE PROCESSING MODIFICATIONS CONTRACT NO. 27

ARCADIS PROJ. NO. AK000343.B002

NO.	DATE	ISSUED FOR	BY

DATE: MAY 2018
PROJECT NO.: AK000343.B002
FILE NAME: M-4G
DESIGNED BY: DAF
DRAWN BY: TNB
CHECKED BY: JJW

SHEET TITLE

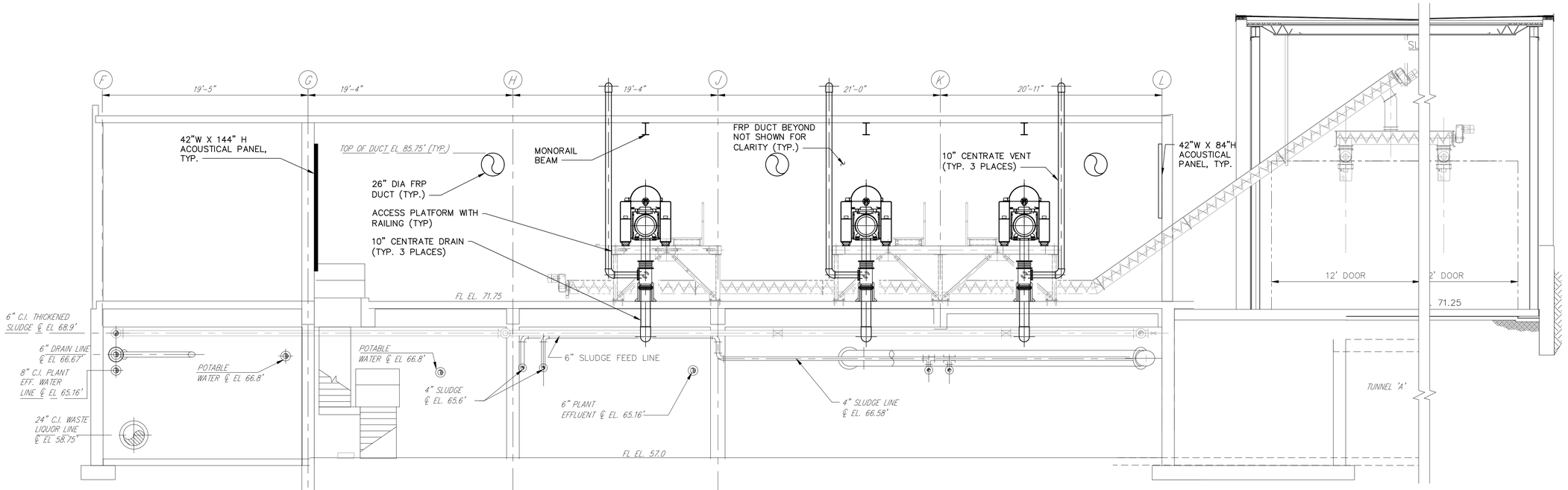
MECHANICAL

SLUDGE HANDLING BUILDING – SECTIONS, GEA

SCALE: AS SHOWN

M-4G

SHEET 31 OF 61



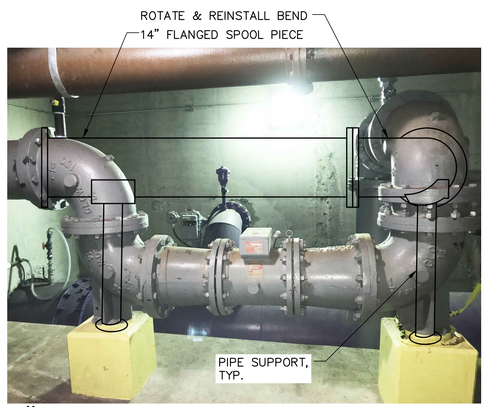
C / M–2A SECTION

SCALE: 3/16" = 1'-0"

0 4' 8' 12'

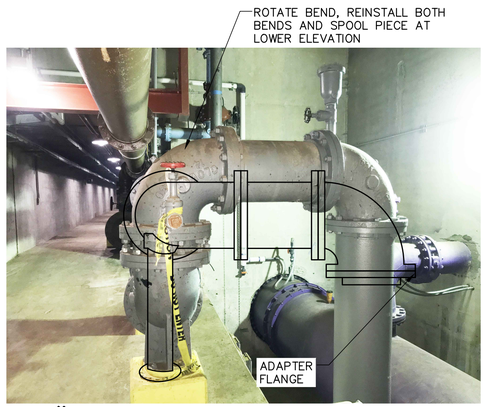
NOTE:

1. DUCT IS CUT APPROXIMATELY 3'–0" WEST OF THE ACTUAL SECTION CUT.



14" DRAIN – WEST ELEVATION

SCALE: NTS

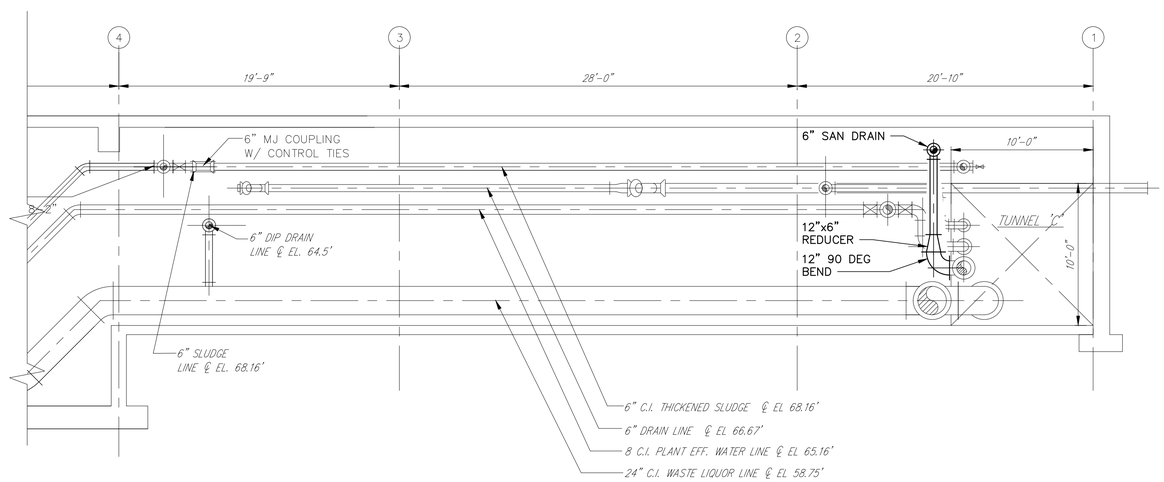


14" DRAIN – SOUTH ELEVATION

SCALE: NTS

NOTES:

1. 14" DRAIN PIPING MODIFICATIONS WORK LOCATED ~60' SOUTH OF BASEMENT IN TUNNEL "C".
2. FLUSH AND CLEAN DEPOSITS IN EX. 12" AND 14" DRAIN PIPING FROM BASEMENT TO THIS 14" PIPING MODIFICATIONS WORK AREA.



TUNNEL 'A' SECTIONAL VIEW

SCALE: 3/16" = 1'-0"

0 4' 8' 12'

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CANTON WATER RECLAMATION FACILITY SLUDGE PROCESSING MODIFICATIONS CONTRACT NO. 27

ARCADIS PROJ. NO. AK000343.B002

NO.	DATE	ISSUED FOR	BY

DATE:	MAY 2018
PROJECT NO.:	AK000343.B002
FILE NAME:	M–5A
DESIGNED BY:	DAF
DRAWN BY:	TNB
CHECKED BY:	JJW

SHEET TITLE

MECHANICAL

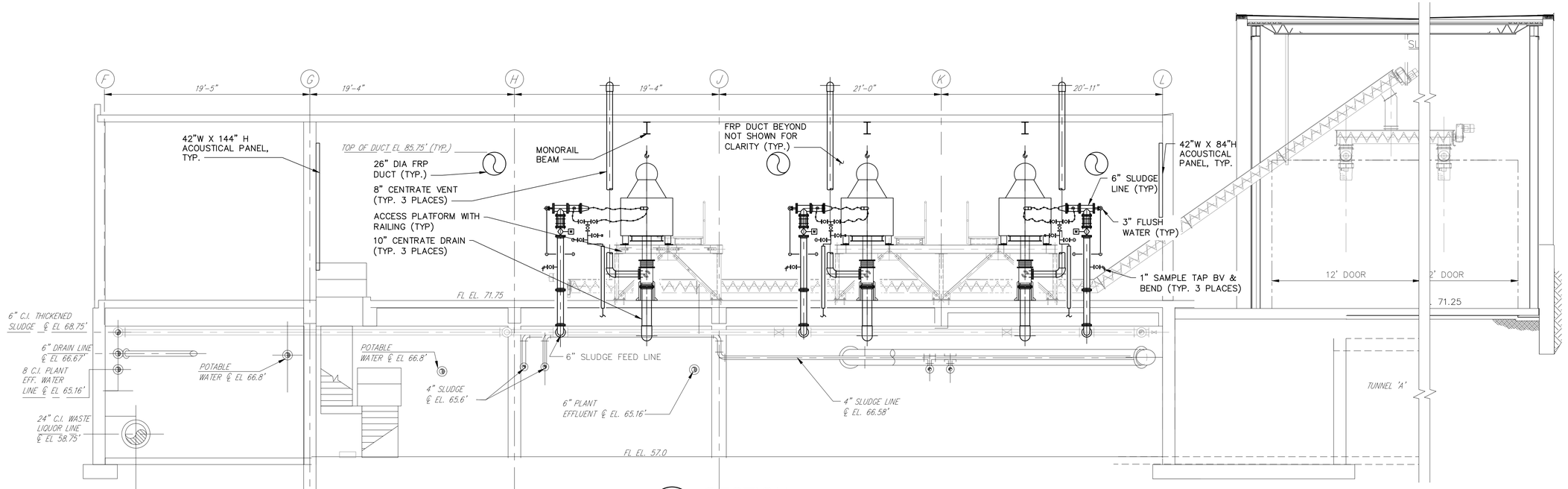
SLUDGE HANDLING BUILDING – ELEVATIONS, ALFA LAVAL

SCALE: AS SHOWN

M–5A

SHEET 32 OF 61

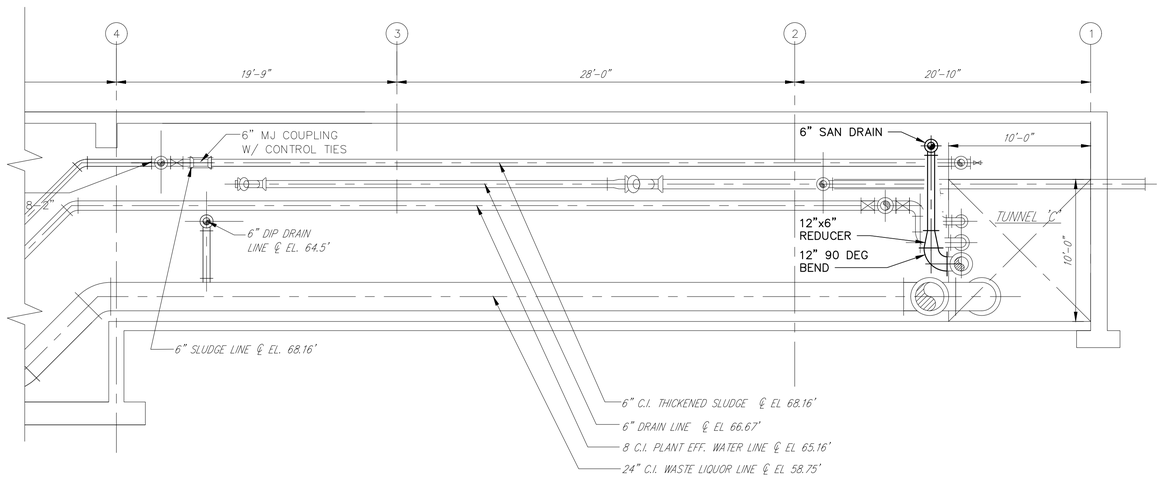
User:YN00655 Spec:AUS-NCSMOD File:I:\WATER\US\KB004316-01_CANTON WRFLE-DRAWINGS\SHEETS\MECHANICAL\M-5A.DWG Scale:1:1/2 SavedDate:5/22/2018 Time:10:47 Plot Date: Nimbargikar, Yoginath: 5/22/2018; 11:57 ; Layout:32



C / M–2G SECTION

SCALE: 3/16" = 1'-0"

0 4' 8' 12'



TUNNEL 'A' SECTIONAL VIEW

SCALE: 3/16" = 1'-0"

0 4' 8' 12'

NOTES:

1. DUCT IS CUT APPROXIMATELY 3'–0" WEST OF THE ACTUAL SECTION CUT.
2. REFER TO SHEET M–5A FOR TUNNEL "C" 14" DRAIN PIPING IMPROVEMENTS.

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CANTON WATER RECLAMATION FACILITY
SLUDGE PROCESSING MODIFICATIONS
CONTRACT NO. 27

ARCADIS PROJ. NO. AK000343.B002

NO.	DATE	ISSUED FOR	BY

DATE: MAY 2018
PROJECT NO.: AK000343.B002
FILE NAME: M–5G
DESIGNED BY: DAF
DRAWN BY: TNB
CHECKED BY: JJW

SHEET TITLE

MECHANICAL

SLUDGE HANDLING BUILDING – ELEVATIONS, GEA

SCALE: AS SHOWN

M–5G

SHEET 33 OF 61

User: YNI00655 Spec: AUS–NCSMOD File: I:\WATER\US\UB004316–01_CANTON MRF\E–DRAWINGS\SHEETS\MECHANICAL\M–5G.DWG Scale:1:1/2 Saved Date: 5/16/2018 Time: 16:28 Plot Date: Nimbargikar, Yoginath; 5/16/2018; 18:43 ; Layout:33

CENTRIFUGE NO. 1 CONTROL PANEL

CENTRIFUGE NO. 2 CONTROL PANEL

CENTRIFUGE NO. 3 CONTROL PANEL

SIDE MOUNT RAILING, SEE DETAILS ON STRUCTURAL DRAWINGS

CURB

RIO-RTU-SH

19'-9"

28'-0"

FD

4" BOOSTED PLANT EFFLUENT (UP) TO CENTRIFUGE (TYP. 3 PLACES) SEE UTILITY PIPING SCHEMATIC AND FLUSH WATER PIPING ELEVATION ON SHEET M-7

3" DI 90° BEND

4"x3" REDUCER

1" PVC BALL VALVE

3" FLUSH (CIP) WATER

2" POLYMER SOLUTION (UP) (INSIDE 4" PVC CASING PIPE TO 3' AFF)

CENTRIFUGE ROOM

ACCESS PLATFORM WITH HANDRAIL (TYP OF 3) (SEE STRUCTURAL)

10" CENTRATE DISCHARGE VENT (UP) (TYP. 3 PLACES)

10" SLOP DRAIN (CONNECT 1" FLUSH WATER TO HOR. BEND) (TYP. 3 PLACES)

3" FLUSH WATER

REMOVABLE STAIRS (TYP OF 3)

CENTRIFUGE NO. 1

CENTRIFUGE NO. 2

CENTRIFUGE NO. 3

4

3

2

L

K

J

H

C-1

PARTIAL PLAN @ CENTRIFUGE FLOOR LEVEL

SCALE: 3/8" = 1'-0"

0 2' 4' 6'

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ARCADIS PROJ. NO. AK000343.B002

NO.	DATE	ISSUED FOR	BY

DATE: MAY 2018

PROJECT NO.: AK000343.B002

FILE NAME: M-6A

DESIGNED BY: DAF

DRAWN BY: TNB

CHECKED BY: JJW

SHEET TITLE

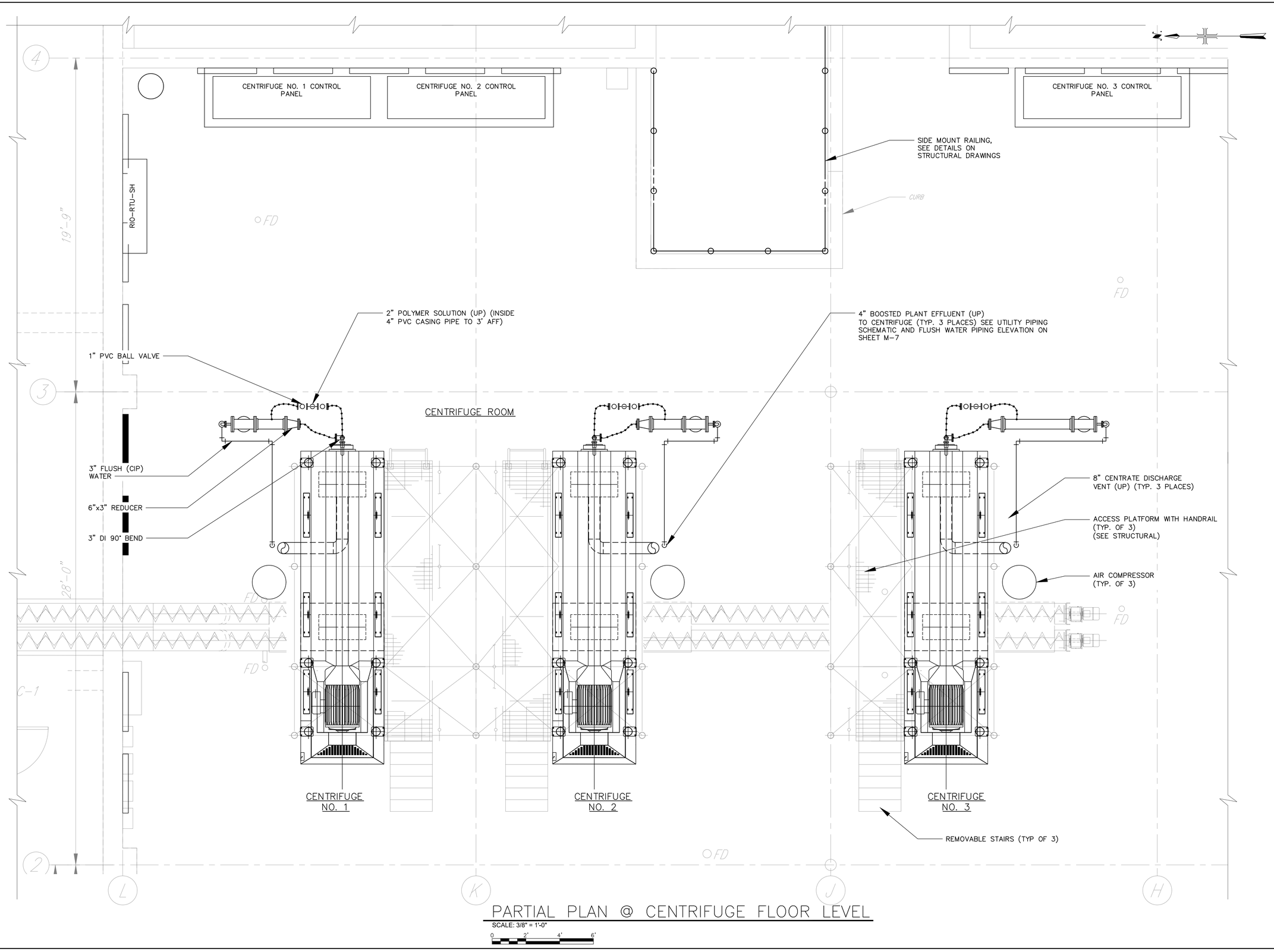
MECHANICAL

SLUDGE HANDLING BUILDING – ENLARGED CENTRIFUGE PLAN, ALFA LAVAL

SCALE: AS SHOWN

M-6A

SHEET 34 OF 61



PARTIAL PLAN @ CENTRIFUGE FLOOR LEVEL

SCALE: 3/8" = 1'-0"

0 2' 4' 6'

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SLUDGE PROCESSING MODIFICATIONS
CONTRACT NO. 27

ARCADIS PROJ. NO. AK000343.B002

NO.	DATE	ISSUED FOR	BY

DATE:	MAY 2018
PROJECT NO.:	AK000343.B002
FILE NAME:	M-6G
DESIGNED BY:	DAF
DRAWN BY:	TNB
CHECKED BY:	JJW

SHEET TITLE

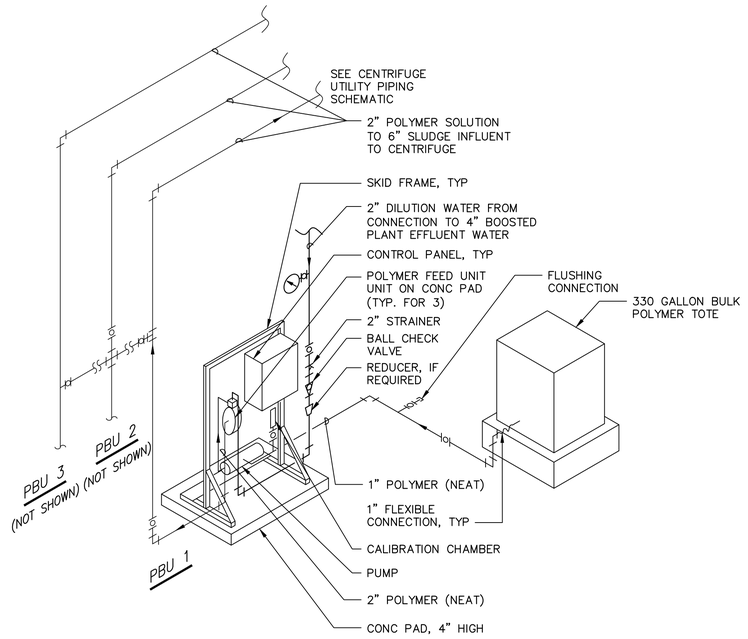
MECHANICAL

SLUDGE HANDLING BUILDING – ENLARGED CENTRIFUGE PLAN, GEA

SCALE: AS SHOWN

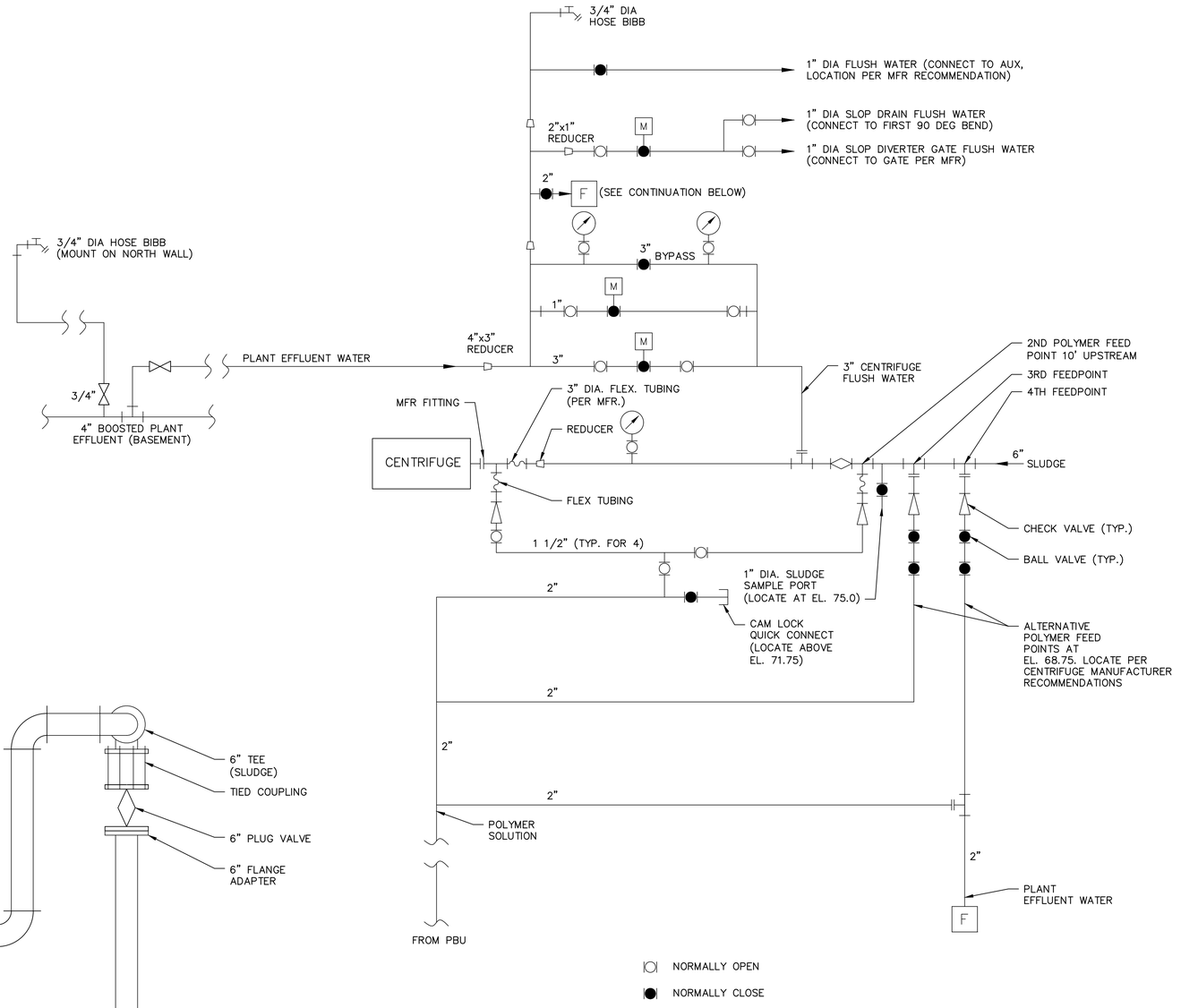
M-6G

SHEET 35 OF 61



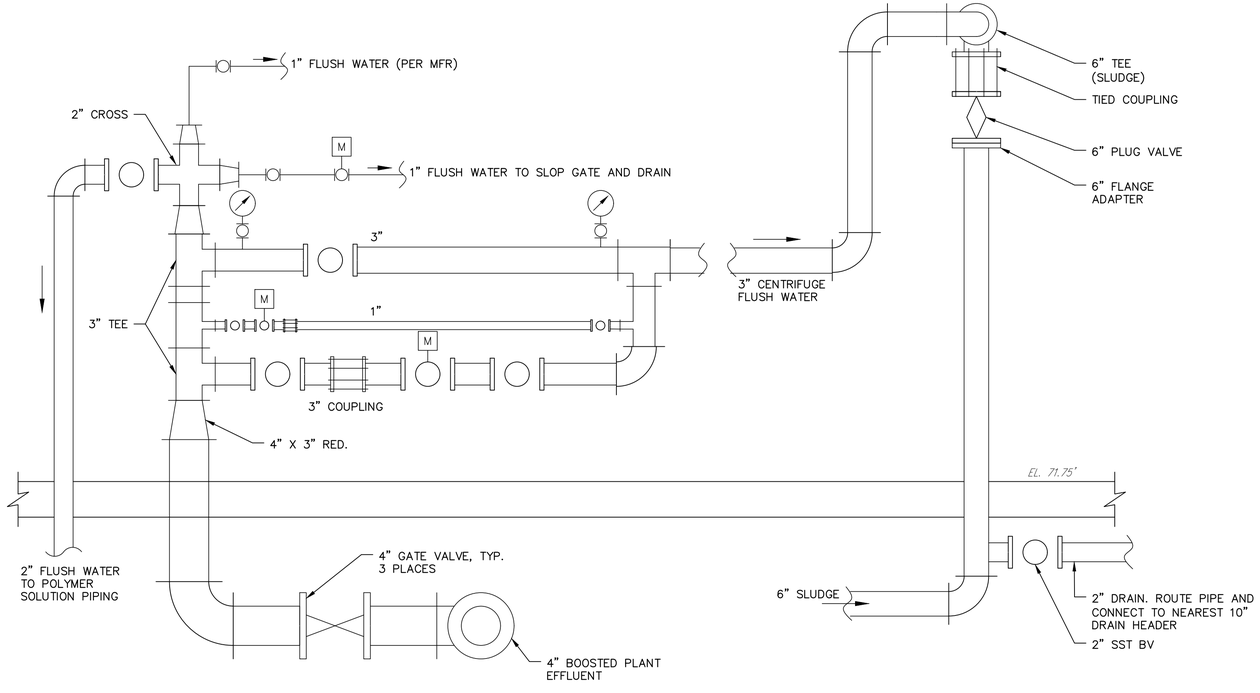
POLYMER BLENDING UNIT (PBU) SCHEMATIC

NTS (TYP. FOR 3 POLYMER BLENDING UNITS)



CENTRIFUGE UTILITY PIPING SCHEMATIC

NTS (TYP. FOR 3 CENTRIFUGES EACH)



FLUSH WATER PIPING ELEVATION

NTS (TYP. FOR EACH ALFA LAVAL CENTRIFUGE, SIMILAR BUT REVERSED FOR GEA)

NOTE:

1. PIPE SUPPORTS NOT SHOWN.

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ARCADIS PROJ. NO. AK000343.B002

NO.	DATE	ISSUED FOR	BY

DATE: MAY 2018
PROJECT NO.: AK000343.B002
FILE NAME: M-7
DESIGNED BY: DAF
DRAWN BY: TNB
CHECKED BY: JJW

SHEET TITLE

MECHANICAL

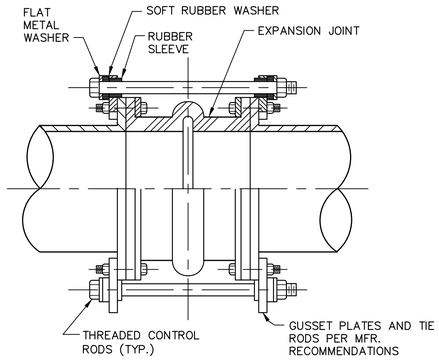
POLYMER BLENDING UNIT AND CENTRIFUGE PARTIAL UTILITY SCHEMATIC

SCALE: AS SHOWN

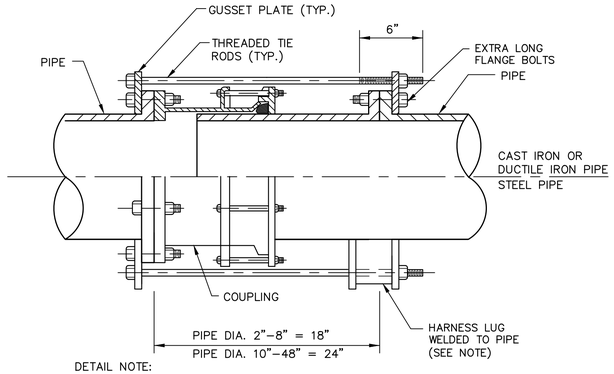
M-7

SHEET 36 OF 61

User:YN00655 Spec:AUS-NCSMOD File:I:\WATER\US\UB004316-01_CANTON WRF\E-DRAWINGS\SHEETS\MECHANICAL\M-7.DWG Scale:1:1 SavedDate:5/22/2018 Time:12:03 Plot Date: Nimbargikar, Yoginath; 5/22/2018, 17:39 ; Layout:36



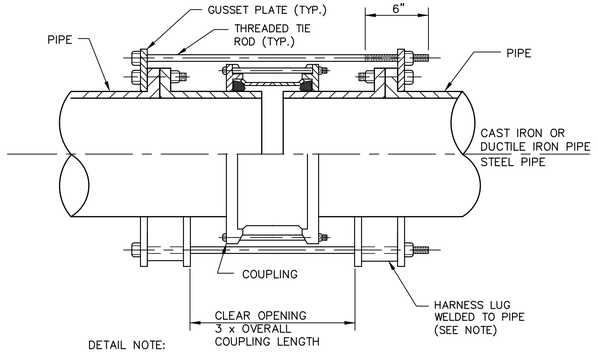
HARNESSED EXPANSION JOINT DETAIL



DETAIL NOTE:

1. THE NUMBER OF TIE RODS, HARNESS LUGS CONFIGURATION AND MATERIAL THICKNESS SHALL BE IN ACCORDANCE WITH AWWA M–11, STEEL PIPE – A GUIDE FOR DESIGN AND INSTALLATION.

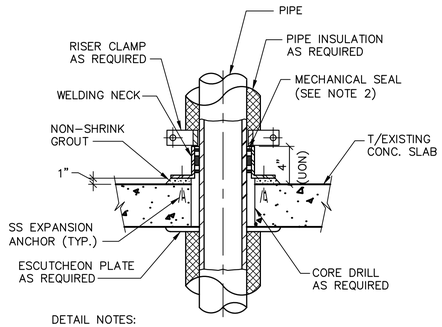
HARNESSED FLANGED COUPLING ADAPTER DETAIL



DETAIL NOTE:

1. THE NUMBER OF TIE RODS, HARNESS LUGS CONFIGURATION AND MATERIAL THICKNESS SHALL BE IN ACCORDANCE WITH AWWA M–11, STEEL PIPE – A GUIDE FOR DESIGN AND INSTALLATION.

HARNESSED SPLIT FLEXIBLE COUPLING DETAIL



DETAIL NOTES:

1. TYPE 1 – MECHANICAL SEAL REQUIRED
   TYPE 2 – MECHANICAL SEAL NOT REQUIRED
2. PROVIDE FIRE RATED MECHANICAL SEALS AS REQUIRED.

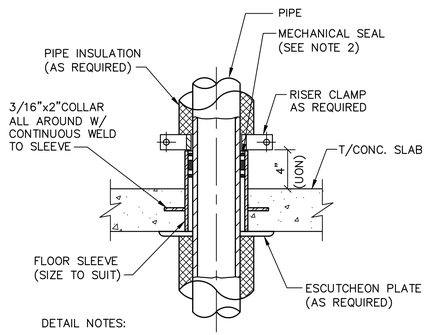
TYPICAL FLOOR CORE DETAIL

PIPE DIAMETER	SHIELD LENGTH	SHIELD THICKNESS
1/2" TO 1 1/2"	12"	18 USG
2" TO 4"	12"	16 USG
5" TO 6"	18"	16 USG
8" TO 14"	24"	14 USG
16" TO 30"	24"	12 USG

HANGER ARRANGEMENT OF INSULATED PIPING

HANGER ARRANGEMENT OF INSULATED PIPING

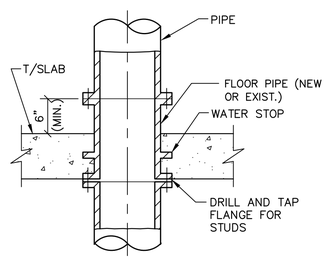
WALL SLEEVE ABANDONMENT DETAIL



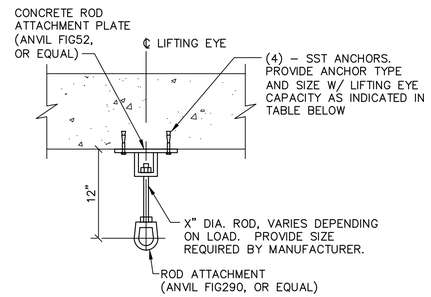
DETAIL NOTES:

1. TYPE 1 – MECHANICAL SEAL REQUIRED
   TYPE 2 – MECHANICAL SEAL NOT REQUIRED
2. PROVIDE FIRE RATED MECHANICAL SEALS AS REQUIRED.

TYPICAL FLOOR SLEEVE DETAIL



TYPICAL FLOOR PIPE DETAIL



REQUIRED CAPACITY	MINIMUM ROD DIAMETER	ANCHOR TYPE AND SIZE
2 kips	5/8"	1/2" DIA. EXPANSION ANCHORS W/ 3 1/2" EMBED (MIN)
4 kips	7/8"	5/8" DIA. THROUGH BOLTS (SEE NOTE 1)
6 kips	1 1/4"	7/8" DIA. THROUGH BOLTS (SEE NOTE 1)

LIFTING EYE DETAIL

NOTES:
1. PROVIDE 1/4"x12" SQUARE TOP PLATE.
2. MINIMUM ROD DIAMETER AND EXPANSION ANCHOR/ THROUGH BOLT DIAMETER BASED ON REQUIRED CAPACITIES AND NAMED PRODUCT MANUFACTURER.
3. UNLESS OTHERWISE NOTED, ALL COMPONENTS SHALL BE HOT–DIP GALVANIZED.

ARCADIS

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SLUDGE PROCESSING MODIFICATIONS
CONTRACT NO. 27

ARCADIS PROJ. NO. AK000343.B002

NO.	DATE	ISSUED FOR	BY

DATE: MAY 2018
PROJECT NO.: AK000343.B002
FILE NAME: M–8
DESIGNED BY: DAF
DRAWN BY: TNB
CHECKED BY: JJW

SHEET TITLE

MECHANICAL

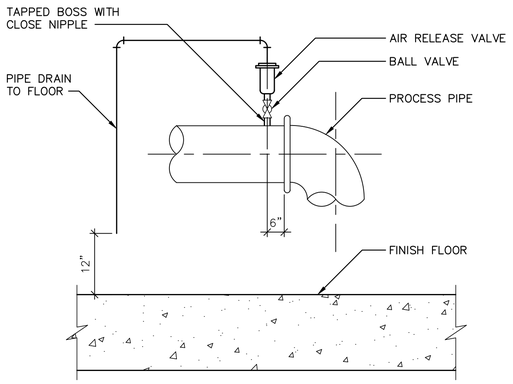
TYPICAL DETAILS SHEET 1 OF 2

SCALE: AS SHOWN

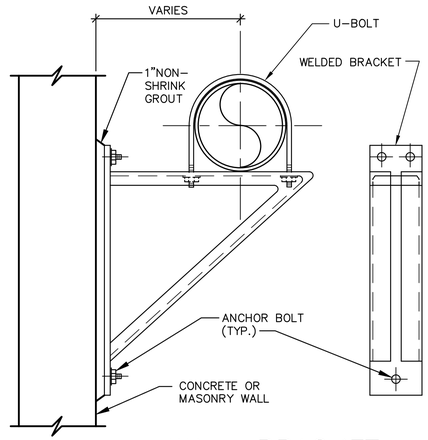
M–8

SHEET 37 OF 61

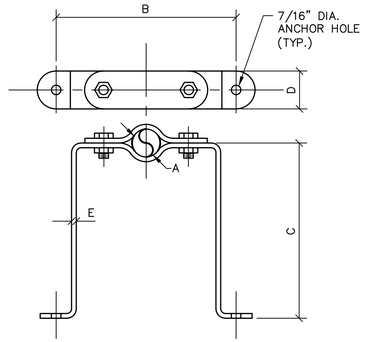
User:TBL00656 Spec:AUS–NCSMOD File:I:\WATER\US\UB000316–01_CANTON WRF\E–DRAWINGS\SHEETS\MECHANICAL\M–8.DWG Scale:1:1 SavedDate:5/14/2018 Time:18:31 Plot Date: Nimbargikar, Yoginath; 5/16/2018, 19:26 ; Layout:37



TYPICAL AIR RELEASE VALVE DETAIL

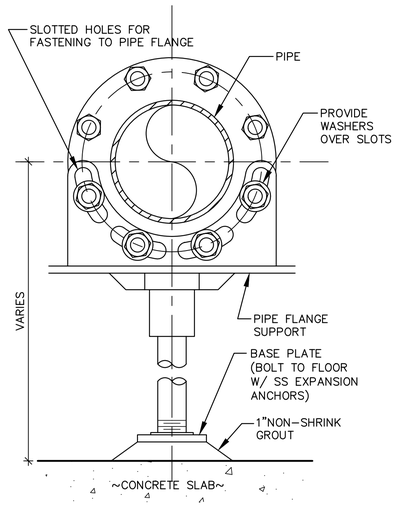


WALL BRACKET PIPE SUPPORT DETAIL

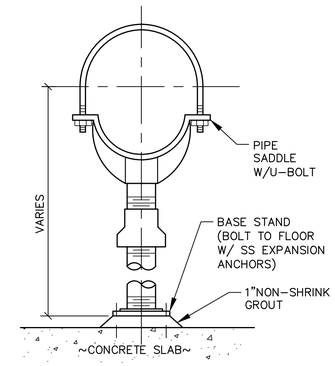


DIM.	PIPE SIZE		
A	1/2"–2"	2"–4"	4"–6"
B	6 1/4"	10"	14"
C	6"–10"	6"–12"	8"–16"
D	1 1/4"	2"	3"
E	3/16"	5/16"	3/8"
C/C SPACING	4'–0"	6'–0"	8'–0"

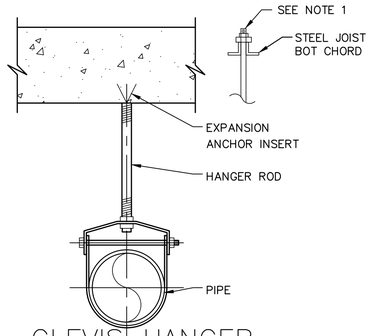
OFFSET CLAMP PIPE SUPPORT DETAIL



FLANGE PIPE SUPPORT DETAIL

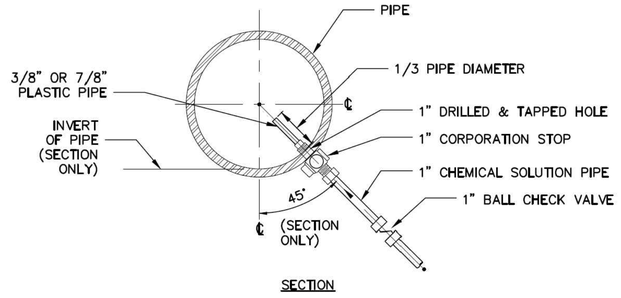


STANCHION SADDLE PIPE SUPPORT DETAIL



CLEVIS HANGER PIPE SUPPORT DETAIL

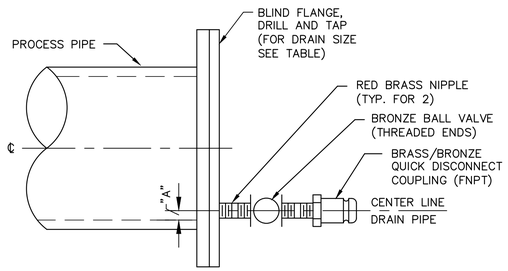
NOTES:
1. PROVIDE ATTACHMENT CONCENTRIC TO STEEL JOIST CHORD, MAXIMUM 50 POUNDS. IF LOAD EXCEEDS 50 POUNDS, JOIST MUST BE REINFORCED USING STEEL JOIST REINFORCING DETAIL ON SHEET S–0.4.



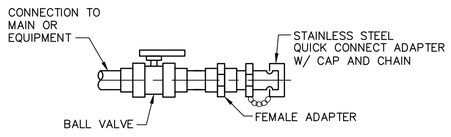
SECTION

TYPICAL CHEMICAL FEED POINT

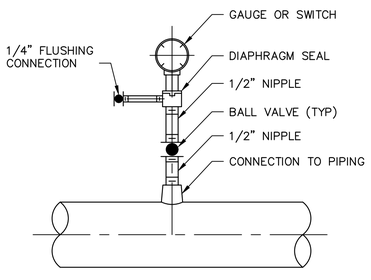
PROCESS PIPE SIZE	DRAIN SIZE	DIM. "A"	NIPPLE LENGTH
UP TO 10"	1 1/2"	1"	3"
12" TO 20"	2"	1"	3"
22" & LARGER	2 1/2"	1 1/2"	4"



FLUSHING/DRAIN CONNECTION W/ QUICK DISCONNECT COUPLING

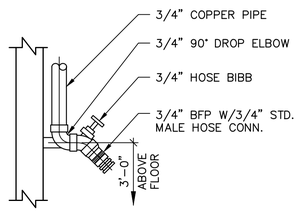


QUICK CONNECT DETAIL



PRESSURE GAUGE MOUNTING DETIAL

NTS



TYPICAL HOSE BIBB DETAIL

NTS NOTE: INSULATION NOT SHOWN

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ARCADIS U.S., INC.

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SEALS

STATE OF OHIO · DAVID A. FRANK · 53268 · REGISTERED PROFESSIONAL ENGINEER

CITY OF CANTON

CANTON WATER RECLAMATION FACILITY SLUDGE PROCESSING MODIFICATIONS CONTRACT NO. 27

ARCADIS PROJ. NO. AK000343.B002

NO.	DATE	ISSUED FOR	BY

DATE: MAY 2018
PROJECT NO.: AK000343.B002
FILE NAME: M–9
DESIGNED BY: DAF
DRAWN BY: TNB
CHECKED BY: JJW

SHEET TITLE

MECHANICAL

TYPICAL DETAILS SHEET 2 OF 2

SCALE: AS SHOWN

M–9

SHEET 38 OF 61

User:TB100656 Spec:AUS-NCSMOD File:I:\WATER\US\UB004316-01_CANTON WRF\E-DRAWINGS\SHEETS\MECHANICAL\M-9.DWG Scale:1:1 SavedDate:5/14/2018 Time:18:31 Plot Date: Nimbargikar, Yoginath; 5/16/2018, 19:25 ; Layout:38

ELECTRICAL SYMBOLS

MOTOR STARTER/CONTROLLER (NON-COMBINATION – COMBINATION – MANUAL) RV DENOTES REDUCED VOLTAGE

LOCAL CONTROL PANEL WITH CONTROLLERS FURNISHED BY EQUIPMENT VENDOR.

DUPLEX CONVENIENCE RECEPTACLE, 2 POLE, 3 WIRE, 120 VOLTS A.C. 20 AMP RECEPTACLE DESIGNATIONS, FIRST NUMBER DENOTES PANEL, SECOND NUMBER DENOTES CIRCUIT NUMBER. GF-DENOTES GROUND FAULT TYPE. SS-DENOTES SURGE SUPPRESSION TYPE

SINGLE CONVENIENCE RECEPTACLE, 2 POLE, 3 WIRE. REFER TO DRAWINGS FOR AMPERE AND VOLTAGE RATING.

POWER RECEPTACLE, 3 PHASE, 4 WIRE, 480V A.C. WITH DISCONNECT SWITCH. REFER TO DRAWINGS FOR AMPERE RATING.

POWER RECEPTACLE, 2 POLE, 3 WIRE 250 VOLTS A.C. REFER TO DRAWINGS FOR AMPERE RATINGS

120 VOLT, 2 POLE, 3 WIRE, CLASS I, DIVISION 1 EXPLOSION-PROOF RECEPTACLE

POWER ON-OFF SNAP SWITCH, 1PH, 120V AC, 20A

SINGLE POLE SWITCH – LOWER CASE LETTER DENOTES SWITCHING.

TWO POLE SWITCH

THREE-WAY SWITCH

FOUR-WAY SWITCH

TWO OR THREE POLE MANUAL STARTER, 20A

LETTERS AND NUMERALS INDICATE PANEL AND CIRCUIT NUMBER (LP1-2). CROSS LINES INDICATE NUMBER OF CONDUCTORS. HALF HASH MARKS INDICATES NEUTRAL. NUMBER DENOTES WIRE SIZE WHEN NOT #12 AWG. CONTINUE CONDUIT AND WIRE RUN FROM BOX TO DEVICE IN ROOM OR AREA AS NOTED BY BRANCH CIRCUIT NUMBER #10 AWG WIRING SHALL BE USED FOR RUNS BETWEEN PANEL AND FIRST LIGHTING FIXTURE OR RECEPTACLE EXCEEDING 50 FT, UNLESS OTHERWISE NOTED ON DRAWING.

INDICATES GROUND CONDUCTOR

INDICATES HOMERUN AND CONDUIT TAG; REFER TO ONE LINE AND INTERCONNECTION DIAGRAM

PUSHBUTTON STATION

PUSHBUTTON STATION WITH LOCK-OUT FEATURE

SELECTOR SWITCH

INDICATING LIGHT

CONTROL STATION

HAND-OFF-AUTO SELECTOR SWITCH CONTROL STATION

LOCAL-OFF-REMOTE SELECTOR SWITCH CONTROL STATION

DEVICE LOCATED IN FIELD AT OR NEAR MOTOR

DEVICE LOCATED IN CONTROL PANEL

CONTROL STATION FURNISHED BY EQUIPMENT VENDOR

AMMETER – AMMETER SWITCH

VOLTMETER – VOLTMETER SWITCH

LINE SWITCH DISCONNECT – UNFUSED OR FUSED F DENOTES FUSING, ONLY WHERE INDICATED. FIRST NUMBER DENOTES SWITCH AMP RATING. SECOND NUMBER DENOTES FUSE SIZE WHEN PROVIDED.

VARIABLE FREQUENCY DRIVE

JUNCTION BOX; SIZE AS REQUIRED BY N.E.C.

CURRENT TRANSFORMER

TERMINAL BOX; SIZE AS REQUIRED BY N.E.C. AND TO ACCOMMODATE ALL TERMINATIONS ON TERMINAL BLOCKS. TERMINATIONS TO INCLUDE SPARE WIRING.

MULTI FUNCTIONAL METERING DEVICE

LIGHTNING ARRESTOR

PULL BOX; SIZE AS REQUIRED BY N.E.C.

LOCK FOR RESPECTIVE KEY INTERLOCK WITH KEY CAPTIVE IN LOCK

OVERTEMPERATURE DEVICE

ELECTRIC MOTOR (NUMBER INDICATES HORSEPOWER).

PROVIDE CHANNEL SUPPORT. FOR 120 VOLT BRANCH CIRCUIT MOTORS, NUMERALS DENOTES DISTRIBUTION OR LIGHTING PANEL AND BRANCH CIRCUIT NUMBER.

MOTORIZED VALVE WITH CONTROLLER

MOTORIZED DAMPER WITH CONTROLLER

GROUND TEST POINT

GROUND ROD

GROUND GRID CABLE CONNECTION

GROUND

#4/0 GROUND CABLE BURIED 2'-6" BELOW GRADE

FUSE-PFD DENOTES PULL FUSE DISCONNECT TYPE

INSTANT OPERATING CONTACT, NORMALLY CLOSED

INSTANT OPERATING CONTACT, NORMALLY OPEN

LIMIT SWITCH, NORMALLY CLOSED

LIMIT SWITCH, NORMALLY OPEN

PRESSURE OR VACUUM SWITCH, NORMALLY CLOSED

PRESSURE OR VACUUM SWITCH, NORMALLY OPEN

LEVEL OR FLOAT SWITCH, NORMALLY CLOSED

LEVEL OR FLOAT SWITCH, NORMALLY OPEN

TEMPERATURE ACTUATED SWITCH OR THERMOSTAT NORMALLY CLOSED

TEMPERATURE ACTUATED SWITCH OR THERMOSTAT NORMALLY OPEN

FLOW SWITCH, NORMALLY OPEN

FLOW SWITCH, NORMALLY CLOSED

2 POSITION SELECTOR SWITCH

SURGE PROTECTIVE DEVICE

LIGHTING FIXTURE – SURFACE OR PENDANT MOUNTED. SEE LIGHTING FIXTURE SCHEDULE FOR TYPE. FIRST NUMERAL DENOTES LIGHTING PANEL (LP1), SECOND NUMBER DENOTES BRANCH CIRCUIT NUMBER. LOWER CASE LETTER DENOTES SWITCHED CIRCUIT.

EXIT SIGN, BATTERY BACKUP TYPE. CONNECT TO ROOM LIGHTING CIRCUIT AHEAD OF SWITCH

FIXTURE DESIGNATION SYMBOL. SEE LIGHTING FIXTURE SCHEDULE FOR DESCRIPTION AND TYPE. ALL FIXTURES SHOWN IN A ROOM WITH THIS SYMBOL SHALL BE OF TYPE INDICATED BY LETTER; NUMBER IN SYMBOL INDICATES LAMP WATTAGE AND NUMBER OF LAMPS WHERE MORE THAN ONE (UNLESS OTHERWISE NOTED). NUMBER BELOW SYMBOL INDICATES MOUNTING HEIGHT ABOVE FINISHED FLOOR OR AS NOTED.

POTENTIAL TRANSFORMER

(FRAME SIZE) / (TRIP SIZE) 2P
THERMAL-MAGNETIC BREAKER
2P DENOTES 2 POLE

LOW VOLTAGE DRAW-OUT POWER CIRCUIT BREAKER ELECTRICALLY OPERATED.

(FRAME SIZE) / (SENSOR RATING) (600P)
DENOTE PLUG RATING
DRAWOUT POWER CIRCUIT BREAKER WITH RMS TYPE SOLID STATE TRIP

FIXED MOUNTED POWER OR MOLDED CASE CIRCUIT BREAKER WITH RMS TYPE SOLID STATE TRIP PROGRAMMER. EO DENOTES ELECTRICALLY OPERATED.

MEDIUM VOLTAGE DRAW-OUT POWER CIRCUIT BREAKER

(CONTINUOUS RATING) / (MOTOR CIRCUIT PROTECTOR)
AC COMBINATION FULL VOLTAGE NON-REVERSING STARTER WITH MAGNETIC BREAKER

UNIT HEATER-NUMERAL DENOTES LIGHTING PANEL AND BRANCH CIRCUIT NUMBER

THERMOSTAT

AIR INTERRUPTER SWITCH WITH FUSING WHERE NOTED

TRANSFORMER- TYPE AND SIZE AS NOTED ON THE THE DRAWINGS AND IN SPECIFICATIONS

SUBMERSIBLE CABLES BY VENDOR

INDICATES NEW EQUIPMENT/CONDUIT

INDICATES EXISTING EQUIPMENT/CONDUIT

INDICATES CONCEALED OR UNDERGROUND EQUIPMENT/CONDUIT

INDICATES AUTOMATIC TRANSFER SWITCH WITH SOLID STATE CONTROLS AND ACCESSORIES

INSTRUMENTS

INSTRUMENT DEVICE: LETTERS IDENTIFY DEVICE FUNCTION, NUMBERS WHERE INDICATED DENOTE LOOP NUMBER

PRESSURE CONTROLLER

PRESSURE SWITCH (PSH DENOTES PRESSURE SWITCH HIGH AND PSL DENOTES PRESSURE LOW)

DIFFERENTIAL PRESSURE SWITCH (dPSH DENOTES PRESSURE SWITCH HIGH AND dPSL DENOTES PRESSURE SWITCH LOW)

DIAPHRAGM LEAK DETECTOR

HIGH SPEED SWITCH

FLOW SWITCH (FSH DENOTES FLOW SWITCH HIGH AND FSL DENOTES FLOW SWITCH LOW)

LIMIT SWITCH

PRESSURE TRANSMITTER (I DENOTES INDICATING TYPE)

INDICATING LIGHT LETTER "A" DENOTES AMBER COLOR LETTER "R" DENOTES RED COLOR

ANALYSIS TRANSMITTER (AE DENOTES ANALYSIS ELEMENT)

TEMPERATURE TRANSMITTER (TE DENOTES TEMPERATURE ELEMENT)

TEMPERATURE SWITCH (TSH DENOTES TEMPERATURE SWITCH HIGH AND TSL DENOTES TEMPERATURE SWITCH LOW)

LEVEL SWITCH (LSH DENOTES LEVEL SWITCH HIGH AND LSL DENOTES LEVEL SWITCH LOW)

MOTORIZED VALVE

SOLENOID VALVE

STROKE POSITIONER

LEVEL TRANSMITTER (LE DENOTES LEVEL ELEMENT)

FLOW TRANSMITTER (FE DENOTES FLOW ELEMENT)

STROBE LIGHT

MISCELLANEOUS SPECIAL SYSTEMS

ACP – ALARM CONTROL PANEL

FACP – FIRE ALARM CONTROL PANEL

FIRE ALARM SYSTEM STROBE LIGHT/HORN COMBINATION

FIRE ALARM SYSTEM MANUAL PULL STATION

SPEAKER HORN
H = HORN
PS = PAGING SPEAKER
C = CEILING MOUNTED SPEAKER

A/V – AUDIO VISUAL DEVICE

A/V-S – AUDIO VISUAL STATION

ALARM BEACON

GENERAL NOTES

1. THE SYMBOLS AND ABBREVIATIONS LIST ON THIS SHEET IS A COMPREHENSIVE STANDARD GUIDE INTENDED FOR GENERAL USE ON ALL PROJECTS. THEREFORE NOT ALL THE SYMBOLS AND ABBREVIATIONS CONTAINED IN THIS LIST ARE NECESSARILY USED ON THIS PARTICULAR PROJECT AND SHOULD BE USED FOR CLARIFICATION ONLY.
2. PROVIDE JUNCTION BOX FOR ANY DEVICE WITH PIG TAIL SUCH AS SOLENOID VALVES, LIMIT SWITCHES, SMOKE DETECTORS AND ETC. FOR PROPER ELECTRICAL CONNECTION. PROVIDE ALL HARDWARE FOR MOUNTING OF JUNCTION BOX.
3. PROVIDE INDEPENDENT SUPPORT FOR DISCONNECT SWITCHES, CONTROL STATIONS, BOXES, PANELS, ETC. WHERE NO WALLS OR OTHER STRUCTURAL SURFACE EXISTS.
4. EQUIPMENT SIZES AND LOCATIONS ARE APPROXIMATE. ACTUAL DIMENSIONS TO BE DETERMINED BY EQUIPMENT FURNISHED.
5. ALL WORK AT THE PROJECT SITE SHALL BE IN ACCORDANCE WITH JOB CONDITIONS SPECIFIED IN SECTION 26 05 05.

ABBREVIATIONS

AC	ALTERNATING CURRENT
AFF	ABOVE FINISH FLOOR
AFG	ABOVE FINISHED GRADE
ATC	AUTOMATIC TEMPERATURE CONTROL PANEL
ATS	AUTOMATIC TRANSFER SWITCH
AWG	AMERICAN WIRE GAUGE
BKR	BREAKER
C	CONDUIT
CBV	CABLE BY VENDOR, INSTALLED BY CONTRACTOR
CKT	CIRCUIT
CNT	CONTROL
CP	CONTROL PANEL
CPT	CONTROL POWER TRANSFORMER
CT	CURRENT TRANSFORMER
DN	DOWN
DP	DISTRIBUTION PANEL
EC	EMPTY CONDUIT
EF	EXHAUST FAN
EL	ELEVATION
EW	EACH WAY
EXP	EXPLOSION PROOF
EXIST	EXISTING
FDR	FEEDER
FIXT	FIXTURE
FVNR	FULL VOLTAGE NON-REVERSING
GI	GALVANIZED IRON
G OR GND	GROUND
GF	GROUND FAULT
HOA	HAND-OFF-AUTOMATIC
I&C	INSTRUMENTATION & CONTROL
IMLR	INTERNAL MIXED LIQUOR RETURN
JB	JUNCTION BOX
K	KCMIL (ONE THOUSAND CIRCULAR MILLS)
LCP	LOCAL CONTROL PANEL
L.O.	LOCKOUT
LP	LIGHTING PANELBOARD
LTG	LIGHTING
M	MOTOR
MCC	MOTOR CONTROL CENTER
MCM	ONE THOUSAND CIRCULAR MILS
MMD	MICROPROCESSOR-BASED METERING DEVICE
MTS	MANUAL TRANSFER SWITCH
NA	NON-AUTOMATIC
NCTC	NORMALLY CLOSED, TIMED TO CLOSE
NCTO	NORMALLY CLOSED, TIMED TO OPEN
NOTC	NORMALLY OPEN, TIMED TO CLOSED
NOTO	NORMALLY OPEN, TIMED TO OPEN
NTS	NOT TO SCALE
OL'S	MOTOR OVERLOAD HEATERS
OT	OVER TEMPERATURE
PB	PULL BOX
PFD	PULL FUSE DISCONNECT
PNL	PANEL
PP	POWER PANEL
PT	POTENTIAL TRANSFORMER
PWR	POWER
R1	RELAY #1
RECEP	RECEPTACLE
RVNR	REDUCED VOLTAGE NON-REVERSING
(S) (SH)	SHIELDED CABLE
SP	SPARE
SS	SELECTOR SWITCH
SWBD	SWITCHBOARD
SWGR	SWITCHGEAR
TEMP	TEMPERATURE
TEW	THERMOCOUPLE EXTENSION WIRE
TR1	TIME DELAY RELAY #1
UON	UNLESS OTHERWISE NOTED
USE	UNDERGROUND SERVICE ENTRANCE
V	CABLE VOLT
VFD	VARIABLE FREQUENCY DRIVE
WP	WEATHERPROOF
WT	WINDING TEMPERATURE RELAY
XFMR	TRANSFORMER
NEC	NATIONAL ELECTRIC CODE
(TYP)	TYPICAL
ø	PHASE
#	NUMBER

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LEGAL ENTITY:
ARCADIS U.S., INC.

CONSULTANTS

SUB CONSULTANTS

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STATE OF OHIO · JOHN MICHAEL SIDOTI · E-71807 · REGISTERED PROFESSIONAL ENGINEER

CITY OF CANTON

CANTON WATER RECLAMATION FACILITY SLUDGE PROCESSING MODIFICATIONS CONTRACT NO. 27

ARCADIS PROJ. NO. AK000343.B002

NO.	DATE	ISSUED FOR	BY

DATE: MAY 2018
PROJECT NO.: AK000343.B002
FILE NAME: E-1
DESIGNED BY: NCP
DRAWN BY: NCP
CHECKED BY: JMS

SHEET TITLE

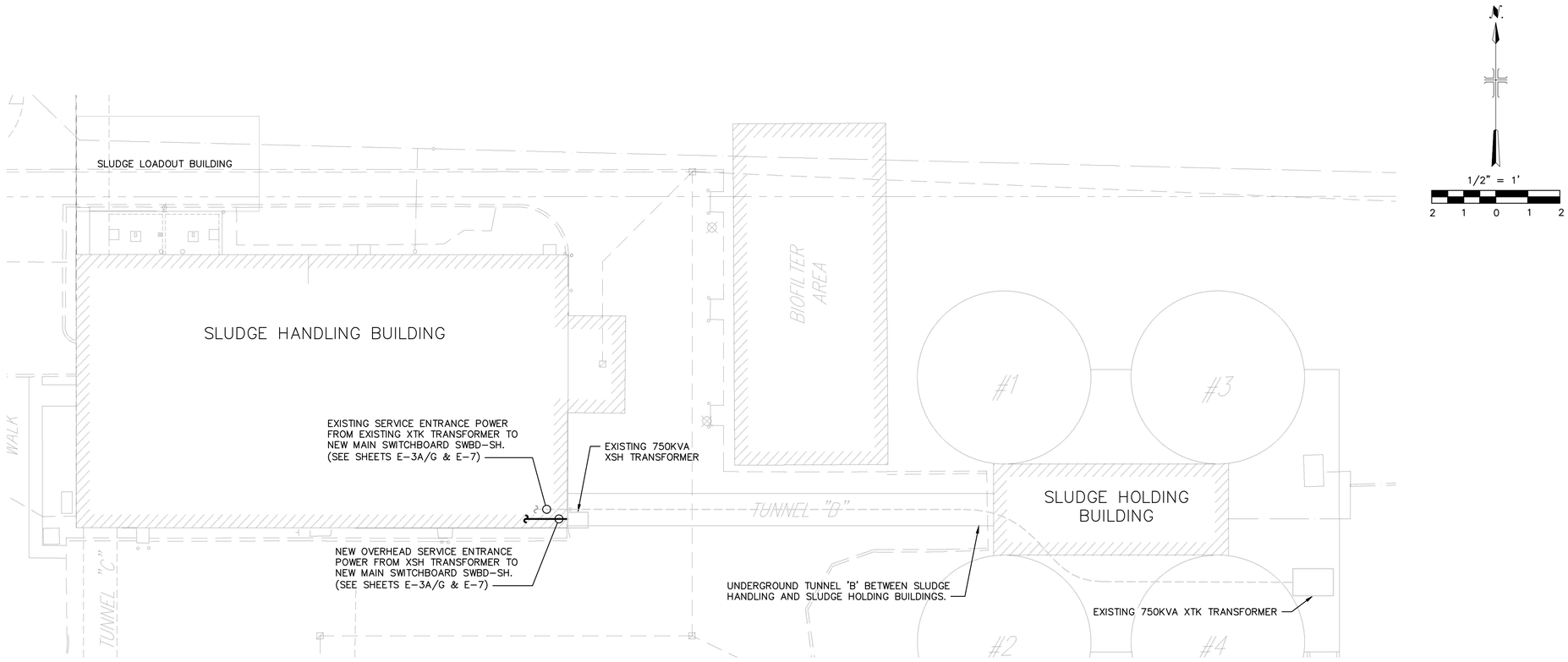
ELECTRICAL

SYMBOLS AND NOTES

SCALE: NOT TO SCALE

E-1

SHEET 39 OF 61



ENLARGED SITE PLAN: SLUDGE HANDLING AND SLUDGE HOLDING BUILDING

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REGISTERED PROFESSIONAL ENGINEER

CITY OF CANTON

CANTON WATER RECLAMATION FACILITY SLUDGE PROCESSING MODIFICATIONS CONTRACT NO. 27

ARCADIS PROJ. NO. AK000343.B002

NO.	DATE	ISSUED FOR	BY

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PROJECT NO.: AK000343.B002
FILE NAME: E-2
DESIGNED BY: NCP
DRAWN BY: NCP
CHECKED BY: JMS

SHEET TITLE

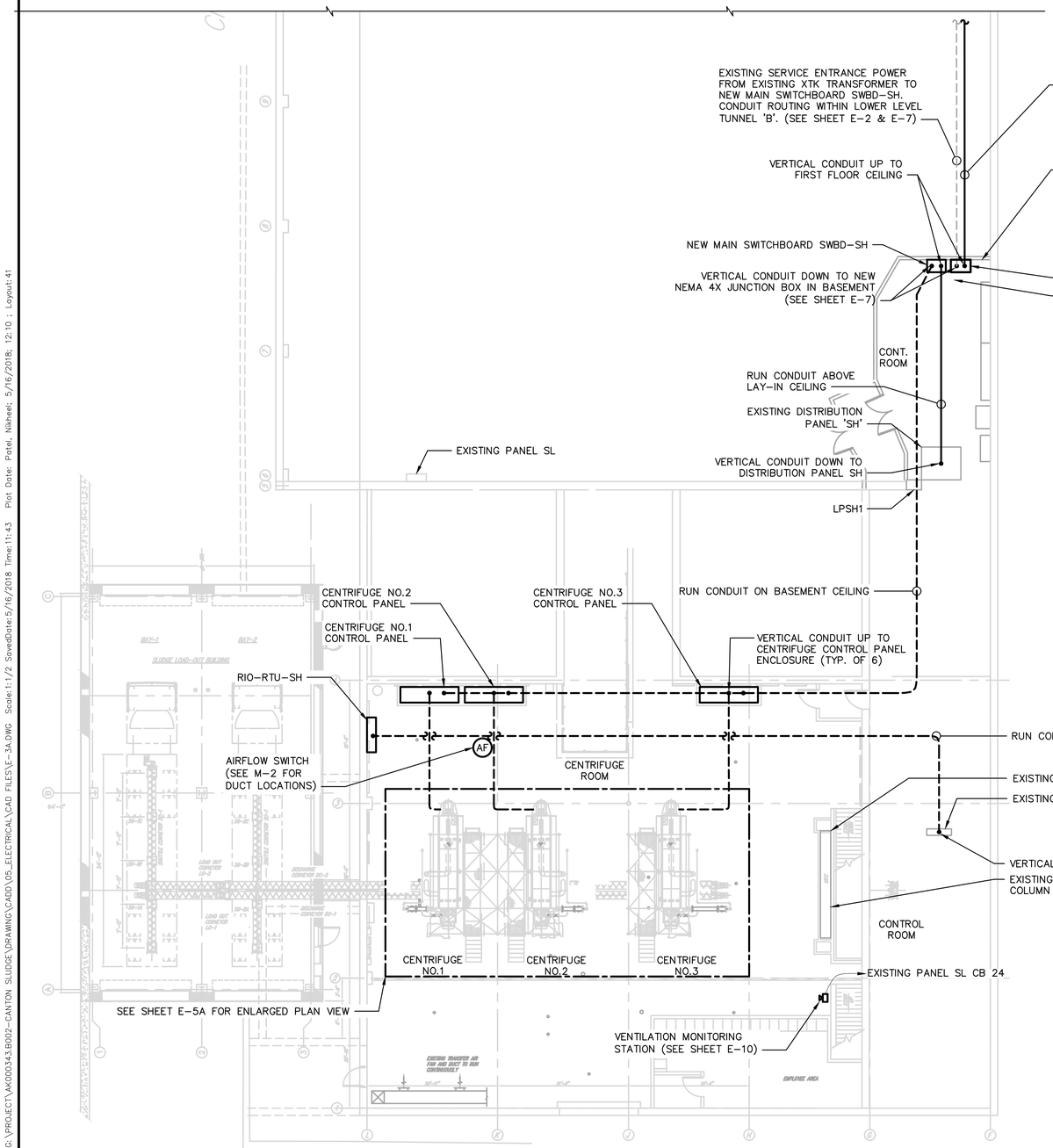
ELECTRICAL

SITE PLAN

SCALE: 1/2" = 1'

E-2

SHEET 40 OF 61



POWER PLAN – FIRST FLOOR

SCALE: 3/32" = 1'-0"

4' 0 8' 16'

POWER PLAN NOTES:

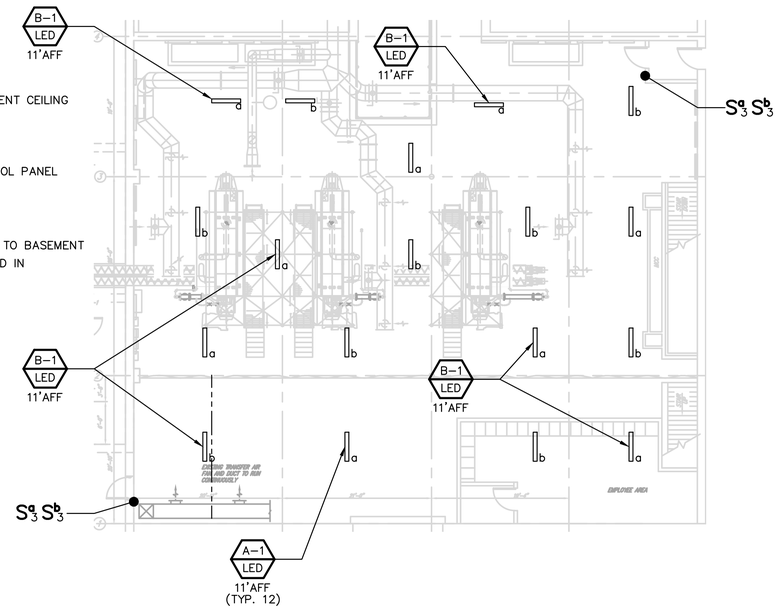
1. ALL OUTDOOR AREAS AND CENTRIFUGE AREA ARE CONSIDERED WET AND CORROSIVE LOCATIONS. CONTROL ROOMS ARE CONSIDERED DUSTY LOCATIONS. ALL MATERIALS, EQUIPMENT, INCIDENTALS, ETC. SHALL CONFORM TO THE REQUIREMENTS OF THE AREA'S CLASSIFICATION.
2. FOR CLARITY NOT ALL CONDUIT RUN AND HOMERUNS ARE SHOWN. REFER TO ONE LINE DIAGRAM (E-7) AND BLOCK DIAGRAM (E-9A/G) FOR CONDUIT AND CABLE INSTALLATION.
3. CONDUIT RUN SHOWN IS DIAGRAMMATIC FOR CONTRACTOR'S GUIDANCE. CONTRACTOR SHALL FIELD DETERMINE FINAL ROUTE TO AVOID INTERFERENCE WITH NEW AND EXISTING EQUIPMENT AND SYSTEM. PROVIDE CONDUIT SUPPORTS, CORE DRILLS, SEALING BUSHINGS AND INCIDENTALS AS REQUIRED.

LIGHTING PLAN NOTES:

1. CONTRACTOR SHALL REUSE (2) EXISTING 20A, 277V, SINGLE POLE LIGHTING CIRCUIT BREAKERS IN PANEL LPSH1.
2. CONTRACTOR SHALL COORDINATE WITH MECHANICAL AND STRUCTURAL DRAWINGS TO ENSURE LUMINAIRE HAVE PROPER CLEARANCE FROM ALL CENTRIFUGE UNITS, DUCTS, VENTS, MONORAIL BEAMS, AND STRUCTURAL BEAMS.
3. CENTRIFUGE ROOM LIGHTING PLAN IS TYPICAL FOR DRAWINGS E-3A AND E-3G.

LUMINAIRE SCHEDULE

FIXTURE TYPE	DESCRIPTION	MANUFACTURER
A-1	LED LIGHT FIXTURE, 4 FOOT LENGTH, STEM MOUNTED, UL LISTED SUITABLE FOR WET LOCATIONS AND NON-CORROSIVE. FIXTURE SHALL HAVE A MINIMUM OF 7000LM, AND OPERATE AT 277V.	PHILIPS DAY-BRITE VAPORLUME LED DW (DWAE70L840-4-UNV) OR EQUAL.
B-1	LED LIGHT FIXTURE, 4 FOOT LENGTH, STEM MOUNTED, UL LISTED SUITABLE FOR WET LOCATIONS AND NON-CORROSIVE. FIXTURE SHALL HAVE A MINIMUM OF 7000LM, INTEGRAL EMERGENCY BACKUP EMLED OPTION AND OPERATE AT 277V.	PHILIPS DAY-BRITE VAPORLUME LED DW (DWAE70L840-4-UNV-EMLED) OR EQUAL.



LIGHTING PLAN

SCALE: 3/32" = 1'-0"

4' 0 8' 16'

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ARCADIS U.S., INC.

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CANTON WATER RECLAMATION FACILITY SLUDGE PROCESSING MODIFICATIONS CONTRACT NO. 27

ARCADIS PROJ. NO. AK000343.B002

NO.	DATE	ISSUED FOR	BY

DATE:	MAY 2018
PROJECT NO.:	AK000343.B002
FILE NAME:	E-3A
DESIGNED BY:	NCP
DRAWN BY:	NCP
CHECKED BY:	JMS

SHEET TITLE

ELECTRICAL

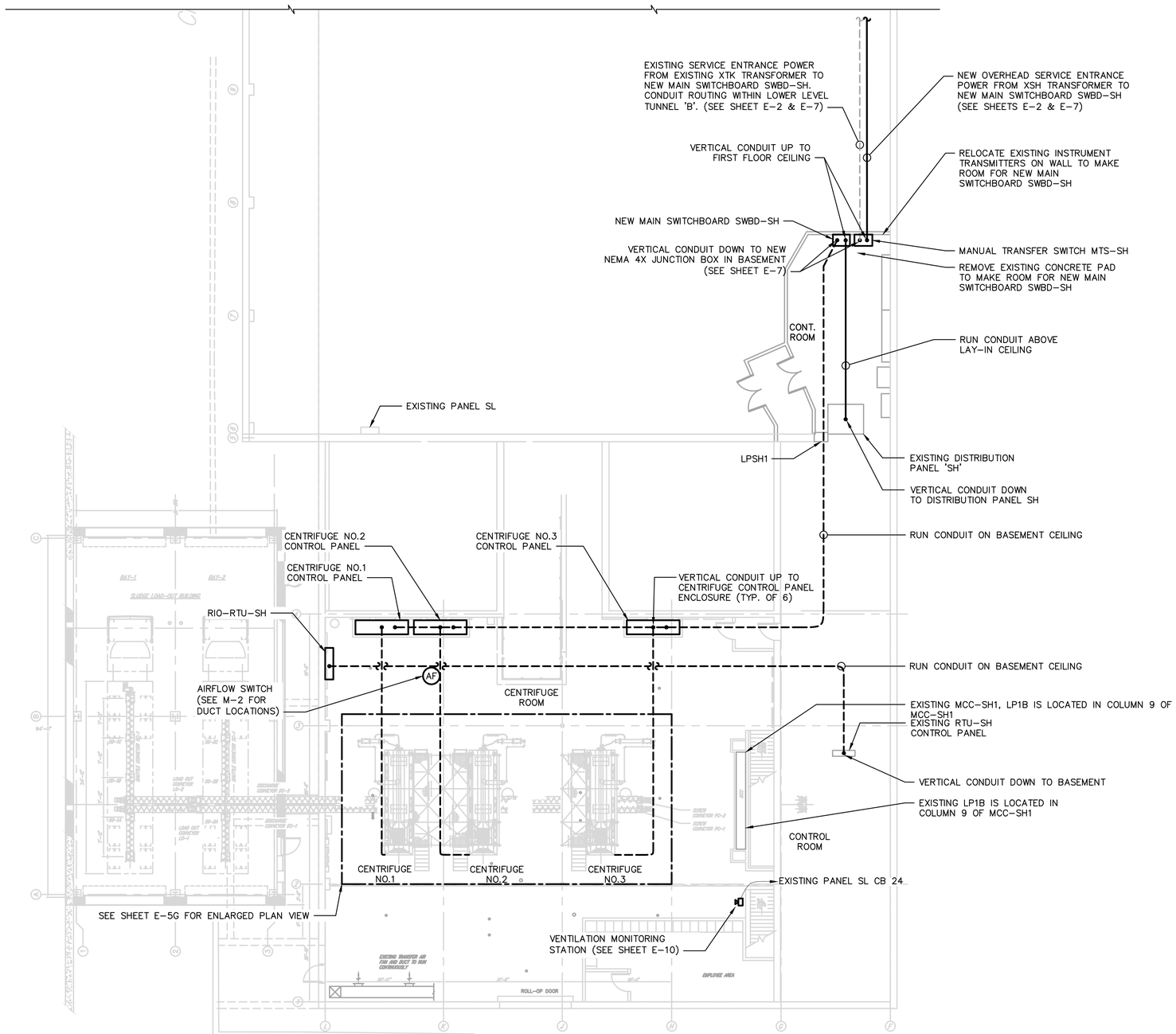
POWER PLAN SLUDGE HANDLING BUILDING – FIRST FLOOR, ALFA LAVAL

SCALE: AS SHOWN

E-3A

SHEET 41 OF 61

User:NPATEL Spec:AUS-NCSM0D File:G:\PROJECT\AK000343.B002-CANTON SLUDGE\DRAWING\CAD\05_ELECTRICAL\CAD FILES\E-3A.DWG Scale:1:1/2 SavedDate:5/16/2018 Time:11:43 Plot Date: Patel, Nikheil; 5/16/2018; 12:10 - Layout:41



POWER PLAN – FIRST FLOOR

SCALE: 3/32" = 1'-0"

4' 0 8' 16'

POWER PLAN NOTES:

1. ALL OUTDOOR AREAS AND CENTRIFUGE AREA ARE CONSIDERED WET AND CORROSIVE LOCATIONS. CONTROL ROOMS ARE CONSIDERED DUSTY LOCATIONS. ALL MATERIALS, EQUIPMENT, INCIDENTALS, ETC. SHALL CONFORM TO THE REQUIREMENTS OF THE AREA'S CLASSIFICATION.
2. FOR CLARITY NOT ALL CONDUIT RUN AND HOMERUNS ARE SHOWN. REFER TO ONE LINE DIAGRAM (E–7) AND BLOCK DIAGRAM (E–9A/G) FOR CONDUIT AND CABLE INSTALLATION.
3. CONDUIT RUN SHOWN IS DIAGRAMMATIC FOR CONTRACTOR'S GUIDANCE. CONTRACTOR SHALL FIELD DETERMINE FINAL ROUTE TO AVOID INTERFERENCE WITH NEW AND EXISTING EQUIPMENT AND SYSTEM. PROVIDE CONDUIT SUPPORTS, CORE DRILLS, SEALING BUSHINGS AND INCIDENTALS AS REQUIRED.
4. SEE DRAWING E–3A FOR CENTRIFUGE ROOM LIGHTING PLAN.

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CANTON WATER RECLAMATION FACILITY SLUDGE PROCESSING MODIFICATIONS CONTRACT NO. 27

ARCADIS PROJ. NO. AK000343.B002

NO.	DATE	ISSUED FOR	BY

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DESIGNED BY:	NCP
DRAWN BY:	NCP
CHECKED BY:	JMS

SHEET TITLE

ELECTRICAL

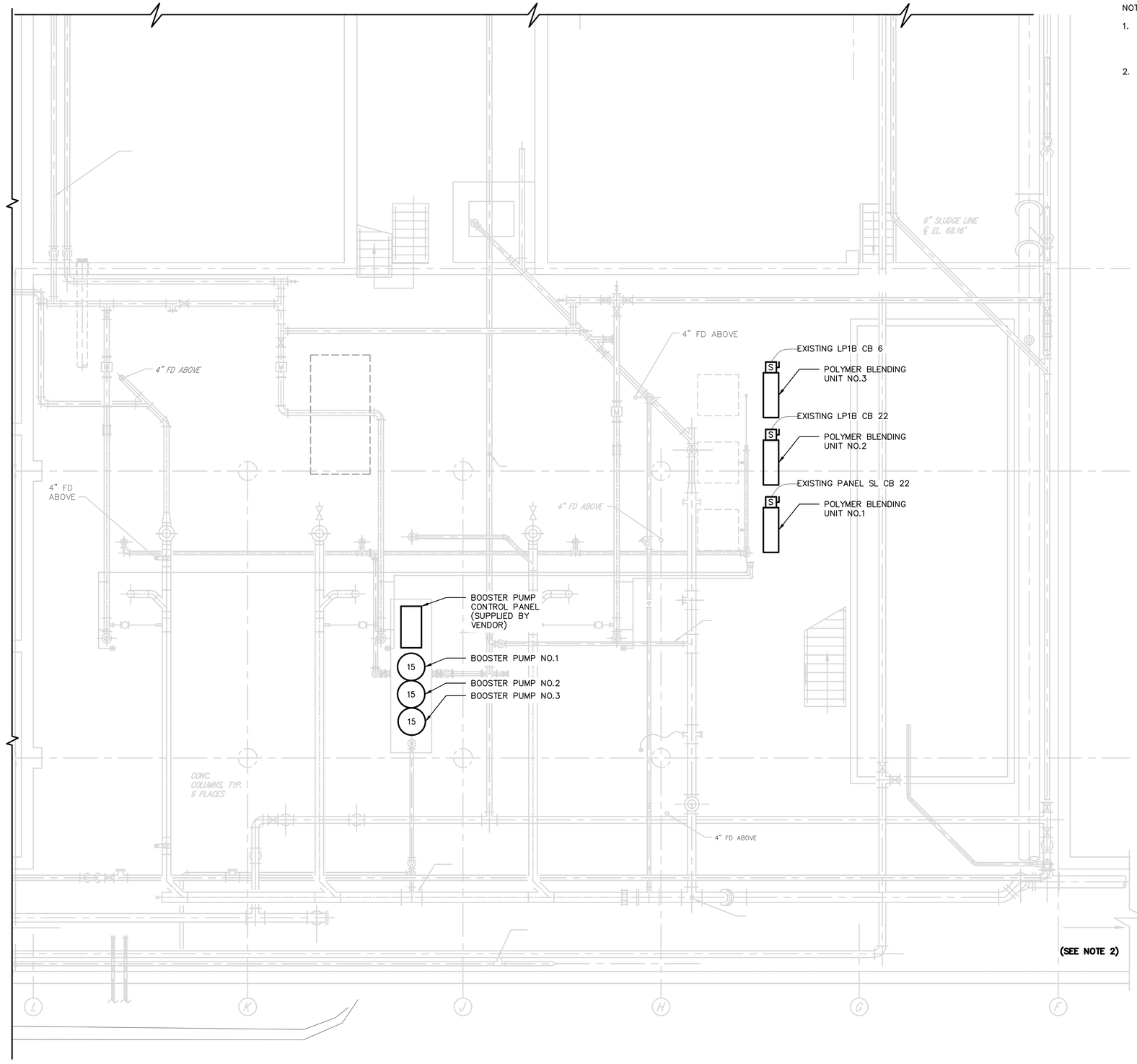
POWER PLAN SLUDGE HANDLING BUILDING – FIRST FLOOR, GEA

SCALE: AS SHOWN

E–3G

SHEET 42 OF 61

User:NPATEL Spec:AUS–NCSM0D File:G:\PROJECT\AK000343.B002–CANTON SLUDGE\DRAWING\CAD\05_ELECTRICAL\CAD FILES\E–3G.DWG Scale:1:1/2 SavedDate:5/16/2018 Time:12:21 Plot Date: Patel, Nikheel; 5/16/2018; 12:23 ; Layout:42



NOTES:

1. SLUDGE HANDLING BUILDING BASEMENT IS CONSIDERED WET AND CORROSIVE LOCATION. ALL MATERIALS, EQUIPMENT, INCIDENTALS, ETC. SHALL CONFORM TO THE REQUIREMENTS OF THE AREA'S CLASSIFICATION.
2. FOR CLARITY NOT ALL CONDUIT RUN AND HOMERUNS ARE SHOWN. REFER TO ONE LINE DIAGRAM AND BLOCK DIAGRAM FOR CONDUIT AND CABLE INSTALLATION.

POWER PLAN – BASEMENT

SCALE : 3/16" = 1'–0"

0 4' 8' 12'

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CANTON WATER RECLAMATION FACILITY SLUDGE PROCESSING MODIFICATIONS CONTRACT NO. 27

ARCADIS PROJ. NO. AK000343.B002

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PROJECT NO.: AK000343.B002
FILE NAME: E–4
DESIGNED BY: NCP
DRAWN BY: NCP
CHECKED BY: JMS

SHEET TITLE

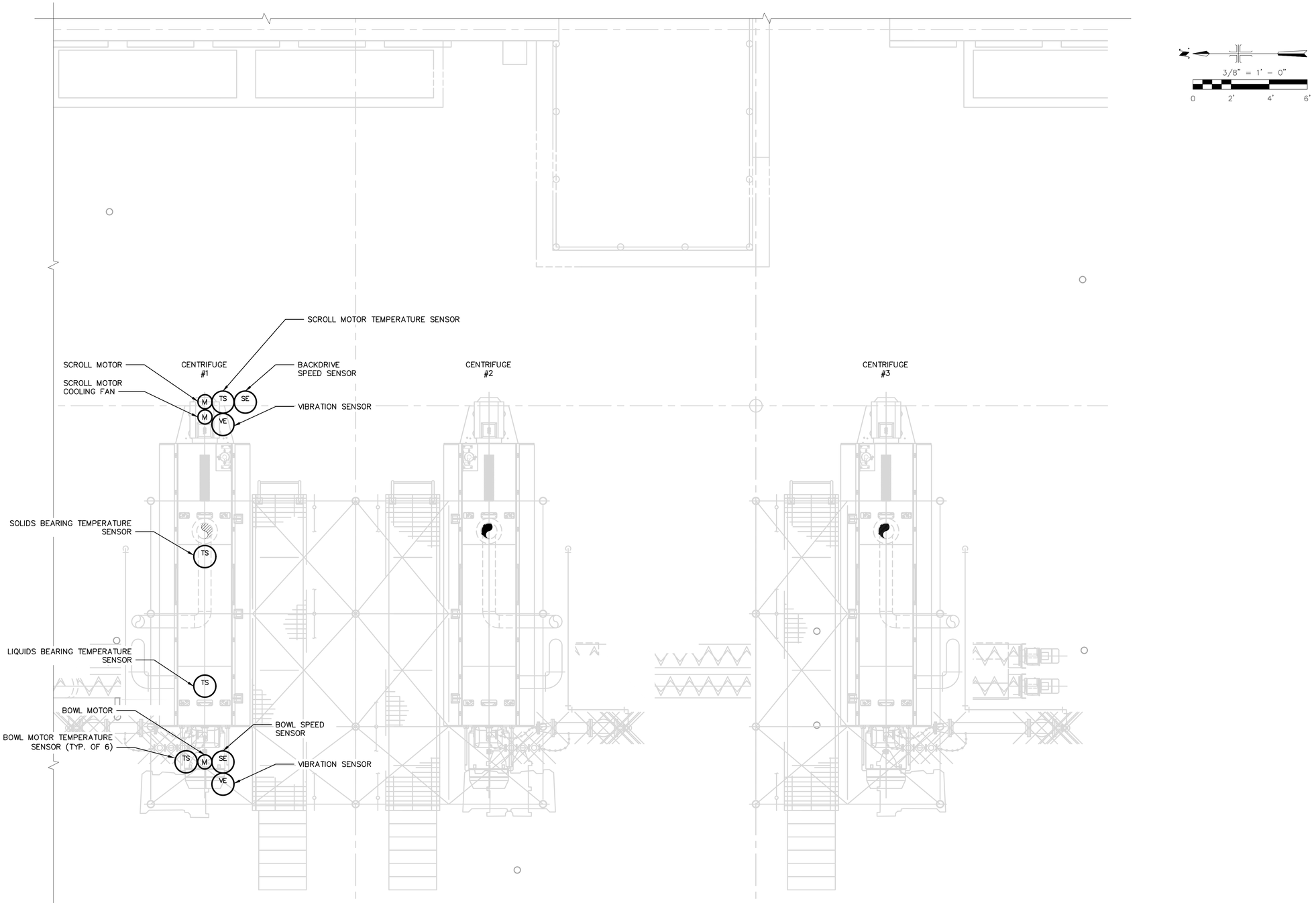
ELECTRICAL

POWER PLAN SLUDGE HANDLING BUILDING BASEMENT

SCALE: AS SHOWN

E–4

SHEET 43 OF 61



PARTIAL PLAN – ALFA LAVAL CENTRIFUGE FLOOR LEVEL

SCALE: 3/8" = 1'-0"

NOTES:

1. THE LOCATION AND QUANTITY OF ALL EQUIPMENT ASSOCIATED WITH THE CENTRIFUGE UNIT MAY VARY BY VENDOR. ALL EQUIPMENT MAY NOT BE SHOWN. CONTRACTOR SHALL PROVIDE ALL REQUIRED EQUIPMENT FOR A COMPLETE AND OPERATIONAL SYSTEM.
2. EQUIPMENT SHOWN FOR CENTRIFUGE #1 IS TYPICAL FOR CENTRIFUGE #2 AND #3.
3. SEE SHEET E-3A FOR OVERALL ELECTRICAL BUILDING PLAN.
4. SEE SHEET E-9A FOR WIRING BLOCK DIAGRAM.

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LEGAL ENTITY:
ARCADIS U.S., INC.

CONSULTANTS

SUB CONSULTANTS

SEALS

STATE OF OHIO
JOHN MICHAEL SIDOTI
E-71807
REGISTERED PROFESSIONAL ENGINEER

CITY OF CANTON

CANTON WATER RECLAMATION FACILITY SLUDGE PROCESSING MODIFICATIONS CONTRACT NO. 27

ARCADIS PROJ. NO. AK000343.B002

NO.	DATE	ISSUED FOR	BY

DATE: MAY 2018
PROJECT NO.: AK000343.B002
FILE NAME: E-5A
DESIGNED BY: NCP
DRAWN BY: NCP
CHECKED BY: JMS

SHEET TITLE

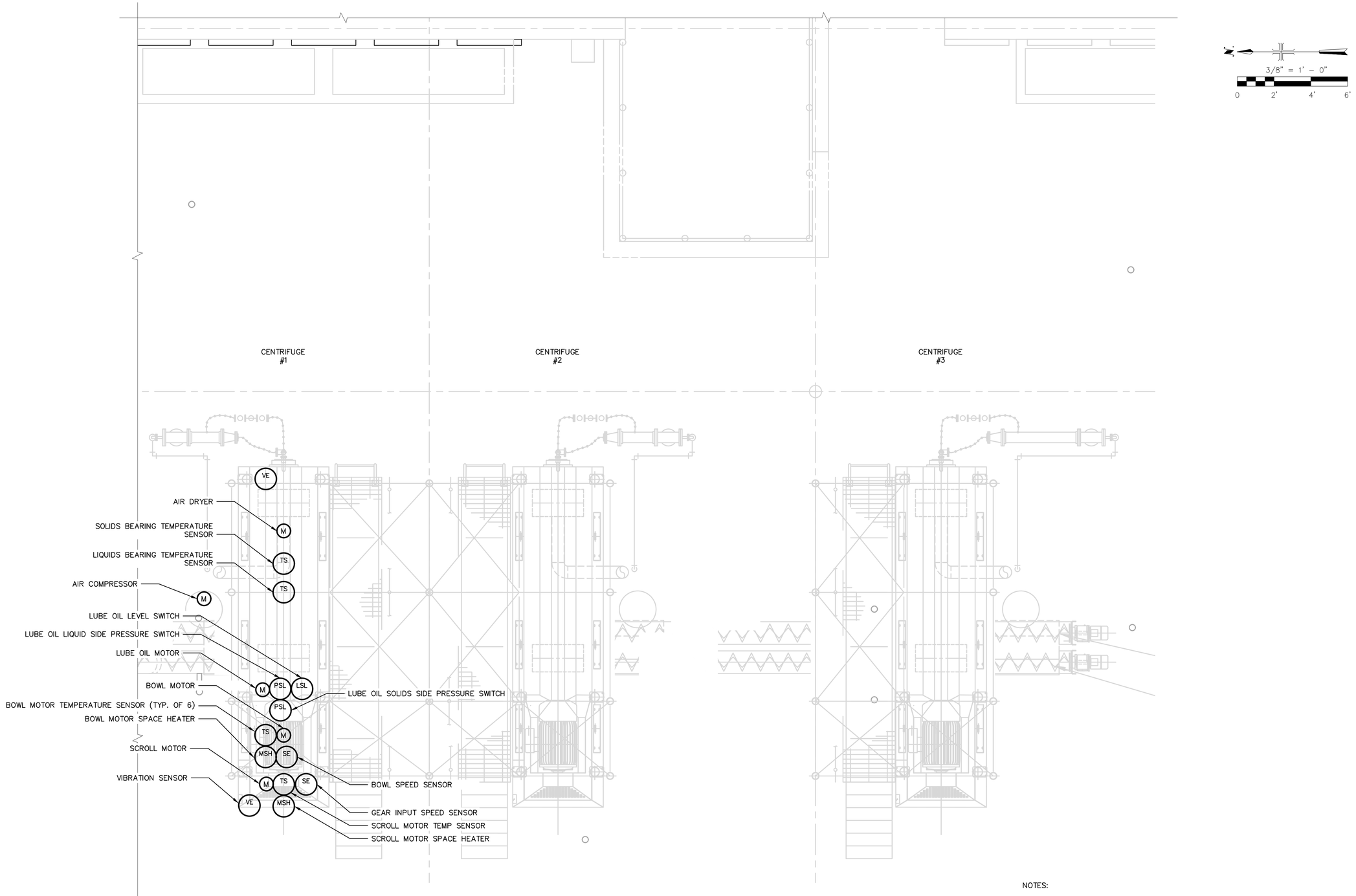
ELECTRICAL

SLUDGE HANDLING BUILDING – ENLARGED ELECTRICAL ALFA LAVAL CENTRIFUGE PLAN

SCALE: AS SHOWN

E-5A

SHEET 44 OF 61



PARTIAL PLAN – GEA CENTRIFUGE FLOOR LEVEL

SCALE: 3/8" = 1'-0"

3/8" = 1' – 0"

0 2' 4' 6'

NOTES:

1. THE LOCATION AND QUANTITY OF ALL EQUIPMENT ASSOCIATED WITH THE CENTRIFUGE UNIT MAY VARY BY VENDOR. ALL EQUIPMENT MAY NOT BE SHOWN. CONTRACTOR SHALL PROVIDE ALL REQUIRED EQUIPMENT FOR A COMPLETE AND OPERATIONAL SYSTEM.
2. EQUIPMENT SHOWN FOR CENTRIFUGE #1 IS TYPICAL FOR CENTRIFUGE #2 AND #3.
3. SEE SHEET E-3G FOR OVERALL ELECTRICAL BUILDING PLAN.
4. SEE SHEET E-9G FOR WIRING BLOCK DIAGRAM.

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ARCADIS PROJ. NO. AK000343.B002

NO.	DATE	ISSUED FOR	BY

DATE: MAY 2018
PROJECT NO.: AK000343.B002
FILE NAME: E-5G
DESIGNED BY: NCP
DRAWN BY: NCP
CHECKED BY: JMS

SHEET TITLE

ELECTRICAL

SLUDGE HANDLING BUILDING – ENLARGED ELECTRICAL GEA CENTRIFUGE PLAN

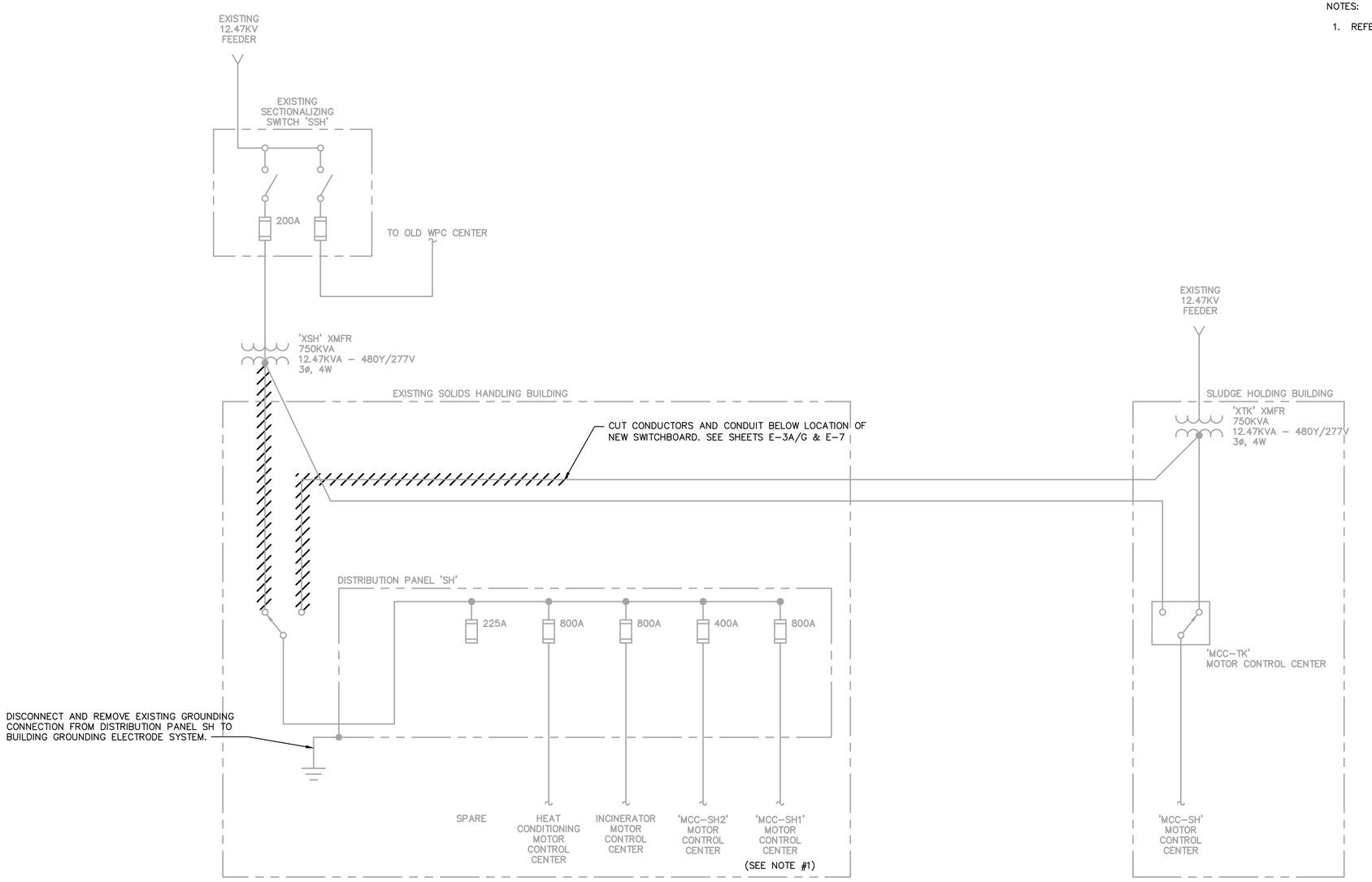
SCALE: AS SHOWN

E-5G

SHEET 45 OF 61

NOTES:

1. REFER TO SHEET E–8 FOR ADDITIONAL WORK REQUIRED.



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ARCADIS PROJ. NO. AK000343.B002

NO.	DATE	ISSUED FOR	BY

DATE: MAY 2018
PROJECT NO.: AK000343.B002
FILE NAME: E–6
DESIGNED BY: NCP
DRAWN BY: NCP
CHECKED BY: JMS

SHEET TITLE

ELECTRICAL

DEMOLITION ONE LINE DIAGRAM

SCALE: NOT TO SCALE

E–6

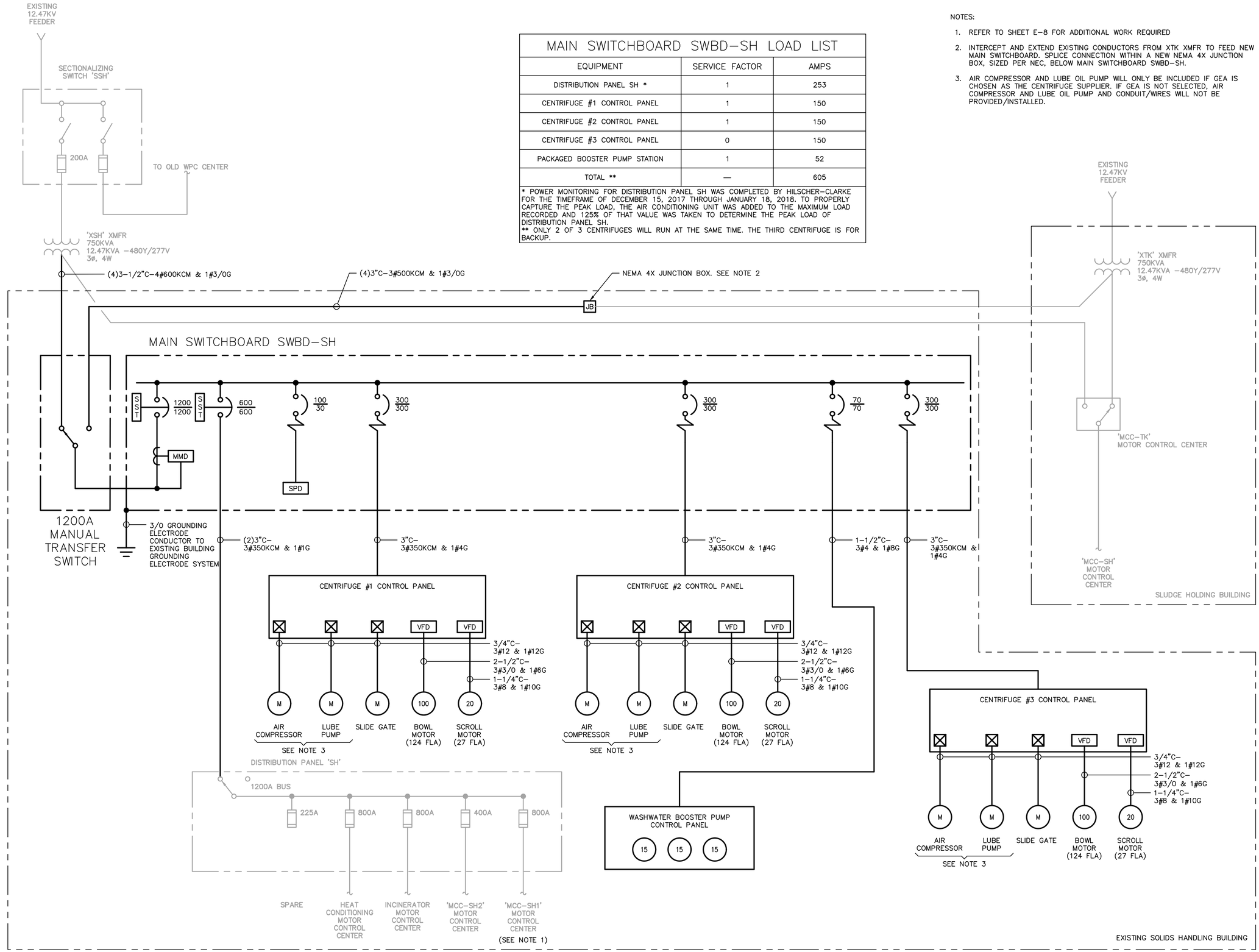
SHEET 46 OF 61

MAIN SWITCHBOARD SWBD–SH LOAD LIST		
EQUIPMENT	SERVICE FACTOR	AMPS
DISTRIBUTION PANEL SH *	1	253
CENTRIFUGE #1 CONTROL PANEL	1	150
CENTRIFUGE #2 CONTROL PANEL	1	150
CENTRIFUGE #3 CONTROL PANEL	0	150
PACKAGED BOOSTER PUMP STATION	1	52
TOTAL **	—	605

* POWER MONITORING FOR DISTRIBUTION PANEL SH WAS COMPLETED BY HILSCHER–CLARKE FOR THE TIMEFRAME OF DECEMBER 15, 2017 THROUGH JANUARY 18, 2018. TO PROPERLY CAPTURE THE PEAK LOAD, THE AIR CONDITIONING UNIT WAS ADDED TO THE MAXIMUM LOAD RECORDED AND 125% OF THAT VALUE WAS TAKEN TO DETERMINE THE PEAK LOAD OF DISTRIBUTION PANEL SH.
** ONLY 2 OF 3 CENTRIFUGES WILL RUN AT THE SAME TIME. THE THIRD CENTRIFUGE IS FOR BACKUP.

NOTES:

1. REFER TO SHEET E–8 FOR ADDITIONAL WORK REQUIRED
2. INTERCEPT AND EXTEND EXISTING CONDUCTORS FROM XTK XMFR TO FEED NEW MAIN SWITCHBOARD. SPLICE CONNECTION WITHIN A NEW NEMA 4X JUNCTION BOX, SIZED PER NEC, BELOW MAIN SWITCHBOARD SWBD–SH.
3. AIR COMPRESSOR AND LUBE OIL PUMP WILL ONLY BE INCLUDED IF GEA IS CHOSEN AS THE CENTRIFUGE SUPPLIER. IF GEA IS NOT SELECTED, AIR COMPRESSOR AND LUBE OIL PUMP AND CONDUIT/WIRES WILL NOT BE PROVIDED/INSTALLED.



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ARCADIS PROJ. NO. AK000343.B002

NO.	DATE	ISSUED FOR	BY

DATE: MAY 2018
PROJECT NO.: AK000343.B002
FILE NAME: E–7
DESIGNED BY: NCP
DRAWN BY: NCP
CHECKED BY: JMS

SHEET TITLE

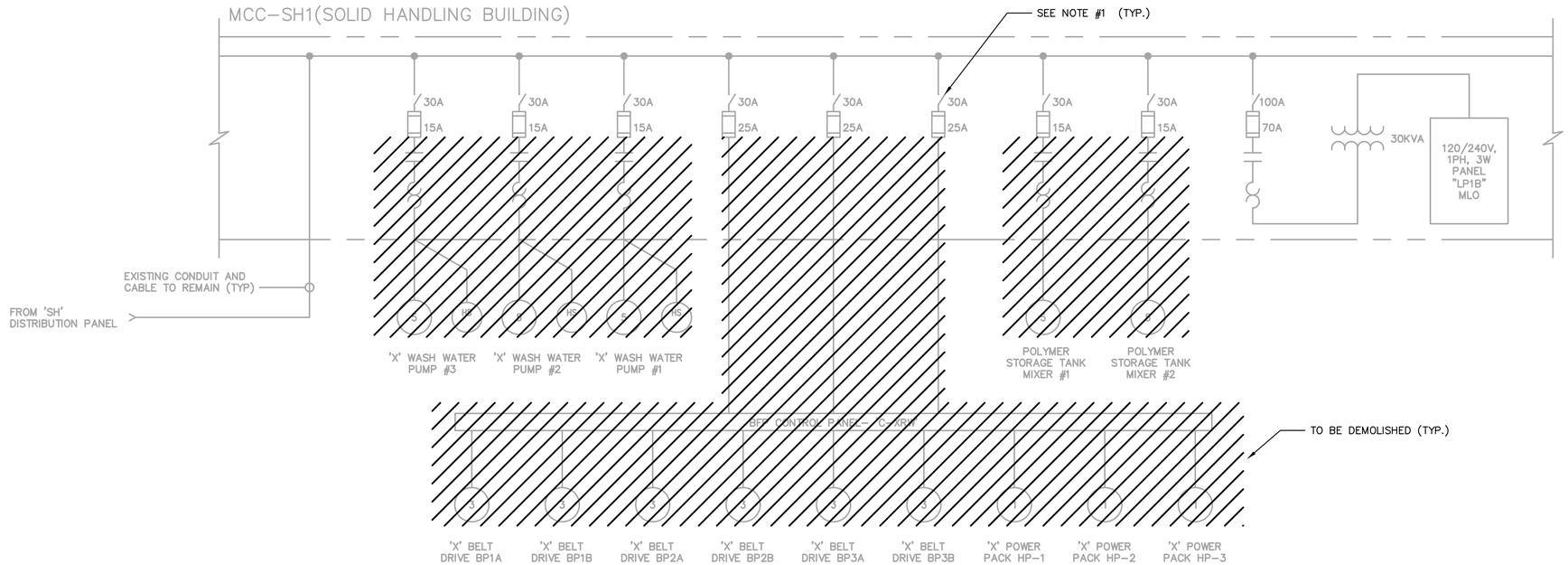
ELECTRICAL

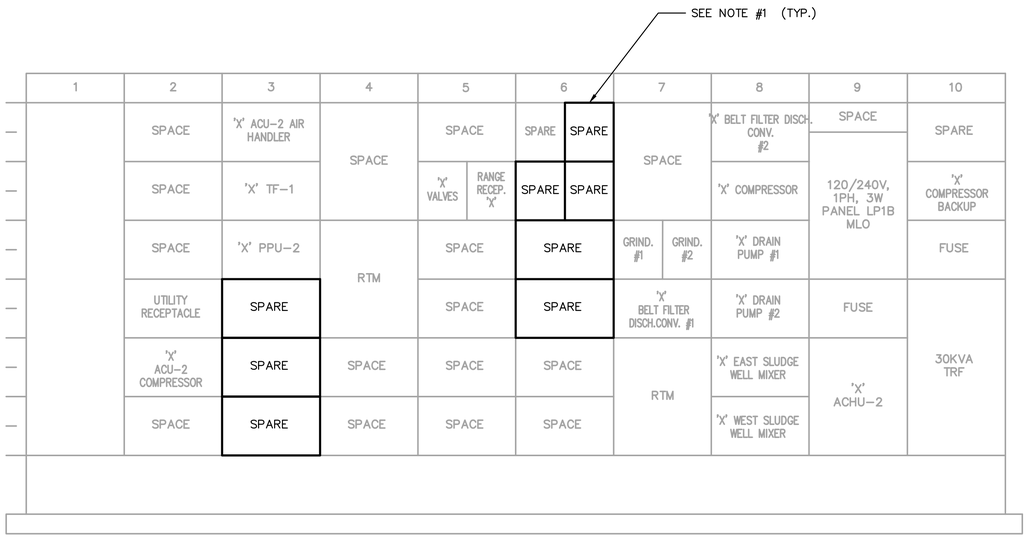
ONE LINE DIAGRAM–1

SCALE: NOT TO SCALE

E–7

SHEET 47 OF 61





MCC–SCH1–FRONT VIEW

NOT TO SCALE

NOTES:

1. EXISTING BREAKER SHALL REMAIN. PROVIDE NEW "SPARE" NAME PLATE UPON COMPLETION.

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ARCADIS PROJ. NO. AK000343.B002

NO.	DATE	ISSUED FOR	BY

DATE: MAY 2018
PROJECT NO.: AK000343.B002
FILE NAME: E–8
DESIGNED BY: NCP
DRAWN BY: NCP
CHECKED BY: JMS

SHEET TITLE

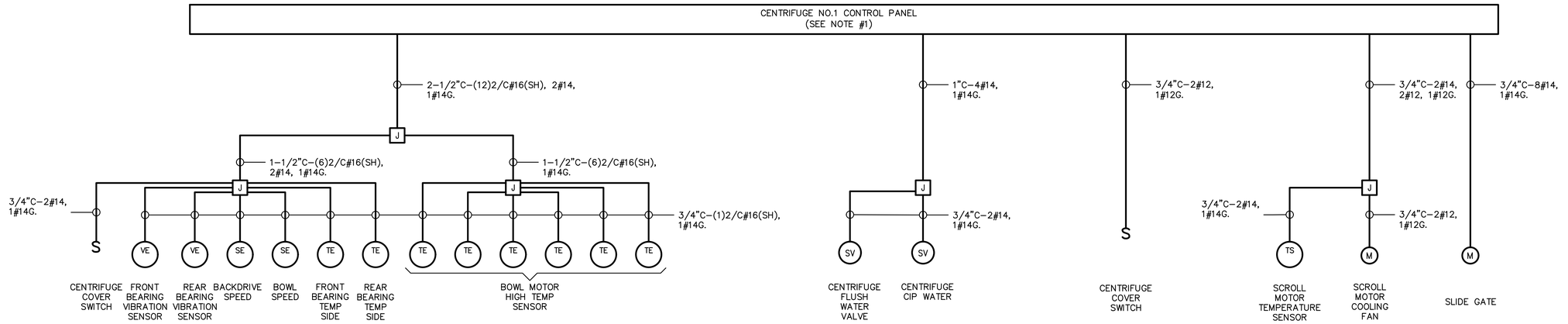
ELECTRICAL

ONE LINE DIAGRAM–2

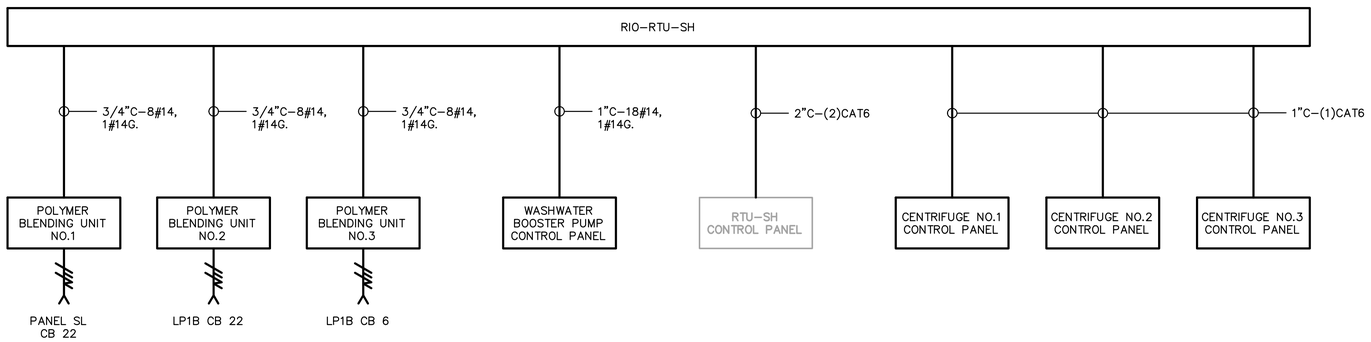
SCALE: NOT TO SCALE

E–8

SHEET 48 OF 61



ALFA LAVAL CENTRIFUGE BLOCK DIAGRAM (TYP. FOR 3)



NOTES:

1. IF ALFA LAVAL IS NOT SELECTED, ALFA LAVAL CENTRIFUGE EQUIPMENT AND CONDUIT/WIRES WILL NOT BE PROVIDED/INSTALLED.

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ARCADIS PROJ. NO. AK000343.B002

NO.	DATE	ISSUED FOR	BY

DATE: MAY 2018
PROJECT NO.: AK000343.B002
FILE NAME: E-9A
DESIGNED BY: NCP
DRAWN BY: NCP
CHECKED BY: JMS

SHEET TITLE

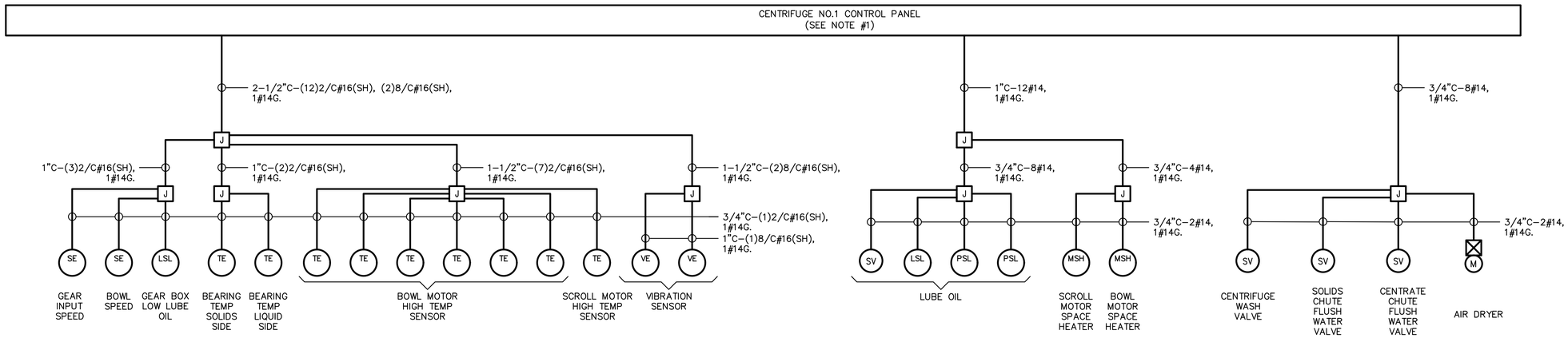
ELECTRICAL

BLOCK DIAGRAM - ALFA LAVAL

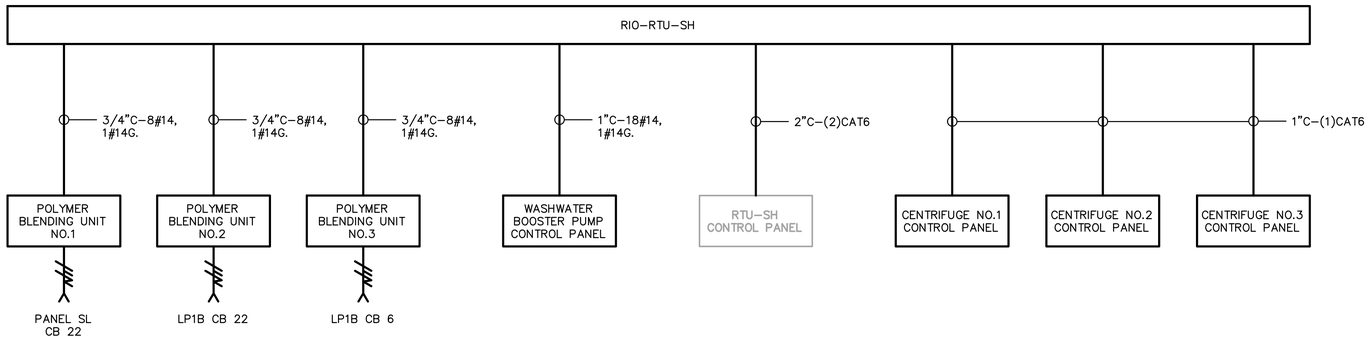
SCALE: NOT TO SCALE

E-9A

SHEET 49 OF 61



GEA CENTRIFUGE BLOCK DIAGRAM (TYP. FOR 3)



NOTES:

1. IF GEA IS NOT SELECTED, GEA CENTRIFUGE EQUIPMENT AND CONDUIT/WIRES WILL NOT BE PROVIDED/INSTALLED.

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ARCADIS PROJ. NO. AK000343.B002

NO.	DATE	ISSUED FOR	BY

DATE: MAY 2018
PROJECT NO.: AK000343.B002
FILE NAME: E-9G
DESIGNED BY: NCP
DRAWN BY: NCP
CHECKED BY: JMS

SHEET TITLE

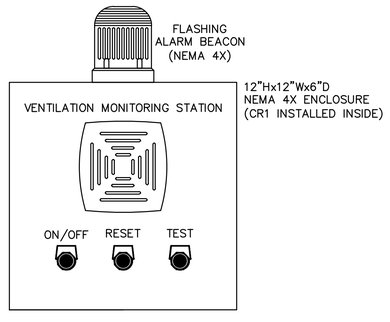
ELECTRICAL

BLOCK DIAGRAM - GEA

SCALE: NOT TO SCALE

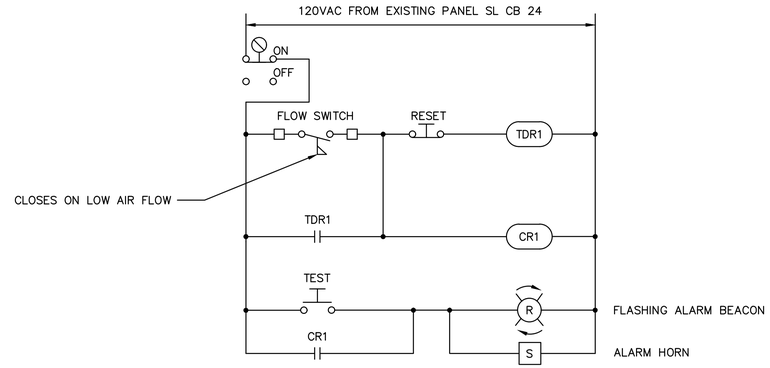
E-9G

SHEET 50 OF 61



VENTILATION MONITORING STATION
PANEL LAYOUT

NO SCALE



VENTILATION MONITORING STATION
SCHEMATIC

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ARCADIS PROJ. NO. AK000343.B002

NO.	DATE	ISSUED FOR	BY

DATE: MAY 2018
PROJECT NO.: AK000343.B002
FILE NAME: E-10
DESIGNED BY: NCP
DRAWN BY: NCP
CHECKED BY: JMS

SHEET TITLE

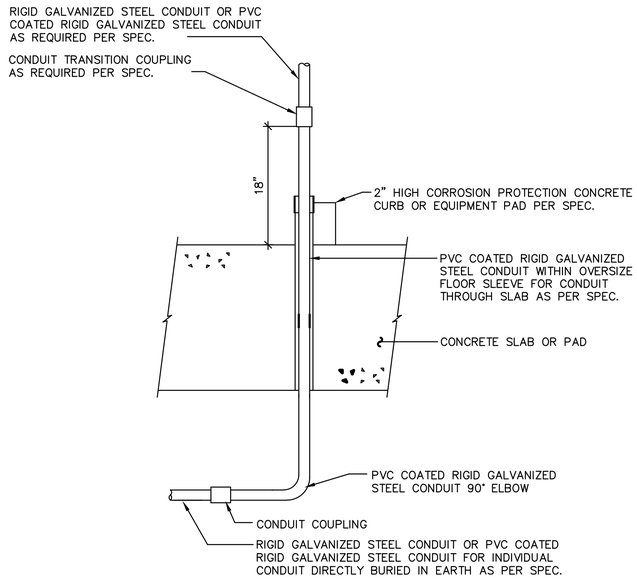
ELECTRICAL

ELECTRICAL DETAILS (1 OF 2)

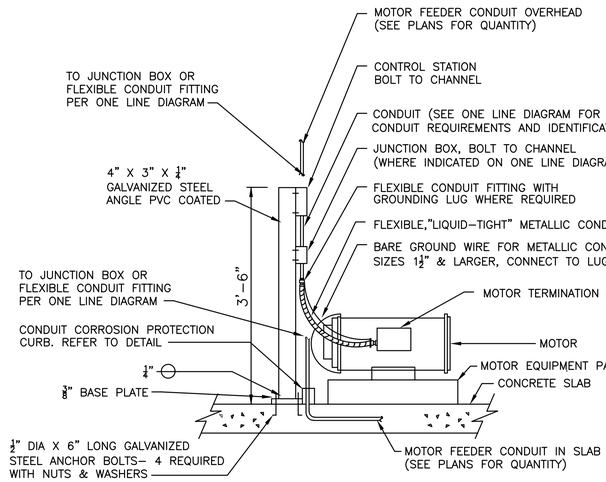
SCALE: NOT TO SCALE

E-10

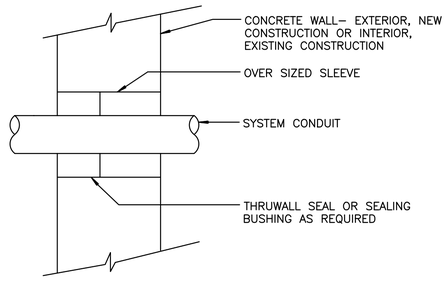
SHEET 51 OF 61



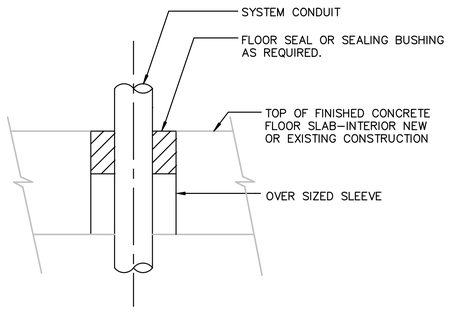
TYPICAL EMBEDDED CONDUIT DETAIL AND CONDUIT CORROSION PROTECTION DETAIL



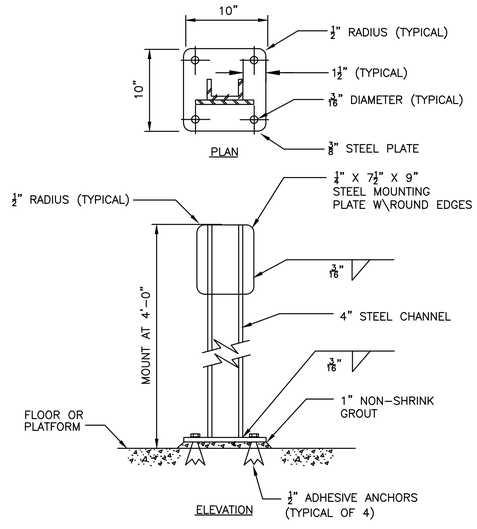
ELECTRIC MOTOR TERMINATION AND DEVICE MOUNTING DETAIL



WALL CORING DETAIL



TYPICAL THRU FLOOR CONDUIT



EQUIPMENT MOUNTING PEDESTAL DETAIL

NOTE:

1. USE WASHERS AND SPLIT LOCK-WASHERS UNDER ALL NUTS.

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ARCADIS PROJ. NO. AK000343.B002

NO.	DATE	ISSUED FOR	BY

DATE: MAY 2018
PROJECT NO.: AK000343.B002
FILE NAME: E-11
DESIGNED BY: NCP
DRAWN BY: NCP
CHECKED BY: JMS

SHEET TITLE

ELECTRICAL

ELECTRICAL DETAILS (2 OF 2)

SCALE: NOT TO SCALE

E-11

SHEET 52 OF 61

INSTRUMENT IDENTIFICATION LEGEND

	FIRST LETTER		SUCCEEDING LETTERS		
	MEASURED OR INITIATING VARIABLE,	MODIFIER	READOUT OR PASSIVE FUNCTION	OUTPUT FUNCTION	MODIFIER
A	ANALYSIS		ALARM		
B	BURNER FLAME		NOT USED	NOT USED	NOT USED
C	CONDUCTIVITY (ELECTRICAL)			CONTROL	CLOSED
D	DENSITY (MASS) OR SPECIFIC GRAVITY	DIFFERENTIAL			
E	VOLTAGE (EMF)		PRIMARY ELEMENT		
F	FLOW RATE	RATIO (FRACTION)			
G	INTRUSION		GLASS GAGE (UNCALIBRATED)		
H	HAND (MANUALLY INITIATED)				HIGH
I	CURRENT (ELECTRICAL)		INDICATE		
J	POWER	SCAN			
K	TIME OR TIME SCHEDULE			CONTROL STATION	
L	LEVEL		LIGHT (PILOT)		LOW
M	MOISTURE OR HUMIDITY				MIDDLE OR INTER-MEDIATE
N	SEQUENCE, STRATEGY		NOT USED	NOT USED	NOT USED
O	NOT USED		ORIFICE (RESTRICTION)		OPEN
P	PRESSURE OR VACUUM		POINT (TEST CONNECTION)	PULSE	
Q	QUANTITY	INTEGRATE OR TOTALIZE			
R	RADIOACTIVITY		RECORD OR PRINT		
S	SPEED, FREQUENCY	SAFETY		SWITCH	
T	TEMPERATURE			TRANSMIT	
U	MULTIVARIABLE		MULTIFUNCTION	MULTIFUNCTION	MULTIFUNCTION
V	VIBRATION			VALVE, DAMPER OR LOUVER	
W	WEIGHT OR FORCE		WELL		
X	UNCLASSIFIED	X AXIS	UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED
Y	EVENT STATUS	Y AXIS		RELAY OR COMPUTE	
Z	POSITION			DRIVE, ACTUATE OR UNCLASSIFIED FINAL CONTROL ELEMENT	

BASE INSTRUMENTATION SYMBOLS

XXX ### — FIELD I/O POINT FOR SHARED VIDEO DISPLAY

\# — PLC INPUT/OUTPUT AND/OR LOGIC FUNCTIONS.
FUNCTION IDENTIFIER:
DI – DIGITAL INPUT
DO – DIGITAL OUTPUT
AI – ANALOG INPUT
AO – ANALOG OUTPUT

XXX ### — FIELD INSTRUMENT. POWER SUPPLY REQUIRED LOCALLY WHERE SHOWN.

XXX ### — INSTRUMENT ON PANEL.

XXX — INSTRUMENT IDENTIFICATION. (SEE THIS SHEET FOR INSTRUMENT IDENTIFICATION LEGEND AND NUMBERING SYSTEM)

— LOOP NUMBER.

\# — CONTROL STRATEGY NUMBER IN SPECIFICATION

INPUT (DISCRETE)

OUTPUT (DISCRETE)

INPUT (ANALOG)

OUTPUT (ANALOG)

a a a a — COMMUNICATION LINK DIRECTION ON SAME DRAWING (SOFTWARE AND HARDWARE TYPES)
ANALOG DIGITAL a MATCHPOINT (LETTER)

M — MAGNETIC FLOWMETER ELEMENT

LE XXXX — LEVEL ELEMENT (SONIC TYPE)

LE XXXX — LEVEL ELEMENT (RADAR TYPE)

* — ASTERISK DENOTES NSTRUMENTS/DEVICES/PANELS PROVIDED BY PACKAGE SYSTEM VENDOR OR EQUIPMENT SUPPLIER. NOT SUPPLIED AS PART OF THE INSTRUMENTATION AND CONTROL SYSTEM SPECIFIED IN DIVISION 40 OF THE SPECIFICATIONS.

INTERCONNECTING LINES WITH DOT INDICATES ROUTING OF THE SAME SIGNAL.

INTERCONNECTING LINES WITHOUT DOT INDICATES ROUTING OF MORE THAN ONE SIGNAL.

120V — 120V AC POWER SUPPLY

S — 120V AC POWER ON–OFF SWITCH

120V PS 24VDC — 24VDC REGULATED INSTRUMENT LOOP POWER SUPPLY (FOR TWO WIRE TRANSMITTERS)

FI — ROTAMETER (FLOW INDICATOR)

LT XXXX — SUBMERSIBLE PRESSURE LEVEL TRANSMITTER

PI XXXX — PRESSURE GAUGE WITH DIAPHRAGM SEAL

PI XXXX / PSH XXXX — PRESSURE SENSOR ASSEMBLY WITH GAUGE AND SWITCH

D — AREA/VELOCITY FLOWMETER

PS — INTRINSICALLY SAFE RELAY

I/I — SIGNAL ISOLATOR

PANEL DEVICE SYMBOLS

HS H/O/A — HAND SWITCH (MANUAL SELECTOR)
FUNCTION SUBSCRIPT

PB H/O/A — PUSHBUTTON
FUNCTION SUBSCRIPT

FUNCTION SUBSCRIPTS FOR HAND SWITCH AND PUSHBUTTON CONTROLS:

ESTOP	E–STOP
F/O/R	FORWARD–OFF–REVERSE
F/O/JR	FORWARD–OFF–JOG REVERSE
H/O/A	HAND–OFF–AUTO
H/O/R	HAND–OFF–REMOTE
H/O/SBY	HAND–OFF–STANDBY
L/O/R	LOCAL–OFF–REMOTE
M/A	MANUAL–AUTO
M/O/A	MANUAL–OFF–AUTO
O/C	OPEN–CLOSE
O/O	ON–OFF
O/S/C	OPEN–STOP–CLOSE
RS	RESET
R/L	REMOTE–LOCAL
R/O	RUN–OFF
SC	SPEED CONTROL POTENTIOMETER
SCR	SILICON CRYSTAL RECTIFIER
S/S	START–STOP
S/SLO	START–STOP WITH LOCKOUT

VFD — VARIABLE FREQUENCY DRIVE

MOTOR STARTER

KQI — ELAPSED TIME METER

AF IL — INDICATING LIGHT UNIT
G–GREEN (OFF,STOP,CLOSED)
R–RED (RUN,START,OPEN)
W–WHITE (POWER ON)
A–AMBER (ALARM CONDITION)
F–FLASHES ON ELECTRIC OR MECHANICAL MALFUNCTION

EQUIPMENT KEYPAD

ELECTRONIC HORN

A — STROBE LIGHT
A – AMBER
W – WHITE
R – RED
B – BLUE

HS HK ZT ZC ZSC M ZSO ILC ILO — ELECTRIC MOTOR OPERATED VALVE OR GATE ACTUATOR WITH INTEGRAL BUILT–IN DEVICES
HK O/S/C – OPEN/STOP/CLOSE PUSHBUTTONS
HS L/O/R – LOCAL/OFF/REMOTE SELECTOR SWITCH
ZSO & ZSC – OPEN & CLOSED LIMIT SWITCHES
ILO & ILC – OPEN & CLOSED INDICATING LIGHTS
ZC – POSITION CONTROLLER
ZT – POSITION TRANSMITTER

INSTRUMENT TAGGING

INSTRUMENTATION LOOP NO. — FE 0701 — INSTRUMENTATION/DEVICE IDENTIFICATION (PER TABLE)

PROCESS AREA: (FIRST AND SECOND NUMBERS)
INSTRUMENT NUMBER: (THIRD AND FOURTH NUMBERS)

ACTUATOR & EQUIPMENT SYMBOLS & ABBR.

M	ELECTRIC MOTOR ACTUATOR (E)
TS	THERMAL SWITCH
MS	MOISTURE SWITCH
MSH	MOTOR STARTER HEATER
VE	VIBRATION SENSOR
TE	TEMPERATURE SENSOR
SE	SPEED SENSOR

EQUIPMENT SYMBOLS

CENTRIFUGAL PUMP

METERING PUMP

CENTRIFUGE

SUBMERSIBLE PUMP

LCD — METERING PUMP

M — MIXER

PIPING SYMBOLS

DIAPHRAGM SEAL WITH ISOLATION VALVE

FLEXIBLE HOSE

QUICK–CONNECT

CALIBRATION COLUMN

EYE WASH/EMERGENCY SHOWER

SLIDE GATE

UNION

RUPTURE DISC

FLEXIBLE COUPLING

BLIND FLANGE

VALVE & GATE SYMBOLS & ABBR.

BALL VALVE (BA)

BUTTERFLY VALVE (BV)

CHECK VALVE (CH)

BALL CHECK VALVE (BCH)

DIAPHRAGM VALVE (DV)

AUTOMATIC PRESSURE REDUCING VALVES (PR)

DRAIN

ANTI–SIPHON VALVE

AIR RELEASE VALVE

GLOBE VALVE

PLUG VALVE

WEIR GATE

GENERAL NOTES

1. COORDINATE WORK WITH OTHER DRAWINGS AND DISCIPLINES.
2. THE SYMBOLS SHOWN ON THIS SHEET ARE STANDARD DESIGNATIONS. NOT ALL SYMBOLS ARE APPLICABLE TO THE INCLUDED DIAGRAMS AND INSTRUMENT TAGGING SYSTEM.
3. NOT ALL PIPING, FITTINGS, AND TANK DETAILS ARE SHOWN. REFER TO PROCESS DRAWINGS FOR ACTUAL DETAILS.

LINE TYPES

SOFTWARE LINK, SYSTEM FUNCTION CONNECTION OR COMMUNICATION LINK

FIBER OPTIC CONNECTION

MAIN PROCESS LINE

AUXILIARY SYSTEMS

ELECTRIC (ELECTRONIC) SIGNAL ARROW INDICATES SIGNAL DIRECTION

PACKAGED SYSTEM BOUNDARY

INSTRUMENT AIR (IA)

ABBREVIATIONS

ATC	AUTOMATIC TEMPERATURE CONTROL
EFF	EFFLUENT
HMI	HUMAN MACHINE INTERFACE
LCS	LOCAL CONTROL STATION
MCC	MOTOR CONTROL CENTER
OIT	OPERATOR INTERFACE TERMINAL
PLC	PROGRAMMABLE LOGIC CONTROLLER
PS	POWER SUPPLY
SEC	SECONDARY
VFD	VARIABLE FREQUENCY DRIVE
NPW	NON POTABLE WATER

DRAWING CONTINUATION LEGEND

PROCESS LINES (ON/OFF PAGE):
PROCESS MEDIUM — CONN | AREA OR EQUIPMENT DRAWING I–XXX

PROCESS LINE NOT WITHIN THE BOUNDARY OF THIS SET OF DRAWINGS
PROCESS MEDIUM — PROCESS EQUIPMENT

CONN: CONNECTION NUMBER

SIGNAL LINES (ON/OFF PAGE):
SIGNAL NAME — CONN | DRAWING I–XXX

SIGNAL LINE NOT WITHIN THE BOUNDARY OF THIS SET OF DRAWINGS
SIGNAL NAME

INTERLOCKS

I — GENERALIZED FOR INTERPOSING RELAY OR UNDEFINED COMPLEX INTERLOCK LOGIC

AND — INTERLOCK IS EFFECTIVE ONLY IF ALL INPUTS EXIST

OR — INTERLOCK IS EFFECTIVE IF ANY ONE OR MORE INPUTS EXIST

I TD — TIME DELAYED ALARM OR CONTROL INTERLOCK FUNCTION

Σ — SUMMATION

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CITY OF CANTON

CANTON WATER RECLAMATION FACILITY SLUDGE PROCESSING MODIFICATIONS CONTRACT NO. 27

ARCADIS PROJ. NO. AK000343.B002

NO.	DATE	ISSUED FOR	BY

DATE: MAY 2018
PROJECT NO.: AK000343.B002
FILE NAME: I–1
DESIGNED BY: NCP
DRAWN BY: NCP
CHECKED BY: JMS

SHEET TITLE

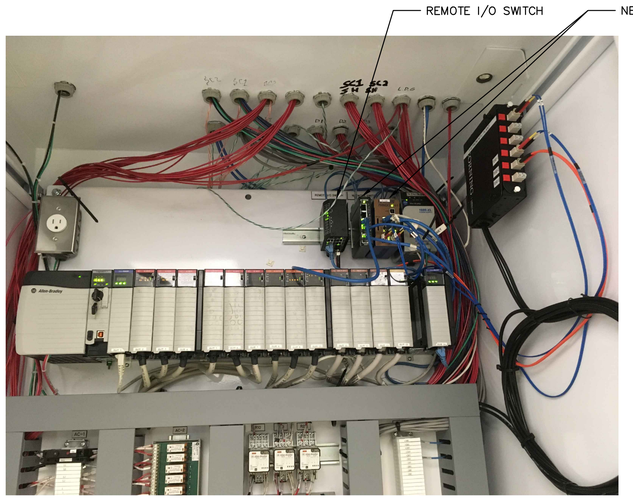
INSTRUMENTATION

ABBREVIATIONS AND SYMBOLS

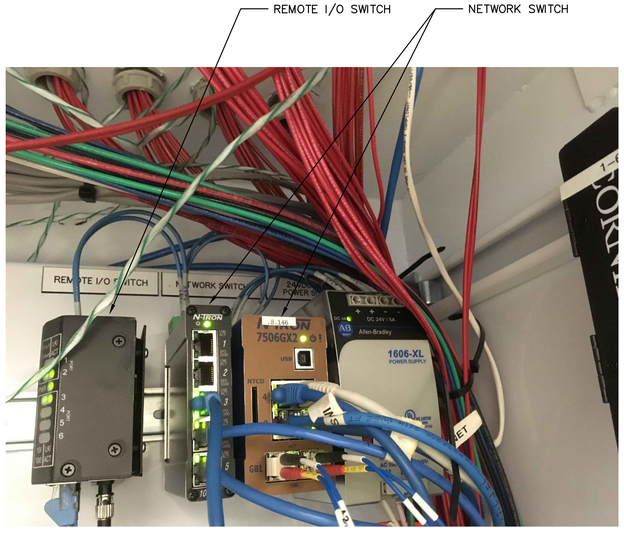
SCALE: NOT TO SCALE

I–1

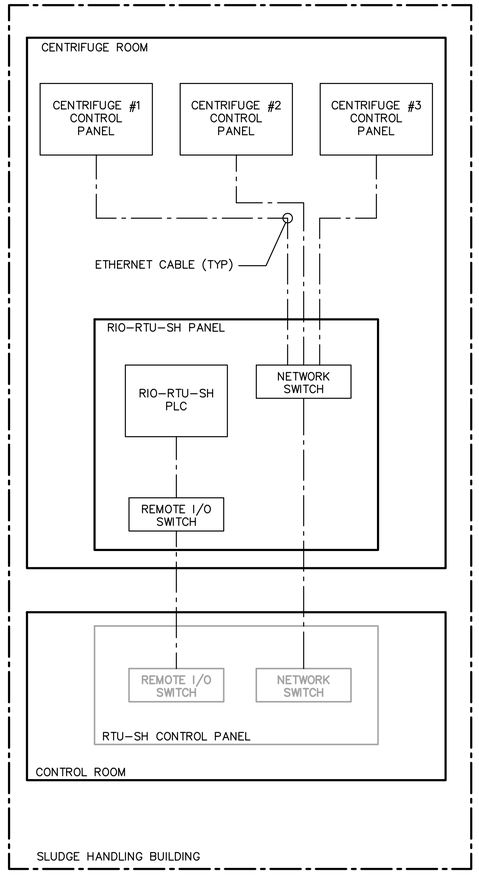
SHEET 53 OF 61



1 / I-2 EXISTING RTU-SH CONTROL PANEL AND PLC-SH



2 / I-2 EXISTING ETHERNET NETWORK



3 / I-2 PARTIAL SCADA SYSTEM DIAGRAM

NOTES:

1. REFERENCE SPECIFICATION 40 61 13 PCS GENERAL PROVISIONS FOR REMOTE I/O AND MODIFICATION WORK REQUIRED.
2. REFERENCE SPECIFICATION 40 61 93 FOR PCS INPUT/OUTPUT (I/O) LIST FOR MODIFICATION OF EXISTING PLC-SH AND THE ADDITION OF NEW REMOTE I/O (RIO-RTU-SH) CONTROL PANEL.
3. REFERENCE SPECIFICATION 40 61 96 PROCESS CONTROL DESCRIPTIONS FOR MODIFICATION PROGRAMMING AND CONFIGURATION CHANGES TO EXISTING PLC-SH PROGRAM AND THE RIO-RTU-SH PANEL TO INCLUDE CONTROL OF ALL THE NEW CENTRIFUGE INTERFACING, WASHWATER SYSTEM AND POLYMER METERING SYSTEM.
4. ALL WORK AND MODIFICATION SHALL BE SCHEDULED WITH THE OWNER BEFORE WORK TAKES PLACE INSIDE RTU-SH PANEL.
5. REFERENCE SPECIFICATION 01 11 13 FOR SUMMARY OF WORK AND ALSO 01 14 16-COORDINATION WITH OWNER'S OPERATION.
6. CENTRIFUGE CONTROL PANELS 1, 2, AND 3 SHALL COMMUNICATE WITH RTU-SH PLANT NETWORK VIA NETWORK SWITCH IN RIO-RTU-SH.
7. RIO-RTU-SH SHALL COMMUNICATE WITH RTU-SH RIO NETWORK VIA NETWORK SWITCH IN RIO-RTU-SH.

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CANTON WATER RECLAMATION FACILITY
SLUDGE PROCESSING MODIFICATIONS
CONTRACT NO. 27

ARCADIS PROJ. NO. AK000343.B002

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CHECKED BY: JMS

SHEET TITLE

INSTRUMENTATION

SLUDGE DEWATERING P&ID – CONTROL SYSTEM CONFIGURATION DIAGRAM

SCALE: NOT TO SCALE

I-2

SHEET 54 OF 61

HMI

MAIN SLUDGE DEWATERING PLC RTU-SH SCADA

CENTRIFUGE 1 SLUDGE FLOW

FI 610A | FQI 610A

AI | AO

CENTRIFUGE 2 SLUDGE FLOW

FI 610B | FQI 610B

AI | AO

CENTRIFUGE 3 SLUDGE FLOW

FI 610C | FQI 610C

AI | AO

HMI

MAIN SLUDGE DEWATERING PLC RTU-SH SCADA

THICKENED SLUDGE PUMP

FIT 610A — 120V

MANF CABLE TYP

FE 610A

M

610-1

6" DI

SLUDGE A — CENTRIFUGE #1 DRAWING I-6A/6G

THICKENED SLUDGE PUMP

FIT 610B — 120V

FE 610B

M

610-2

6" DI

SLUDGE B — CENTRIFUGE #2 DRAWING I-6A/6G

THICKENED SLUDGE PUMP

FIT 610C — 120V

FE 610C

M

610-3

6" DI

SLUDGE C — CENTRIFUGE #3 DRAWING I-6A/6G

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ARCADIS PROJ. NO. AK000343.B002

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DATE: MAY 2018
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DESIGNED BY: NCP
DRAWN BY: NCP
CHECKED BY: JMS

SHEET TITLE

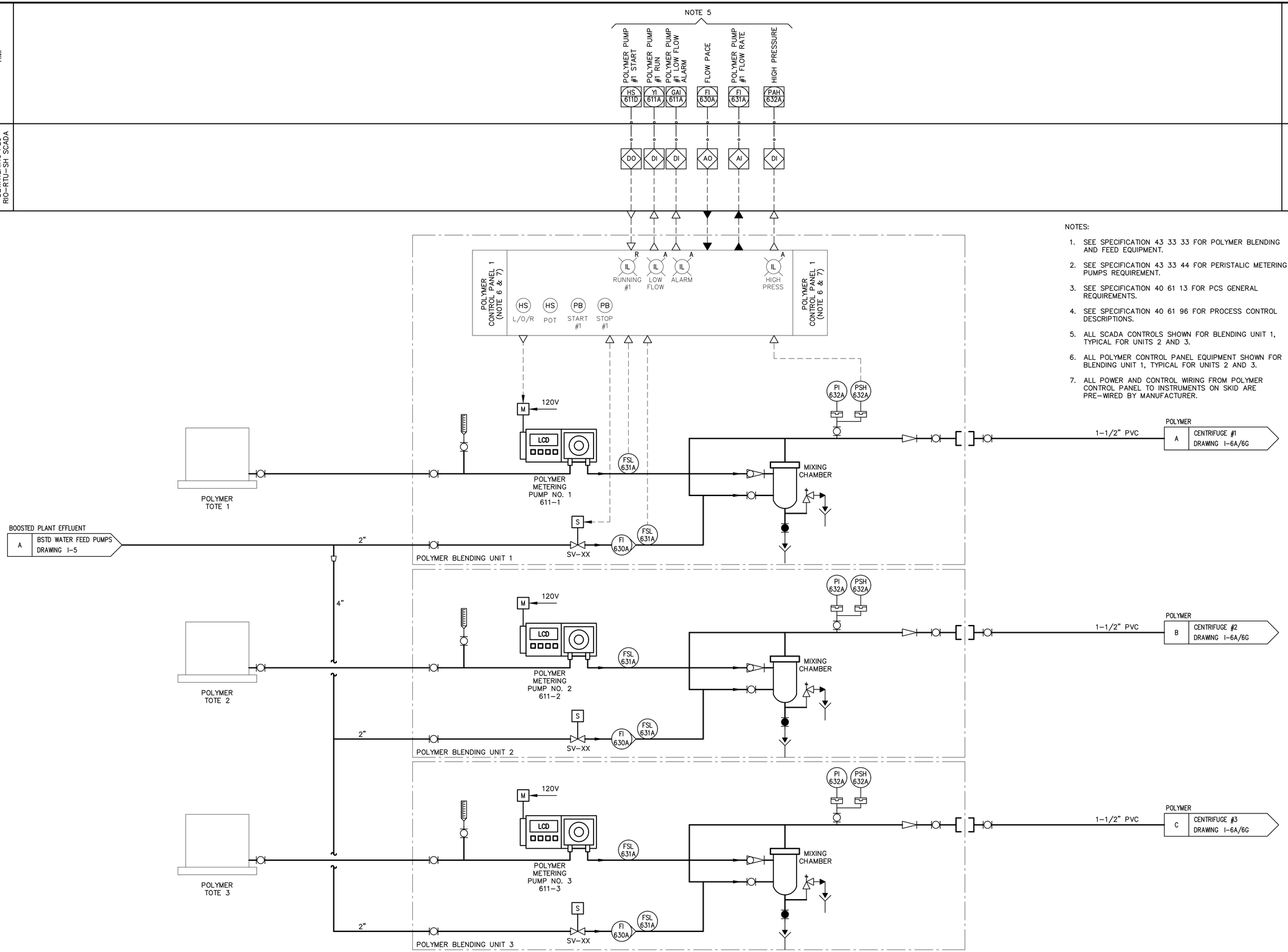
INSTRUMENTATION

SLUDGE DEWATERING SLUDGE FLOW P&ID

SCALE: NOT TO SCALE

I-3

SHEET 55 OF 61



NOTES:

1. SEE SPECIFICATION 43 33 33 FOR POLYMER BLENDING AND FEED EQUIPMENT.
2. SEE SPECIFICATION 43 33 44 FOR PERISTALIC METERING PUMPS REQUIREMENT.
3. SEE SPECIFICATION 40 61 13 FOR PCS GENERAL REQUIREMENTS.
4. SEE SPECIFICATION 40 61 96 FOR PROCESS CONTROL DESCRIPTIONS.
5. ALL SCADA CONTROLS SHOWN FOR BLENDING UNIT 1, TYPICAL FOR UNITS 2 AND 3.
6. ALL POLYMER CONTROL PANEL EQUIPMENT SHOWN FOR BLENDING UNIT 1, TYPICAL FOR UNITS 2 AND 3.
7. ALL POWER AND CONTROL WIRING FROM POLYMER CONTROL PANEL TO INSTRUMENTS ON SKID ARE PRE-WIRED BY MANUFACTURER.

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ARCADIS PROJ. NO. AK000343.B002

NO.	DATE	ISSUED FOR	BY

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PROJECT NO.:	AK000343.B002
FILE NAME:	I-4
DESIGNED BY:	NCP
DRAWN BY:	NCP
CHECKED BY:	JMS

SHEET TITLE

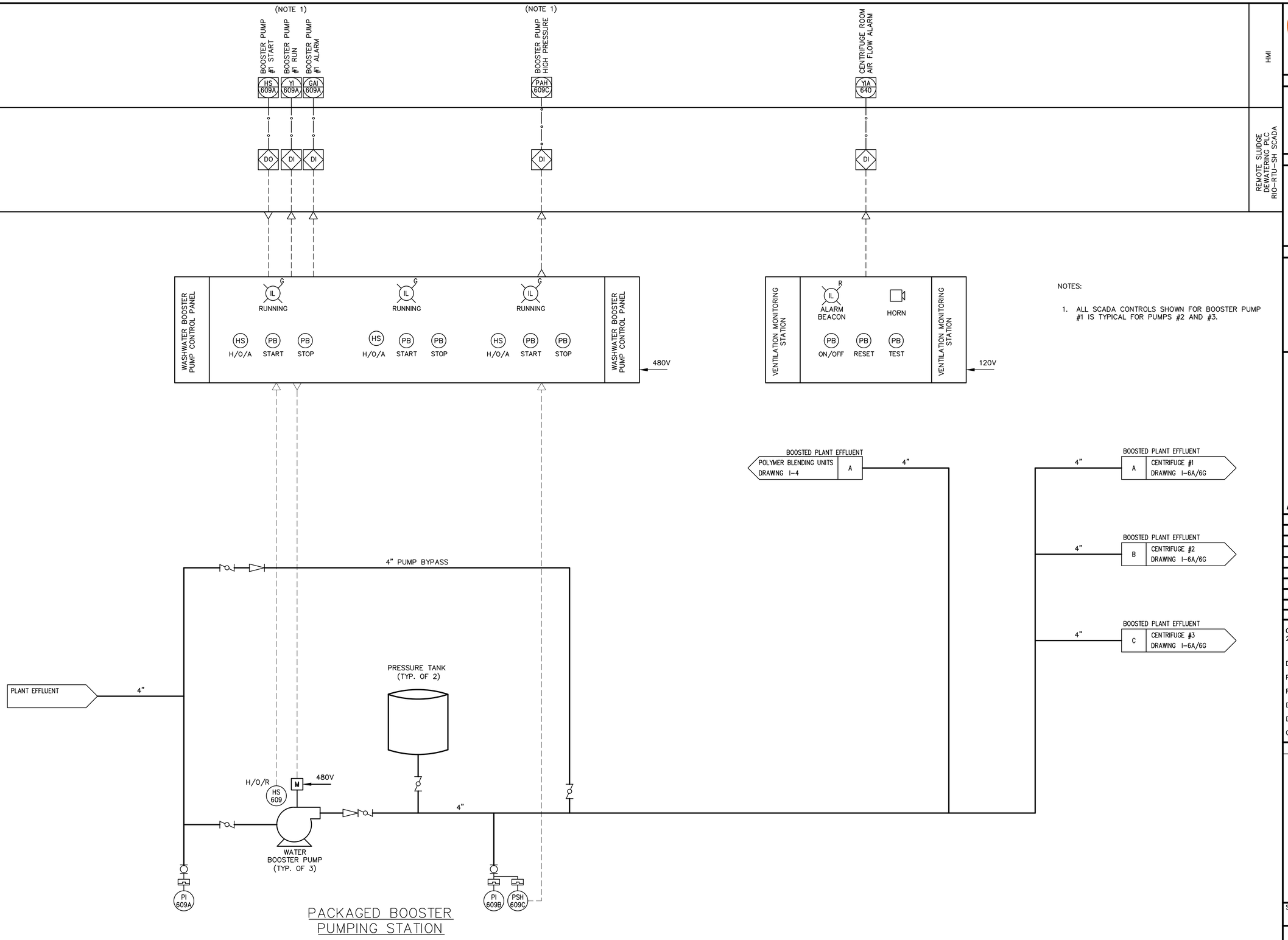
INSTRUMENTATION

SLUDGE DEWATERING POLYMER BLENDING SYSTEM P&ID

SCALE: NOT TO SCALE

I-4

SHEET 56 OF 61



PACKAGED BOOSTER PUMPING STATION

NOTES:

1. ALL SCADA CONTROLS SHOWN FOR BOOSTER PUMP #1 IS TYPICAL FOR PUMPS #2 AND #3.

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ARCADIS PROJ. NO. AK000343.B002

NO.	DATE	ISSUED FOR	BY

DATE: MAY 2018
PROJECT NO.: AK000343.B002
FILE NAME: I-5
DESIGNED BY: NCP
DRAWN BY: NCP
CHECKED BY: JMS

SHEET TITLE

INSTRUMENTATION

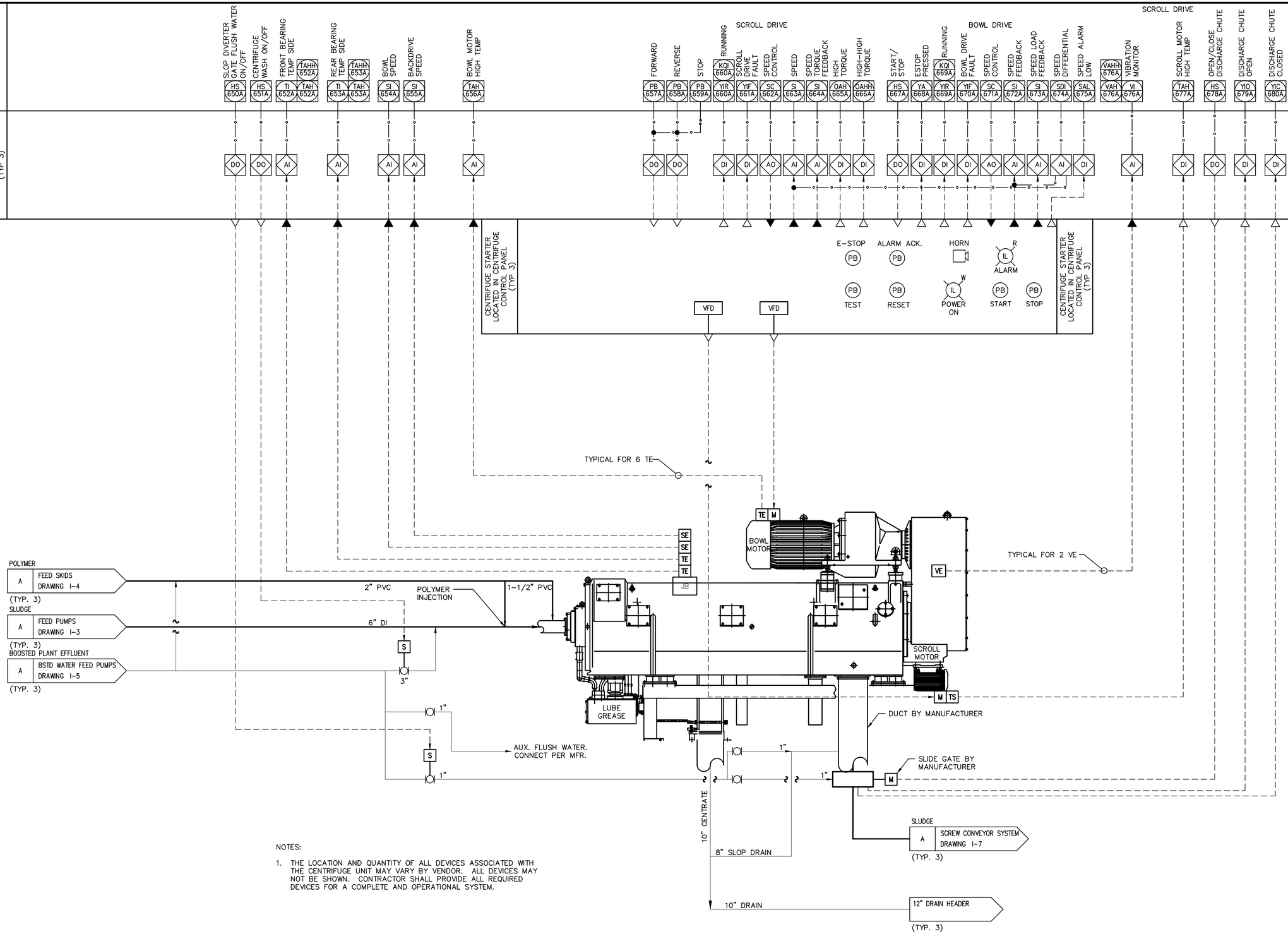
SLUDGE DEWATERING WASHWATER SYSTEM P&ID

SCALE: NOT TO SCALE

I-5

SHEET 57 OF 61

User:ZPYLE Spec:AUS-NCSMOD File:G:\PROJECT\AK000343.B002-CANTON SLUDGE\DRAWING\CADD\06_INSTRUMENTATION\CAD FILES\I-5.DWG Scale:1:1 SavedDate:5/17/2018 Time:15:38 Plot Date: Sidoti, John; 5/18/2018; 07:56 ; Layout:57



NOTES:

1. THE LOCATION AND QUANTITY OF ALL DEVICES ASSOCIATED WITH THE CENTRIFUGE UNIT MAY VARY BY VENDOR. ALL DEVICES MAY NOT BE SHOWN. CONTRACTOR SHALL PROVIDE ALL REQUIRED DEVICES FOR A COMPLETE AND OPERATIONAL SYSTEM.

CENTRIFUGE #1
(TYP. OF 3)

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ARCADIS PROJ. NO. AK000343.B002

NO.	DATE	ISSUED FOR	BY

DATE:	MAY 2018
PROJECT NO.:	AK000343.B002
FILE NAME:	I-6A
DESIGNED BY:	NCP
DRAWN BY:	NCP
CHECKED BY:	JMS

SHEET TITLE

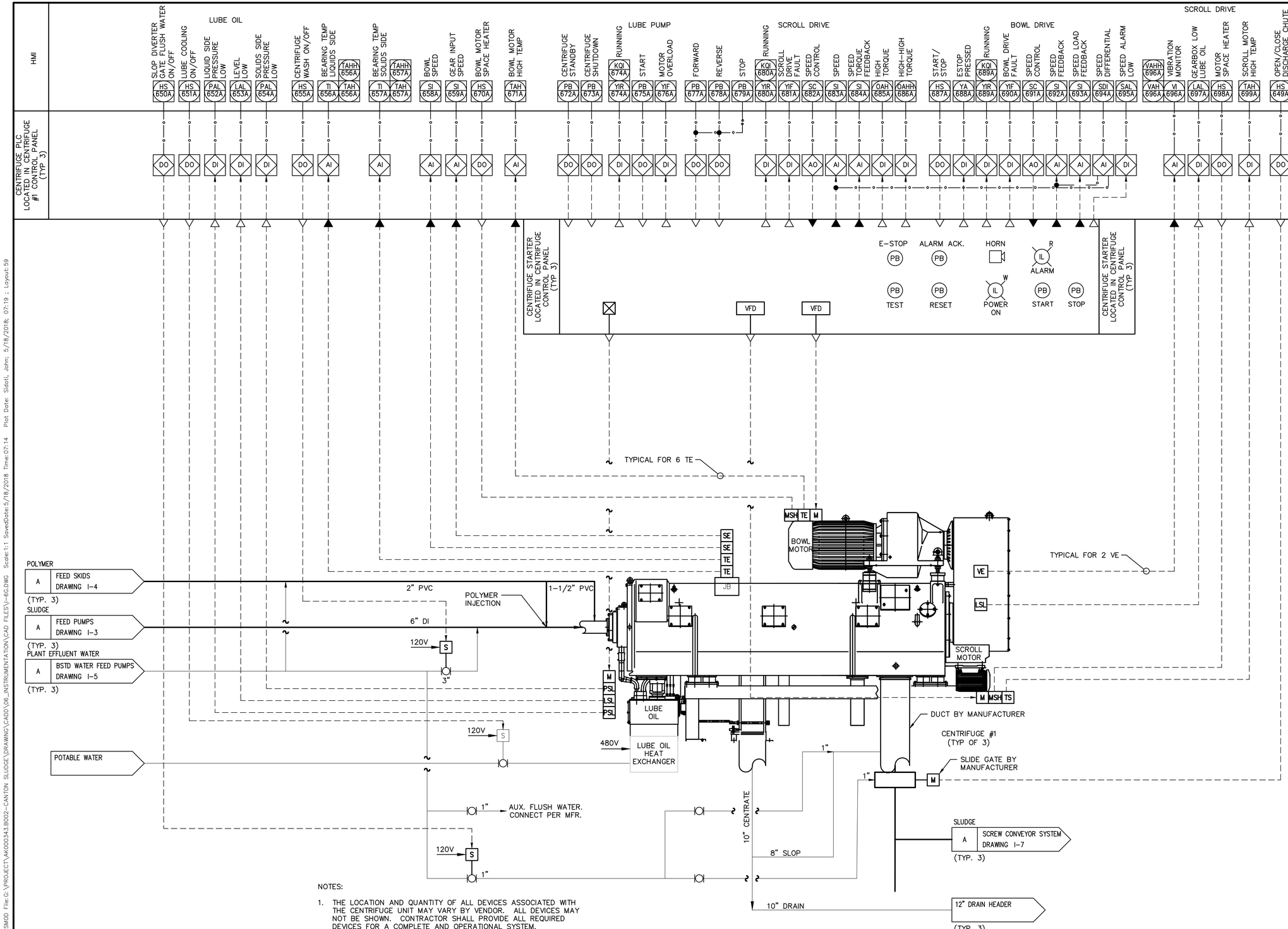
INSTRUMENTATION

SLUDGE DEWATERING CENTRIFUGE 1, 2, AND 3
P&ID – ALFA LAVAL

SCALE: NOT TO SCALE

I-6A

SHEET 58 OF 61



NOTES:

1. THE LOCATION AND QUANTITY OF ALL DEVICES ASSOCIATED WITH THE CENTRIFUGE UNIT MAY VARY BY VENDOR. ALL DEVICES MAY NOT BE SHOWN. CONTRACTOR SHALL PROVIDE ALL REQUIRED DEVICES FOR A COMPLETE AND OPERATIONAL SYSTEM.

CENTRIFUGE #1 (TYP. OF 3)

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CONTRACT NO. 27

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DATE: MAY 2018
PROJECT NO.: AK000343.B002
FILE NAME: I-6G
DESIGNED BY: NCP
DRAWN BY: NCP
CHECKED BY: JMS

SHEET TITLE

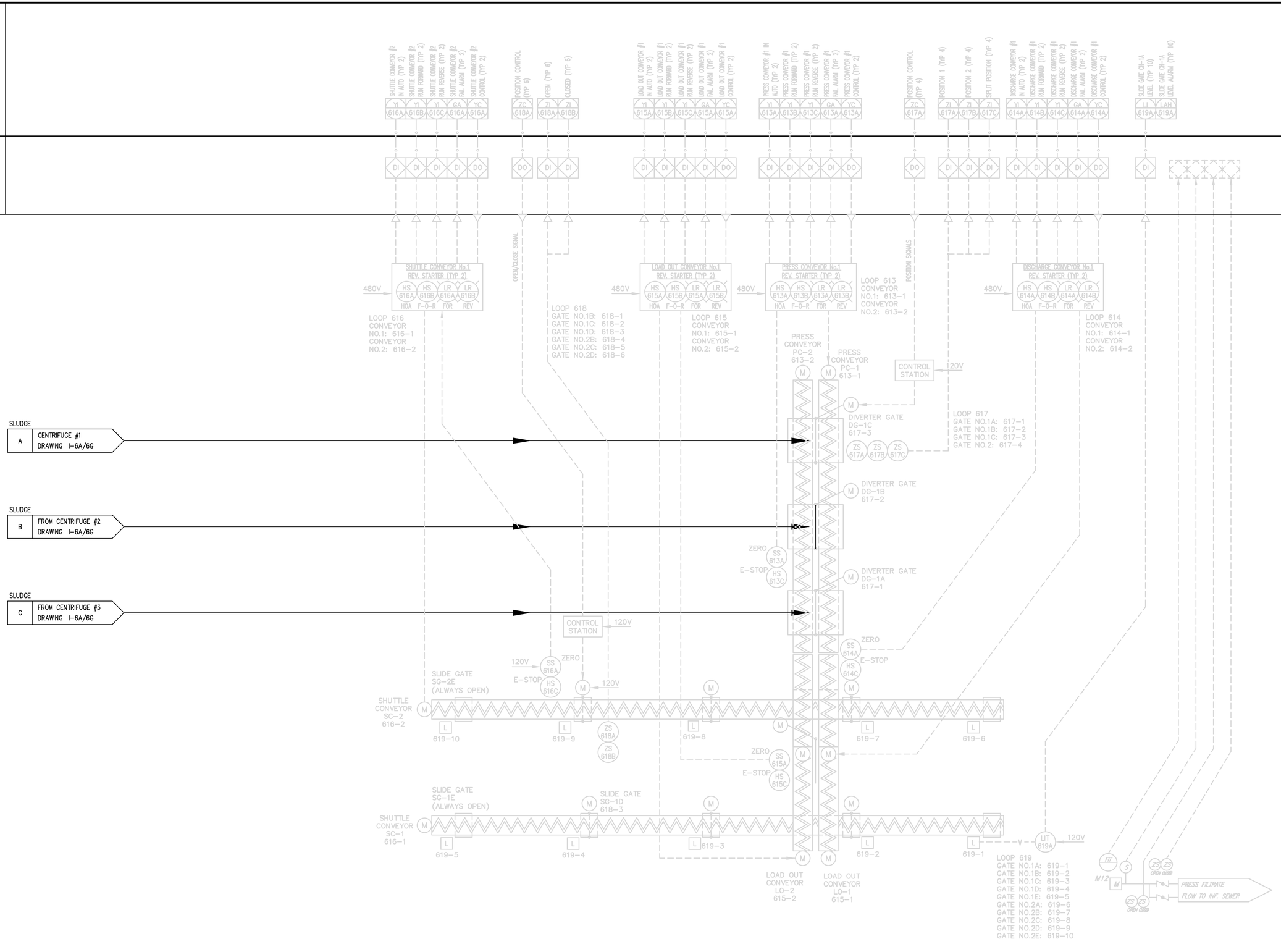
INSTRUMENTATION

SLUDGE DEWATERING CENTRIFUGE 1, 2, AND 3
P&ID – GEA

SCALE: NOT TO SCALE

I-6G

SHEET 59 OF 61



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ARCADIS PROJ. NO. AK000343.B002

NO.	DATE	ISSUED FOR	BY

DATE:	MAY 2018
PROJECT NO.:	AK000343.B002
FILE NAME:	I-7
DESIGNED BY:	NCP
DRAWN BY:	NCP
CHECKED BY:	JMS

SHEET TITLE

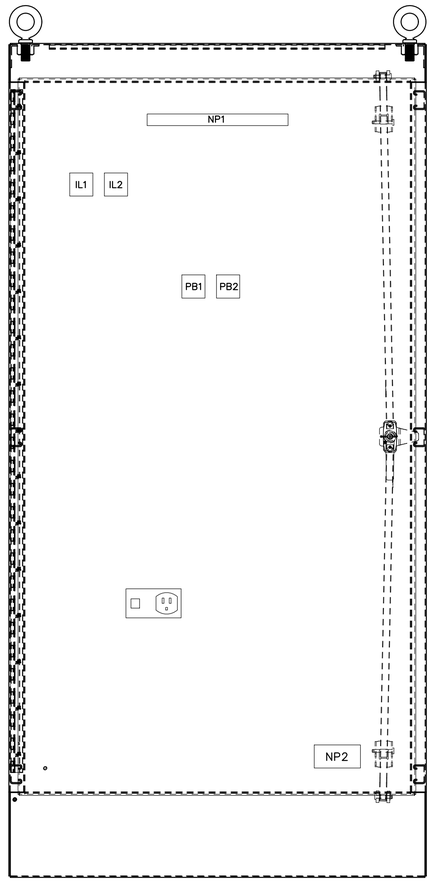
INSTRUMENTATION

SLUDGE DEWATERING CONVEYOR AND TRUCK LOADING P&ID

SCALE: **NOT TO SCALE**

I-7

SHEET 60 OF 61



SLUDGE HANDLING BUILDING REMOTE I/O PANEL RIO–RTU–SH FRONT FACE LAYOUT

PAINTED STEEL, NEMA 4X

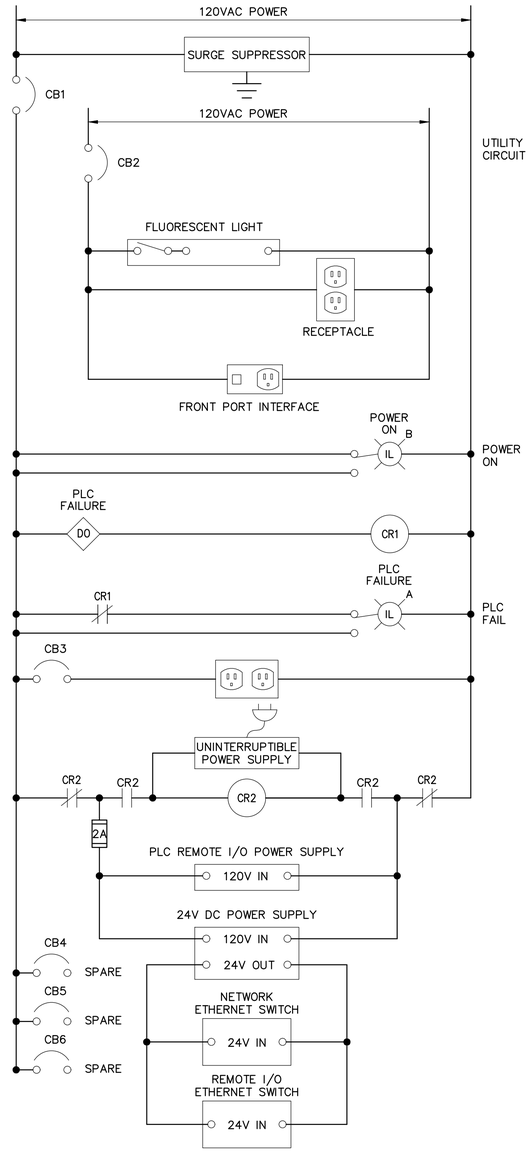
MINIMUM DIMENSIONS:
72"H x 36"W x 18"D

NO.	LETTERING (IN.)	NAMEPLATE TEXT
NP1	1/2	SLUDGE HANDLING BUILDING REMOTE I/O PANEL RIO–RTU–SH
NP2	3/8	WARNING – ORANGE WIRING NOT DE–ENERGIZED BY PANEL DISCONNECT

LIGHT NO.	LENS COLOR	TYPE	LEGEND PLATE TEXT
IL1	BLUE	TRANSFORMER	POWER ON
IL2	AMBER	TRANSFORMER	PLC FAIL

BUTTON NO.	BUTTON COLOR	TYPE	LEGEND PLATE TEXT
PB1	BLACK	PUSHBUTTON	TEST
PB2	BLACK	PUSHBUTTON	SILENCE

SLUDGE HANDLING BUILDING REMOTE I/O PANEL RIO–RTU–SH COMPONENT DESCRIPTIONS



SLUDGE HANDLING BUILDING REMOTE I/O PANEL RIO–RTU–SH PARTIAL WIRING DIAGRAM

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ARCADIS PROJ. NO. AK000343.B002

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DATE: MAY 2018
PROJECT NO.: AK000343.B002
FILE NAME: I–8
DESIGNED BY: NCP
DRAWN BY: NCP
CHECKED BY: JMS

SHEET TITLE

INSTRUMENTATION

SLUDGE HANDLING BUILDING REMOTE I/O PANEL LAYOUT AND WIRING DIAGRAM

SCALE: **NOT TO SCALE**

I–8

SHEET 61 OF 61