

PROJECT MANUAL

for

SOUTH QUINCY LIFT STATION REHABILITATION PROJECT

for the

CITY OF QUINCY, ILLINOIS



Prepared jointly by
Klingner & Associates, P.C.
and the
Department of Utilities & Engineering
City of Quincy, Illinois
October 11, 2019

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**NOTICE TO CONTRACTORS
CITY OF QUINCY, ILLINOIS**

Sealed proposals for the South Quincy Lift Station Rehabilitation project, Adams County, Illinois, described herein will be received at the office of the City Clerk, 730 Maine Street, City Hall, Quincy, Illinois 62301 until 11:00 AM, November 6, 2019 and at that time publicly opened and read aloud in the Council Chamber of the Quincy City Hall.

The project includes furnishing and installing approximately two (2) 100 HP self-priming centrifugal pumps, piping, valves & instrumentation; construction of elevated concrete slabs, walls and miscellaneous concrete structures; furnishing and installing electrical control panels, diesel generator and miscellaneous electrical improvements; removing and replacing structural metal roofing; and other related construction.

Plans and specifications are available online at www.quincyl.gov/bids and may be examined at the office of Department of Utilities and Engineering, City Hall, 730 Maine Street, Quincy, IL 62301.

All proposals shall be accompanied by either a bid bond on the "Proposal Bid" form contained in the proposal, executed by a corporate surety company satisfactory to the City of Quincy, or a bank cashier's check, or a properly certified check for not less than 5 percent of the amount bid, or for the amount listed in the specifications.

The City Council of Quincy reserves the right to reject any or all proposals and to waive technicalities.

No bid may be withdrawn after the time for opening of the bids is past.

The City of Quincy is an Equal Opportunity Employer and encourages minority group participation in the bidding and construction process.

Bidders are notified that not less than the prevailing wage rate as determined by the Illinois Department of Labor shall be paid to all workers performing work under this contract.

This contract contains the requirement that 50 percent of the workers on this project must be residents of Adams County, Illinois.

BY ORDER OF:

Jeffrey Conte
Director of Utilities & Engineering
October 11, 2019

NOTICE TO BIDDERS

Those firms interested in returning a proposal by mail shall enclose **ALL PORTIONS** of the bid document marked "**RETURN WITH BID**" document in a sealed envelope addressed to:

City Clerk
City of Quincy
730 Maine Street
Quincy, Illinois 62301

The outside envelope should be clearly marked:

Bid to the City of Quincy
Project: South Quincy Lift Station Rehabilitation
Bid Opening Date: November 6, 2019
Bid Opening Time: 11:00 a.m.
Bid Opening Location: City Council Chambers

Proposals may be hand delivered in an envelope, marked with the same information, to the City Clerk's Office. Any Proposal submitted without **ALL PORTIONS** marked "**RETURN WITH BID**" will be considered an incomplete bid.

Bidders are invited to attend the bid opening at the time and location indicated in the bid documents.

A summary of the bids received showing prices will be available from the City of Quincy Department of Utilities & Engineering upon request.

BID PROPOSAL FORM

TO THE MAYOR AND CITY COUNCIL OF QUINCY, ILLINOIS:

1. Proposal of:

_____ *Name of Bidder*

_____ *Street Address* *City* *State* *ZIP*

for the proposed **South Quincy Lift Station Rehabilitation** project dated October 11, 2019.

2. The plans and specifications for the proposed improvement are those jointly prepared by Klingner & Associates, P.C. and the city of Quincy Department of Utilities & Engineering.

3. In submitting this proposal, the undersigned declares that the only persons or parties interested in the proposal as principals are those named herein; and that the proposal is made without collusion with any other person, firm or corporation.

4. The undersigned further declares that the Bidding and Contract Documents, and the following Addenda, receipt of all which is hereby acknowledged,

<u>Addendum No.</u>	<u>Addendum Date</u>
_____	_____
_____	_____
_____	_____

have been carefully examined, the site(s) of the proposed work inspected in detail and the undersigned is familiar with all local conditions affecting the contract and the detailed requirements of construction, and understands that in making this proposal waives all right to plead any misunderstanding regarding the same.

5. The undersigned further understands and agrees that if this proposal is accepted he is to furnish and provide all necessary machinery, tools, apparatus and other means of construction, and to do all of the work in accordance with the requirements therein set forth.

6. The undersigned further understands that payment will be made on a unit price bid basis for the work herein specified.

7. The undersigned further agrees that the Owner may at any time during the progress of the work covered by this contract order other work or materials incidental thereto and that all such work and materials as do not appear in the proposal or contract as a specific item accompanied by a unit price, and which are not included under the bid price for other items in this contract, shall be performed as extra work.

Return with Bid

8. The undersigned further agrees to execute a contract for this work and present the same to the City within fifteen (15) days after the date of Notice of Award of the contract to him.
9. The undersigned further agrees that he and his surety will execute and present within fifteen (15) days after the date of Notice of Award of contract, a contract bond satisfactory to and in the form prescribed by the city, in the penal sum of the full amount of the contract, guaranteeing the faithful performance of the work in accordance with the terms of the contract.
10. The undersigned further agrees to begin work not later than ten (10) days after the date of the Notice to Proceed, unless otherwise provided, and to prosecute the work in such manner and with sufficient materials, equipment, and labor as will insure its completion within the time limit specified herein, it being understood and agreed that the completion within the time limit is an essential part of the contract. The undersigned agrees to complete the work within two-hundred seventy (270) consecutive calendar days after the date of the **Notice to Proceed**, unless additional time shall be granted by the Owner in accordance with the provisions of this specification. In case of failure to complete the work within the time named herein or within such extra time as may have been allowed by extensions, the undersigned agrees that the City shall withhold, from such sums as may be due him under the terms of this contract, the costs set forth in these specifications, which costs shall be considered and treated not as a penalty but as damages due the owner from the undersigned by reason of inconvenience to the public, added cost of engineering and subdivision, maintenance of detours, and other items which have caused an expenditure of public funds resulting from the failure of the undersigned to complete the work within the time specified in the contract.
11. Accompanying this proposal is a bid bond, bank cashier's check, or certified check, in the amount of five percent (5%) of the total bid price, made payable to the City Treasurer of Quincy, Illinois. The amount of the bid deposit is: _____ (\$ _____)
- If this proposal is accepted and the undersigned shall fail to execute a contract and contract bond as required herein, it is hereby agreed that the amount of the bid deposit shall become the property of the Owner, and shall be considered as payment of damages due to delay and other causes suffered by the Owner because of the failure to execute said contract and contract bond; otherwise said check shall be returned to the undersigned. Bid Bonds will not be returned.

**ATTACH BANK CASHIER'S CHECK, OR CERTIFIED CHECK HERE - OR
COPY OF IRREVOCABLE LETTER OF CREDIT- OR
INCLUDE BID BOND WITHIN PROPOSAL**

12. The undersigned Contractor hereby proposed to furnish all labor, tools, materials, machinery and equipment to complete the Work in accordance with the Contract Documents for the following **LUMP SUM PRICE:**

_____ Dollars (\$ _____)

Words *Figures*

Return with Bid

BIDDING SIGNATURE FORM

By signing this "BIDDING SIGNATURE FORM" the undersigned Prime Contractor certifies that it is not barred from contracting with the city of Quincy, Illinois as a result of a violation of either Section 5/33E-3 or 5/33E-4 of the Illinois Compiled Statutes - Chapter 720).

ALSO, pursuant to Illinois Compiled Statutes, Chapter 65, Section 5/11-42.1-1, the undersigned Contractor or duly authorized agent of the Contractor, certifies, under oath, that the Contractor is not delinquent in the payment of any tax administered by the Illinois Department of Revenue, unless the Contractor is contesting the Contractor's liability for the tax or the amount thereof, in accordance with the procedures established by the appropriate revenue act.

Failure to complete this notarized certification will result in the bid not being read at the bid opening and thereby rejected.

(If an individual) Signature of Bidder _____(SEAL)
Business Address _____

(If a co-partnership) Firm Name _____
Signed by _____(SEAL)
Business Address _____

(Insert Names and
Addresses of All
Members of the
Co-Partnership) _____

(If a Corporation) Corporate Name _____
Signed by _____(SEAL)
President
Business Address _____

(Insert
Names of
Officers) _____ President

_____ Secretary
_____ Treasurer

SIGNED and SWORN to before me this _____ day of _____, 20____.

Notary Public

(NOTARY
SEAL)

Return with Bid

PROPOSAL BID BOND

We, _____, as PRINCIPAL, and _____, as SURETY, are held and firmly bound unto the City of Quincy in the penal sum of _____ Dollars (\$_____).

We bind ourselves, our heirs, executors, administrators, successors and assigns jointly to pay to the City of Quincy this sum under the conditions of this instrument.

WHEREAS, THE CONDITION OF THE FOREGOING OBLIGATION IS SUCH that, said PRINCIPAL is submitting a written proposal to the City of Quincy for construction of the work designated and outlined in this proposal.

THEREFORE, if the proposal is accepted and a contract awarded to the PRINCIPAL by the City of Quincy for the above-designated project, and the PRINCIPAL shall within the time period specified in the contract documents after award enter into a formal contract, furnish surety guaranteeing faithful performance of the work, and furnish evidence of the required insurance coverage, all as provided in the General Conditions, then this obligation shall become void; otherwise it shall remain in full force and effect.

IN THE EVENT the City of Quincy determines the PRINCIPAL has failed to enter into a formal contract in compliance with any requirements set forth in the preceding paragraph, then the City of Quincy shall immediately be entitled to recover the full penal sum set out above, together with all court costs, all attorney fees, and any other expense of recovery.

Return with Bid

IN TESTIMONY WHEREOF, the said PRINCIPAL and the said SURETY have caused this instrument to be signed by their respective officers and their corporate seals to be hereunto affixed this ____ day of _____ 20____.

PRINCIPAL

Company Name Seal Company Name Seal

By: _____ By:- _____
Signature & Title Signature & Title

(IF PRINCIPAL is a joint venture of two or more Contractors, the company names, seals and authorized signatures of each Contractor must be affixed.)

SURETY

Company Name Seal By: _____
Signature & Title

STATE OF)
) ss.
COUNTY OF)

I, _____, a Notary Public in and for said County, do hereby certify that

Insert names of individuals signing on behalf of PRINCIPAL & SURETY

who are each personally known to me to be the same persons whose names are subscribed to the foregoing instrument on behalf of PRINCIPAL and SURETY, appeared before me this day in person and acknowledged respectively, that they signed, sealed, and delivered said instrument as their free and voluntary act for the uses and purposes therein set forth.

Given under my hand and notarial seal this ____ day of _____, 20____.

Notary Public (NOTARY SEAL)

End of Part 1.

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NOTICE OF AWARD

Date: _____

To: _____

Project Description: South Quincy Lift Station Rehabilitation

The OWNER has considered the Bid submitted by you for the above described WORK in response to its Invitation for Bids dated October 13, 2019.

You are hereby notified that your Bid has been accepted for items in the amount of \$_____.

You are required by the Invitation for Bids to execute the CONTRACT and furnish the required CONTRACTOR'S CONTRACT Bond and certificates of insurance within fifteen (15) calendar days from the date of this Notice to you.

If you fail to execute said CONTRACT and to furnish said Bond within fifteen (15) days from the date of this Notice, said OWNER will be entitled to consider all your rights arising out of the OWNER'S acceptance of your Bid as abandoned and as a forfeiture of your Bid Bond. The OWNER will be entitled to such rights as may be granted by law.

You are required to return an acknowledged copy of this Notice of Award to the OWNER.

Dated this ____ day of _____, 2019

OWNER CITY OF QUINCY

By _____

Title Director of Utilities

ACCEPTANCE OF NOTICE

Receipt of the above Notice of Award is hereby acknowledged.

Dated this ____ day of _____, 20____

CONTRACTOR _____

By _____

Title _____

NOTICE TO PROCEED

Date: _____

To: _____

Project Description: South Quincy Lift Station Rehabilitation

You are hereby notified to commence WORK by _____, 20__ in accordance with the CONTRACT dated _____, 20__ , and you are to complete the WORK within 270 consecutive calendar days thereafter. The date of completion of all WORK is therefore _____, 2020.

You are required to return an acknowledged copy of this Notice of Award to the OWNER.

Dated this ____ day of _____, 20____

OWNER CITY OF QUINCY

By _____

Title _____

ACCEPTANCE OF NOTICE

Receipt of the above Notice to Proceed is hereby acknowledged.

Dated this ____ day of _____, 20____

CONTRACTOR _____

By _____

Title _____

CONTRACT

1. THIS AGREEMENT, made and executed this ____ day of _____, 2019 between the CITY OF QUINCY, known as the OWNER and _____ his/their executors, administrators, successors, or assigns, known as the CONTRACTOR.

2. WITNESSETH: That for and in consideration of the payments and agreements mentioned in the Bid Documents hereto attached, to be made and performed by the OWNER, and according to the terms expressed in the Bond referring to these present, the CONTRACTOR agrees with the OWNER at his/their own proper cost and expense to do all the WORK furnish all materials and all labor necessary to complete the WORK in accordance with the Plans and Specifications hereinafter described and in full compliance with all of the plans of this agreement and the requirements of the ENGINEER under it.

3. And it is also understood and agreed that the Invitation for Bids, Addenda, General Conditions, Special Conditions, Special Provisions, Bid, Plans and Specifications, Notice of Award, Notice to Proceed, and Contract Performance and Payment Bonds hereto attached, for the **South Quincy Lift Station Rehabilitation** project are all essential documents of this Contract and are a part hereof.

4. IN WITNESS WHEREOF: The said parties have executed these presents on the date above mentioned.

For the OWNER

CITY OF QUINCY

By _____
Title Mayor

For the CONTRACTOR

Corporate Name _____
By _____
Title _____
Attest _____
Title _____
Business Address _____

CONTRACT BOND

KNOWN ALL MEN BY THESE PRESENT, That we _____
as Principal, and _____
a corporation organized and existing under the laws of the State of _____ with authority to do
business in the State of Illinois as Surety, are held and firmly bound unto the CITY OF QUINCY, State of
Illinois, in the penal sum of _____ Dollars
(\$ _____), lawful money of the United States, well and truly to be paid unto said
_____, for the payment of which we bind ourselves, our heirs, executors, administrators,
successors, and assigns, jointly, severally, and firmly by these presents.

THE CONDITION OF THE FOREGOING OBLIGATIONS IS SUCH that whereas, the said Principal has entered
into a written contract with the OWNER which is and act through for the construction of the WORK
designated as which CONTRACT is hereby referred to and made a part hereof, as if written herein at
length, and whereby the said Principal has promised and agreed to perform said WORK in accordance
with the terms of said CONTRACT, and has promised to pay all sums of money due for any labor,
materials, apparatus, fixtures or machinery furnished to such Principal for the purpose of performing
such WORK and has further agreed to pay all direct and indirect damages to any person, firm, company,
or corporation suffered or sustained on account of the performance of such WORK during the time
thereof and until such WORK is completed and accepted; and has further agreed that this Bond shall
insure to the benefit of any person, firm, company or corporation, to whom any money may be due
from the Principal, subcontractor or otherwise, for any such labor, materials, apparatus, fixtures or
machinery so furnished and that suit may be maintained on such Bond by any such person, firm,
company, or corporation, for the recovery of any such money.

NOW THEREFORE, if the said Principal shall well and truly perform said WORK in accordance with the
terms of said CONTRACT, and shall pay all sums of money due or to become due for any labor, materials,
apparatus, fixtures or machinery furnished to him for the purpose of constructing such WORK, and shall
commence and complete the WORK within the time prescribed in said CONTRACT, and shall pay and
discharge such WORK during the time of the performance thereof and until the said WORK shall have
been accepted, and shall hold the aforesaid OWNER and its or his agents, harmless on account of any
such damages, and shall in all respects fully and faithfully comply with all the provisions, conditions, and
requirements of said CONTRACT, then this obligation to be void; otherwise to remain in full force and
effect.

CONTRACT BOND (continued)

IN WITNESS WHEREOF, this instrument is executed this _____ day of _____, 20__.

In the presence of: _____

Principal

(Address)

By: _____

ATTEST: _____

SURETY: _____

By: _____

Attorney-in-Fact

ATTEST: _____

State of _____)

)ss.

County of _____)

On this ____ day of _____, 20__ before me personally appeared

_____ Principal

and _____ Surety

all personally known to me to be the persons described in and who executed the above bond, and severally and individually acknowledged to me that they executed the same.

Given under my hand and notarial seal, this ____ day of _____, 20__.

(Notary Public)

My commission expires _____

End of Part 2.

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Part 3. General Conditions

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GENERAL CONDITIONS

ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

- A. Wherever used in the Bidding Requirements or Contract Documents and printed with initial capital letters, the terms listed below will have the meanings indicated which are applicable to both the singular and plural thereof. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.
1. *Addenda* – Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the proposed Contract Documents.
 2. *Agency* – The Federal or state agency named as such in the Agreement.
 3. *Agreement* – The written instrument which is evidence of the agreement between Owner and Contractor covering the Work.
 4. *Application for Payment* – The form acceptable to Engineer which is to be used by Contractor during the course of the Work in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.
 5. *Asbestos* – Any material that contains more than one percent asbestos and is friable or is releasing asbestos fibers into the air above current action levels established by the United States Occupational Safety and Health Administration.
 6. *Bid* – The offer or proposal of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.
 7. *Bidder* – The individual or entity who submits a Bid directly to Owner.
 8. *Bidding Documents* – The Bidding Requirements and the proposed Contract Documents (including all Addenda).
 9. *Bidding Requirements* – The Advertisement or Invitation to Bid, Instructions to Bidders, bid security of acceptable form, if any, and the Bid Form with any supplements.
 10. *Change Order* – A document recommended by Engineer which is signed by Contractor and Owner and Agency and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, issued on or after the Effective Date of the Agreement.
 11. *Claim* – A demand or assertion by Owner or Contractor seeking an adjustment of Contract Price or Contract Times, or both, or other relief with respect to the terms of the Contract. A demand for money or services by a third party is not a Claim.
 12. *Contract* – The entire and integrated written agreement between the Owner and Contractor concerning the Work. The Contract supersedes prior negotiations, representations, or agreements, whether written or oral.
 13. *Contract Documents* – Those items so designated in the Agreement. Only printed or hard copies of the items listed in the Agreement are Contract Documents. Approved Shop Drawings, other Contractor's submittals, and the reports and drawings of subsurface and physical conditions are not Contract Documents.

14. *Contract Price* – The moneys payable by Owner to Contractor for completion of the Work in accordance with the Contract Documents as stated in the Agreement (subject to the provisions of Paragraph 11.03 in the case of Unit Price Work).
15. *Contract Times* – The number of days or the dates stated in the Agreement to: (i) achieve Milestones, if any, (ii) achieve Substantial Completion; and (iii) complete the Work so that it is ready for final payment as evidenced by Engineer’s written recommendation of final payment.
16. *Contractor* – The individual or entity with whom Owner has entered into the Agreement.
17. *Cost of the Work* – See Paragraph 11.01.A for definition.
18. *Drawings* – That part of the Contract Documents prepared or approved by Engineer which graphically shows the scope, extent, and character of the Work to be performed by Contractor. Shop Drawings and other Contractor submittals are not Drawings as so defined.
19. *Effective Date of the Agreement* – The date indicated in the Agreement on which it becomes effective, but if no such date is indicated, it means the date on which the Agreement is signed and delivered by the last of the two parties to sign and deliver.
20. *Engineer* – The individual or entity named as such in the Agreement.
21. *Field Order* – A written order issued by Engineer which requires minor changes in the Work but which does not involve a change in the Contract Price or the Contract Times.
22. *General Requirements* – Sections of Division 1 of the Specifications. The General Requirements pertain to all sections of the Specifications.
23. *Hazardous Environmental Condition* – The presence at the Site of Asbestos, PCBs, Petroleum, Hazardous Waste, or Radioactive Material in such quantities or circumstances that may present a substantial danger to persons or property exposed thereto in connection with the Work.
24. *Hazardous Waste* – The term Hazardous Waste shall have the meaning provided in Section 1004 of the Solid Waste Disposal Act (42 USC Section 6903) as amended from time to time.
25. *Laws and Regulations; Laws or Regulations* – Any and all applicable laws, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.
26. *Liens* – Charges, security interests, or encumbrances upon Project funds, real property, or personal property.
27. *Milestone* – A principal event specified in the Contract Documents relating to an intermediate completion date or time prior to Substantial Completion of all the Work.
28. *Notice of Award* – The written notice by Owner to the Successful Bidder stating that upon timely compliance by the Successful Bidder with the conditions precedent listed therein, Owner will sign and deliver the Agreement.
29. *Notice to Proceed* – A written notice given by Owner to Contractor fixing the date or expected River Crest on which the Contract Times will commence to run and on which Contractor shall start to perform the Work under the Contract Documents.
30. *Owner* – The individual or entity with whom Contractor has entered into the Agreement and for whom the Work is to be performed.
31. *PCBs* – Polychlorinated biphenyls.

32. *Petroleum* – Petroleum, including crude oil or any fraction thereof which is liquid at standard conditions of temperature and pressure (60 degrees Fahrenheit and 14.7 pounds per square inch absolute), such as oil, petroleum, fuel oil, oil sludge, oil refuse, gasoline, kerosene, and oil mixed with other non-Hazardous Waste and crude oils.
33. *Progress Schedule* – A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising the Contractor’s plan to accomplish the Work within the Contract Times.
34. *Project* – The total construction of which the Work to be performed under the Contract Documents may be the whole, or a part.
35. *Project Manual* – The bound documentary information prepared for bidding and constructing the Work. A listing of the contents of the Project Manual, which may be bound in one or more volumes, is contained in the table(s) of contents.
36. *Radioactive Material* – Source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954 (42 USC Section 2011 et seq.) as amended from time to time.
37. *Related Entity* – An officer, director, partner, employee, agent, consultant, or subcontractor.
38. *Resident Project Representative* – The authorized representative of Engineer who may be assigned to the Site or any part thereof.
39. *Samples* – Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and which establish the standards by which such portion of the Work will be judged.
40. *Schedule of Submittals* – A schedule, prepared and maintained by Contractor, of required submittals and the time requirements to support scheduled performance of related construction activities.
41. *Schedule of Values* – A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor’s Applications for Payment.
42. *Shop Drawings* – All drawings, diagrams, illustrations, schedules, and other data or information which are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work.
43. *Site* – Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements for access thereto, and such other lands furnished by Owner which are designated for the use of Contractor.
44. *Specifications* – That part of the Contract Documents consisting of written requirements for materials, equipment, systems, standards and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable thereto.
45. *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.
46. *Substantial Completion* – The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms “substantially complete” and “substantially completed” as applied to all or part of the Work refer to Substantial Completion thereof.
47. *Successful Bidder* – The Bidder submitting a responsive Bid to whom Owner makes an award.

48. *Supplementary Conditions* – That part of the Contract Documents which amends or supplements these General Conditions.
49. *Supplier* – A manufacturer, fabricator, supplier, distributor, materialman, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or any Subcontractor.
50. *Underground Facilities* – All underground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities, including those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.
51. *Unit Price Work* – Work to be paid for on the basis of unit prices.
52. *Work* – The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction, and furnishing, installing, and incorporating all materials and equipment into such construction, all as required by the Contract Documents.
53. *Work Change Directive* – A written statement to Contractor issued on or after the Effective Date of the Agreement and signed by Owner and Agency upon recommendation of the Engineer ordering an addition, deletion, or revision in the Work, or responding to differing or unforeseen subsurface or physical conditions under which the Work is to be performed or to emergencies. A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the change ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or Contract Times.

1.02 *Terminology*

- A. The following words or terms are not defined but, when used in the Bidding Requirements or Contract Documents, have the following meaning.
- B. *Intent of Certain Terms or Adjectives*
 1. The Contract Documents include the terms “as allowed,” “as approved,” “as ordered”, “as directed” or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives “reasonable,” “suitable,” “acceptable,” “proper,” “satisfactory,” or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Work. It is intended that such exercise of professional judgment, action or determination will be solely to evaluate, in general, the Work for compliance with the requirements of and information in the Contract Documents and conformance with the design concept of the completed Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Engineer any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility contrary to the provisions of Paragraph 9.09 or any other provision of the Contract Documents.
- C. *Day*
 1. The word “day” means a calendar day of 24 hours measured from midnight to the next midnight.
- D. *Defective*
 1. The word “defective,” when modifying the word “Work,” refers to Work that is unsatisfactory, faulty, or deficient in that it:
 - a. does not conform to the Contract Documents, or

- b. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents, or
 - c. has been damaged prior to Engineer's recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion in accordance with Paragraph 14.04 or 14.05).
- E. *Furnish, Install, Perform, Provide*
- 1. The word "furnish," when used in connection with services, materials, or equipment, shall mean to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.
 - 2. The word "install," when used in connection with services, materials, or equipment, shall mean to put into use or place in final position said services, materials, or equipment complete and ready for intended use.
 - 3. The words "perform" or "provide," when used in connection with services, materials, or equipment, shall mean to furnish and install said services, materials, or equipment complete and ready for intended use.
 - 4. When "furnish," "install," "perform," or "provide" is not used in connection with services, materials, or equipment in a context clearly requiring an obligation of Contractor, "provide" is implied.
- F. Unless stated otherwise in the Contract Documents, words or phrases which have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

ARTICLE 2 – PRELIMINARY MATTERS

2.01 Delivery of Bonds and Evidence of Insurance

- A. When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner such bonds as Contractor may be required to furnish.
- B. *Evidence of Insurance:* Before any Work at the Site is started, Contractor and Owner shall each deliver to the other, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance which either of them or any additional insured may reasonably request) which Contractor and Owner respectively are required to purchase and maintain in accordance with Article 5.

2.02 Copies of Documents

- A. Owner shall furnish to Contractor up to five printed or hard copies of the Drawings and Project Manual. Additional copies will be furnished upon request at the cost of reproduction.

2.03 Commencement of Contract Times; Notice to Proceed

- A. The Contract Times will commence to run 24 hours after the Effective Date of the Agreement or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed (NTP). A Notice to Proceed may be given at any time within 365 days after the Effective Date of the Agreement.
- B. Due to the emergency nature of this work the contractor shall be fully mobilized and working on the project within 18 hours of receiving a NTP
- C. 75% of the sand, by visual inspection, shall be in-place within 32 hrs. of receiving a NTP.

- D. The Contractor shall have 95% of the sand in place, as well as all polyethylene, sandbags, and other miscellaneous material within 44 hrs. of receiving NTP
- E. Substantial completion shall be completed within 48 hours of receiving NTP.
- F. Once flood waters have retreated a second NTP will be issued for the Removal of Closure and placement of Surface Aggregate as described in the JSP's. Access to the Barge dock shall be re-established within 2 days of receiving the NTP with all work being completed within 6 days of the NTP.

2.04 *Starting the Work*

- A. Contractor shall start to perform the Work on the date when the Contract Times commence to run. All Work done at the Site prior to the date on which the Contract Times commence shall be coordinated and approved by the owner

2.05 *This section is not applicable and has been removed*

2.06 *Construction Conference*

- A. During emergency flood periods the Owner will hold daily or weekly meetings. The contractors may be required to attend one or more of these meetings to update the owner on the progress of the closure. These meetings will be considered incidental to construction.

2.07 *Construction schedule:*

- A. Due to the emergency nature of this work a schedule has been outlined in Section 2.03 *Commencement of Contract Times*, and will be strictly enforced. Any delays in this schedule will be grounds for termination of this contract as described in Article 15 of the General Conditions.

ARTICLE 3 – CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE

3.01 *Intent*

- A. The Contract Documents are complementary; what is required by one is as binding as if required by all.
- B. It is the intent of the Contract Documents to describe a functionally complete Project (or part thereof) to be constructed in accordance with the Contract Documents. Any labor, documentation, services, materials, or equipment that may reasonably be inferred from the Contract Documents or from prevailing custom or trade usage as being required to produce the intended result will be provided whether or not specifically called for at no additional cost to Owner.
- C. Clarifications and interpretations of the Contract Documents shall be issued by Engineer as provided in Article 9.

3.02 *Reference Standards*

- A. *Standards, Specifications, Codes, Laws, and Regulations*
 - 1. Reference to standards, specifications, manuals, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, shall mean the standard, specification, manual, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Agreement if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.
 - 2. No provision of any such standard, specification, manual or code, or any instruction of a Supplier shall be effective to change the duties or responsibilities of Owner, Contractor, or Engineer, or any of their

subcontractors, consultants, agents, or employees from those set forth in the Contract Documents. No such provision or instruction shall be effective to assign to Owner, or Engineer, or any of their Related Entities, any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the Contract Documents.

3.03 *Reporting and Resolving Discrepancies*

A. Reporting Discrepancies

1. *Contractor's Review of Contract Documents Before Starting Work:* Before undertaking each part of the Work, Contractor shall carefully study and compare the Contract Documents and check and verify pertinent figures therein and all applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy which Contractor may discover and shall obtain a written interpretation or clarification from Engineer before proceeding with any Work affected thereby.
2. *Contractor's Review of Contract Documents During Performance of Work:* If, during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents or between the Contract Documents and any provision of any Law or Regulation applicable to the performance of the Work or of any standard, specification, manual or code, or of any instruction of any Supplier, Contractor shall promptly report it to Engineer in writing. Contractor shall not proceed with the Work affected thereby (except in an emergency as required by Paragraph 6.16.A) until an amendment or supplement to the Contract Documents has been issued by one of the methods indicated in Paragraph 3.04.
3. Contractor shall not be liable to Owner or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Contractor knew or reasonably should have known thereof.

B. Resolving Discrepancies

1. Except as may be otherwise specifically stated in the Contract Documents, the provisions of the Contract Documents shall take precedence in resolving any conflict, error, ambiguity, or discrepancy between the provisions of the Contract Documents and:
 - a. the provisions of any standard, specification, manual, code, or instruction (whether or not specifically incorporated by reference in the Contract Documents); or
 - b. the provisions of any Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

3.04 *Amending and Supplementing Contract Documents*

- A. The Contract Documents may be amended to provide for additions, deletions, and revisions in the Work or to modify the terms and conditions thereof by either a Change Order or a Work Change Directive.
- B. The requirements of the Contract Documents may be supplemented, and minor variations and deviations in the Work may be authorized, by one or more of the following ways:
 1. A Field Order;
 2. Engineer's approval of a Shop Drawing or Sample; (Subject to the provisions of Paragraph 6.17.D.3) or
 3. Engineer's written interpretation or clarification.

3.01 *Reuse of Documents*

- A. Contractor and any Subcontractor or Supplier shall not:
 - 1. have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or Engineer's consultants, including electronic media editions; or
 - 2. reuse any of such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of Owner and Engineer and specific written verification or adaptation by Engineer.
- B. The prohibition of this Paragraph 3.05 will survive final payment, or termination of the Contract. Nothing herein shall preclude Contractor from retaining copies of the Contract Documents for record purposes.

3.02 *Electronic Data*

- A. Copies of data furnished by Owner or Engineer to Contractor or Contractor to Owner or Engineer that may be relied upon are limited to the printed copies (also known as hard copies). Files in electronic media format of text, data, graphics, or other types are furnished only for the convenience of the receiving party. Any conclusion or information obtained or derived from such electronic files will be at the user's sole risk. If there is a discrepancy between the electronic files and the hard copies, the hard copies govern.
- B. Because data stored in electronic media format can deteriorate or be modified inadvertently or otherwise without authorization of the data's creator, the party receiving electronic files agrees that it will perform acceptance tests or procedures within 60 days, after which the receiving party shall be deemed to have accepted the data thus transferred. Any errors detected within the 60-day acceptance period will be corrected by the transferring party.
- C. When transferring documents in electronic media format, the transferring party makes no representations as to long term compatibility, usability, or readability of documents resulting from the use of software application packages, operating systems, or computer hardware differing from those used by the data's creator.

ARTICLE 4 – AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS; REFERENCE POINTS

4.01 *Availability of Lands*

- A. Owner shall furnish the Site. Owner shall notify Contractor of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work. Owner will obtain in a timely manner and pay for easements for permanent structures or permanent changes in existing facilities.
- B. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

4.02 *Subsurface and Physical Conditions*

- A. *Reports and Drawings:* The Supplementary Conditions identify:
 - 1. those reports of explorations and tests of subsurface conditions at or contiguous to the Site that Engineer has used in preparing the Contract Documents; and
 - 2. those drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site (except Underground Facilities) that Engineer has used in preparing the Contract Documents.

B. *Limited Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the general accuracy of the “technical data” contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such “technical data” is identified in the Supplementary Conditions. Except for such reliance on such “technical data,” Contractor may not rely upon or make any claim against Owner or Engineer, or any of their Related Entities with respect to:

1. the completeness of such reports and drawings for Contractor’s purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto; or
2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or
3. any Contractor interpretation of or conclusion drawn from any “technical data” or any such other data, interpretations, opinions, or information.

4.03 *Differing Subsurface or Physical Conditions*

A. *Notice:* If Contractor believes that any subsurface or physical condition at or contiguous to the Site that is uncovered or revealed either:

1. is of such a nature as to establish that any “technical data” on which Contractor is entitled to rely as provided in Paragraph 4.02 is materially inaccurate; or
2. is of such a nature as to require a change in the Contract Documents; or
3. differs materially from that shown or indicated in the Contract Documents; or
4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents;

then Contractor shall, promptly after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith (except in an emergency as required by Paragraph 6.16.A), notify Owner and Engineer in writing about such condition. Contractor shall not further disturb such condition or perform any Work in connection therewith (except as aforesaid) until receipt of written order to do so.

B. *Engineer’s Review:* After receipt of written notice as required by Paragraph 4.03.A, Engineer will promptly review the pertinent condition, determine the necessity of Owner’s obtaining additional exploration or tests with respect thereto, and advise Owner in writing (with a copy to Contractor) of Engineer’s findings and conclusions.

C. *Possible Price and Times Adjustments*

1. The Contract Price or the Contract Times, or both, will be equitably adjusted to the extent that the existence of such differing subsurface or physical condition causes an increase or decrease in Contractor’s cost of, or time required for, performance of the Work; subject, however, to the following:
 - a. such condition must meet any one or more of the categories described in Paragraph 4.03.A; and
 - b. with respect to Work that is paid for on a Unit Price Basis, any adjustment in Contract Price will be subject to the provisions of Paragraphs 9.07 and 11.03.
2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times if:

- a. Contractor knew of the existence of such conditions at the time Contractor made a final commitment to Owner with respect to Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract; or
 - b. the existence of such condition could reasonably have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such final commitment; or
 - c. Contractor failed to give the written notice as required by Paragraph 4.03.A.
3. If Owner 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, or both, a Claim may be made therefor as provided in Paragraph 10.05. However, Owner and Engineer, and any of their Related Entities shall not be liable to Contractor for any claims, costs, losses, or damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Contractor on or in connection with any other project or anticipated project.

4.04 *Underground Facilities*

- A. *Shown or Indicated:* The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or contiguous to the Site is based on information and data furnished to Owner or Engineer by the owners of such Underground Facilities, including Owner, or by others. Unless it is otherwise expressly provided in the Supplementary Conditions:
 1. Owner and Engineer shall not be responsible for the accuracy or completeness of any such information or data; and
 2. the cost of all of the following will be included in the Contract Price, and Contractor shall have full responsibility for:
 - a. reviewing and checking all such information and data,
 - b. locating all Underground Facilities shown or indicated in the Contract Documents,
 - c. coordination of the Work with the owners of such Underground Facilities, including Owner, during construction, and
 - d. the safety and protection of all such Underground Facilities and repairing any damage thereto resulting from the Work.
- B. *Not Shown or Indicated*
 1. If an Underground Facility is uncovered or revealed at or contiguous to the Site which was not shown or indicated, or not shown or indicated with reasonable accuracy in the Contract Documents, Contractor shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by Paragraph 6.16.A), identify the owner of such Underground Facility and give written notice to that owner and to Owner and Engineer. Engineer will promptly review the Underground Facility and determine the extent, if any, to which a change is required in the Contract Documents to reflect and document the consequences of the existence or location of the Underground Facility. During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.
 2. If Engineer concludes that a change in the Contract Documents is required, a Work Change Directive or a Change Order will be issued to reflect and document such consequences. An equitable adjustment shall be made in the Contract Price or Contract Times, or both, to the extent that they are attributable to the existence

or location of any Underground Facility that was not shown or indicated or not shown or indicated with reasonable accuracy in the Contract Documents and that Contractor did not know of and could not reasonably have been expected to be aware of or to have anticipated. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment in Contract Price or Contract Times, Owner or Contractor may make a Claim therefor as provided in Paragraph 10.05.

4.05 *Reference Points*

- A. Owner shall provide engineering surveys to establish reference points for construction which in Engineer's judgment are necessary to enable Contractor to proceed with the Work. Contractor shall be responsible for laying out the Work, shall protect and preserve the established reference points and property monuments, and shall make no changes or relocations without the prior written approval of Owner. Contractor shall report to Engineer whenever any reference point or property monument is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points or property monuments by professionally qualified personnel.

ARTICLE 5 – BONDS AND INSURANCE

5.01 *Performance, Payment, and Other Bonds*

- A. Contractor shall furnish performance and payment bonds, each in an amount at least equal to the Contract Price as security for the faithful performance and payment of all of Contractor's obligations under the Contract Documents. These bonds shall remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 13.07, whichever is later, except as provided otherwise by Laws or Regulations or by the Contract Documents. Contractor shall also furnish such other bonds as are required by the Contract Documents.
- B. All bonds shall be in the form prescribed by the Contract Documents except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in the current list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (amended) by the Financial Management Service, Surety Bond Branch, U.S. Department of the Treasury. All bonds signed by an agent must be accompanied by a certified copy of the agent's authority to act.
- C. If the surety on any bond furnished by Contractor is declared bankrupt or becomes insolvent or its right to do business is terminated in any state where any part of the Project is located or it ceases to meet the requirements of Paragraph 5.01.B, Contractor shall promptly notify Owner and Engineer and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which shall comply with the requirements of Paragraphs 5.01.B and 5.02.

5.02 *Licensed Sureties and Insurers*

- A. All bonds and insurance required by the Contract Documents to be purchased and maintained by Owner or Contractor shall be obtained from surety or insurance companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue bonds or insurance policies for the limits and coverages so required. Such surety and insurance companies shall also meet such additional requirements and qualifications as may be provided in the Supplementary Conditions.

5.03 *Certificates of Insurance*

- A. Contractor shall deliver to Owner, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by Owner or any other additional insured) which Contractor is required to purchase and maintain.

- B. Owner shall deliver to Contractor, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by Contractor or any other additional insured) which Owner is required to purchase and maintain.

5.04 *Contractor's Liability Insurance*

- A. Contractor shall purchase and maintain such liability and other insurance as is appropriate for the Work being performed and as will provide protection from claims set forth below which may arise out of or result from Contractor's performance of the Work and Contractor's other obligations under the Contract Documents, whether it is to be performed by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable:
 - 1. claims under workers' compensation, disability benefits, and other similar employee benefit acts;
 - 2. claims for damages because of bodily injury, occupational sickness or disease, or death of Contractor's employees;
 - 3. claims for damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees;
 - 4. claims for damages insured by reasonably available personal injury liability coverage which are sustained:
 - a. by any person as a result of an offense directly or indirectly related to the employment of such person by Contractor, or
 - b. by any other person for any other reason;
 - 5. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom; and
 - 6. claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance or use of any motor vehicle.
- B. The policies of insurance required by this Paragraph 5.04 shall:
 - 1. with respect to insurance required by Paragraphs 5.04.A.3 through 5.04.A.6 inclusive, include as additional insureds (subject to any customary exclusion regarding professional liability) Owner and Engineer, and any other individuals or entities identified in the Supplementary Conditions, all of whom shall be listed as additional insureds, and include coverage for the respective officers, directors, partners, employees, agents, consultants and subcontractors of each and any of all such additional insureds, and the insurance afforded to these additional insureds shall provide primary coverage for all claims covered thereby;
 - 2. include at least the specific coverages and be written for not less than the limits of liability provided in the Supplementary Conditions or required by Laws or Regulations, whichever is greater;
 - 3. include completed operations insurance;
 - 4. include contractual liability insurance covering Contractor's indemnity obligations under Paragraphs 6.11 and 6.20;
 - 5. contain a provision or endorsement that the coverage afforded will not be canceled, materially changed or renewal refused until at least 30 days prior written notice has been given to Owner and Contractor and to each other additional insured identified in the Supplementary Conditions to whom a certificate of insurance has been issued (and the certificates of insurance furnished by the Contractor pursuant to Paragraph 5.03 will so provide);

6. remain in effect at least until final payment and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work in accordance with Paragraph 13.07; and
7. with respect to completed operations insurance, and any insurance coverage written on a claims-made basis, remain in effect for at least two years after final payment.
 - a. Contractor shall furnish Owner and each other additional insured identified in the Supplementary Conditions, to whom a certificate of insurance has been issued, evidence satisfactory to Owner and any such additional insured of continuation of such insurance at final payment and one year thereafter.

5.05 *Acceptance of Bonds and Insurance; Option to Replace*

- A. If either Owner or Contractor has any objection to the coverage afforded by or other provisions of the bonds or insurance required to be purchased and maintained by the other party in accordance with Article 5 on the basis of non-conformance with the Contract Documents, the objecting party shall so notify the other party in writing within 10 days after receipt of the certificates (or other evidence requested) required by Paragraph 2.01.B. Owner and Contractor shall each provide to the other such additional information in respect of insurance provided as the other may reasonably request. If either party does not purchase or maintain all of the bonds and insurance required of such party by the Contract Documents, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage. Without prejudice to any other right or remedy, the other party may elect to obtain equivalent bonds or insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and a Change Order shall be issued to adjust the Contract Price accordingly.

ARTICLE 6 – CONTRACTOR'S RESPONSIBILITIES

6.01 *Supervision and Superintendence*

- A. Contractor shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction. Contractor shall not be responsible for the negligence of Owner or Engineer in the design or specification of a specific means, method, technique, sequence, or procedure of construction which is shown or indicated in and expressly required by the Contract Documents.
- B. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who shall not be replaced without written notice to Owner and Engineer except under extraordinary circumstances. The superintendent will be Contractor's representative at the Site and shall have authority to act on behalf of Contractor. All communications given to or received from the superintendent shall be binding on Contractor.

6.02 *Labor; Working Hours*

- A. Contractor shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. Contractor shall at all times maintain good discipline and order at the Site.
- B. This work will be completed under 24hr/day emergency working hours. Contractors shall coordinate with the owner anticipated working hours so the owner can coordinate with other emergency activities.

6.03 *Services, Materials, and Equipment*

- A. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start-up, and completion of the Work.

- B. All materials and equipment incorporated into the Work shall be as specified or, if not specified, shall be of good quality and new, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications shall expressly run to the benefit of Owner. If required by Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.
- C. All materials and equipment shall be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents.

6.04 *Concerning Subcontractors, Suppliers, and Others*

- A. Contractor shall not employ any Subcontractor, Supplier, or other individual or entity (including those acceptable to Owner as indicated in Paragraph 6.06.B), whether initially or as a replacement, against whom Owner may have reasonable objection. Contractor shall not be required to employ any Subcontractor, Supplier, or other individual or entity to furnish or perform any of the Work against whom Contractor has reasonable objection.
- B. If the Supplementary Conditions require the identity of certain Subcontractors, Suppliers, or other individuals or entities to be submitted to Owner in advance for acceptance by Owner by a specified date prior to the Effective Date of the Agreement, and if Contractor has submitted a list thereof in accordance with the Supplementary Conditions, Owner's acceptance (either in writing or by failing to make written objection thereto by the date indicated for acceptance or objection in the Bidding Documents or the Contract Documents) of any such Subcontractor, Supplier, or other individual or entity so identified may be revoked on the basis of reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor, Supplier, or other individual or entity, and the Contract Price will be adjusted by the difference in the cost occasioned by such replacement, and an appropriate Change Order will be issued. No acceptance by Owner of any such Subcontractor, Supplier, or other individual or entity, whether initially or as a replacement, shall constitute a waiver of any right of Owner or Engineer to reject defective Work.
- C. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of the Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work just as Contractor is responsible for Contractor's own acts and omissions. Nothing in the Contract Documents:
 - 1. shall create for the benefit of any such Subcontractor, Supplier, or other individual or entity any contractual relationship between Owner or Engineer and any such Subcontractor, Supplier or other individual or entity, nor
 - 2. shall anything in the Contract Documents create any obligation on the part of Owner or Engineer to pay or to see to the payment of any moneys due any such Subcontractor, Supplier, or other individual or entity except as may otherwise be required by Laws and Regulations.
- D. Contractor shall be solely responsible for scheduling and coordinating the Work of Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work under a direct or indirect contract with Contractor.
- E. Contractor shall require all Subcontractors, Suppliers, and such other individuals or entities performing or furnishing any of the Work to communicate with Engineer through Contractor.
- F. The divisions and sections of the Specifications and the identifications of any Drawings shall not control Contractor in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.
- G. All Work performed for Contractor by a Subcontractor or Supplier will be pursuant to an appropriate agreement between Contractor and the Subcontractor or Supplier which specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of Owner and Engineer. Whenever any such agreement is with a Subcontractor or Supplier who is listed as an additional insured on the property insurance

provided in Paragraph 5.06, the agreement between the Contractor and the Subcontractor or Supplier will contain provisions whereby the Subcontractor or Supplier waives all rights against Owner, Contractor, and Engineer, and all other individuals or entities identified in the Supplementary Conditions to be listed as insureds or additional insureds (and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them) for all losses and damages caused by, arising out of, relating to, or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work. If the insurers on any such policies require separate waiver forms to be signed by any Subcontractor or Supplier, Contractor will obtain the same.

6.05 *Laws and Regulations*

- A. Contractor shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws or Regulations.
- B. If Contractor performs any Work knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work. However, it shall not be Contractor's primary responsibility to make certain that the Specifications and Drawings are in accordance with Laws and Regulations, but this shall not relieve Contractor of Contractor's obligations under Paragraph 3.03.
- C. Changes in Laws or Regulations not known at the time of opening of Bids (or, on the Effective Date of the Agreement if there were no Bids) having an effect on the cost or time of performance of the Work shall be the subject of an adjustment in Contract Price or Contract Times. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a Claim may be made therefor as provided in Paragraph 10.05.

6.06 *Taxes*

- A. Contractor shall pay all sales, consumer, use, and other similar taxes required to be paid by Contractor in accordance with the Laws and Regulations of the place of the Project which are applicable during the performance of the Work.

6.07 *Use of Site and Other Areas*

A. *Limitation on Use of Site and Other Areas*

- 1. Contractor shall confine construction equipment, the storage of materials and equipment, and the operations of workers to the Site and other areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and other areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for any damage to any such land or area, or to the owner or occupant thereof, or of any adjacent land or areas resulting from the performance of the Work.
- 2. Should any claim be made by any such owner or occupant because of the performance of the Work, Contractor shall promptly settle with such other party by negotiation or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law.
- 3. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused by or based upon Contractor's performance of the Work.

- B. *Removal of Debris During Performance of the Work:* During the progress of the Work Contractor shall keep the Site and other areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris shall conform to applicable Laws and Regulations.
- C. *Cleaning:* Prior to Substantial Completion of the Work, Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work Contractor shall remove from the Site all tools, appliances, construction equipment and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.
- D. *Loading Structures:* Contractor shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall Contractor subject any part of the Work or adjacent property to stresses or pressures that will endanger it.

6.08 *Safety and Protection*

- A. Contractor shall be solely responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to:
 - 1. all persons on the Site or who may be affected by the Work;
 - 2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and
 - 3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.
- B. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection. Contractor shall notify owners of adjacent property and of Underground Facilities and other utility owners when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property.
- C. All damage, injury, or loss to any property referred to in Paragraph 6.13.A.2 or 6.13.A.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or , or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).
- D. Contractor's duties and responsibilities for safety and for protection of the Work shall continue until such time as all the Work is completed and Engineer has issued a notice to Owner and Contractor in accordance with Paragraph 14.07.B that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).

6.09 *Safety Representative*

- A. Contractor shall designate a qualified and experienced safety representative at the Site whose duties and responsibilities shall be the prevention of accidents and the maintaining and supervising of safety precautions and programs.

6.10 *Hazard Communication Programs*

- A. Contractor shall be responsible for coordinating any exchange of material safety data sheets or other hazard communication information required to be made available to or exchanged between or among employers at the Site in accordance with Laws or Regulations.

6.11 *Emergencies*

- A. In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, Contractor is obligated to act to prevent threatened damage, injury, or loss. Contractor shall give Engineer prompt written notice if Contractor believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby or are required as a result thereof. If Engineer determines that a change in the Contract Documents is required because of the action taken by Contractor in response to such an emergency, a Work Change Directive or Change Order will be issued.

6.12 *Continuing the Work*

- A. Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with Owner. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, except as permitted by Paragraph 15.04 or as Owner and Contractor may otherwise agree in writing.

6.13 *Contractor's General Warranty and Guarantee*

- A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer and its Related Entities shall be entitled to rely on representation of Contractor's warranty and guarantee.
- B. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:
 - 1. abuse, modification, or improper maintenance or operation by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or
 - 2. normal wear and tear under normal usage.
- C. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents or a release of Contractor's obligation to perform the Work in accordance with the Contract Documents:
 - 1. observations by Engineer;
 - 2. recommendation by Engineer or payment by Owner of any progress or final payment;
 - 3. the issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner;
 - 4. use or occupancy of the Work or any part thereof by Owner;
 - 5. any review and approval of a Shop Drawing or Sample submittal or the issuance of a notice of acceptability by Engineer;
 - 6. any inspection, test, or approval by others; or
 - 7. any correction of defective Work by Owner.

6.14 *Indemnification*

- A. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the performance of the Work, provided that any such claim, cost, loss, or damage is attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom but only to the extent caused by any negligent act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work or anyone for whose acts any of them may be liable.
- B. In any and all claims against Owner or Engineer or any of their respective consultants, agents, officers, directors, partners, or employees by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 6.20.A shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.
- C. The indemnification obligations of Contractor under Paragraph 6.20.A shall not extend to the liability of Engineer and Engineer's officers, directors, partners, employees, agents, consultants and subcontractors arising out of:
 - 1. the preparation or approval of, or the failure to prepare or approve, maps, Drawings, opinions, reports, surveys, Change Orders, designs, or Specifications; or
 - 2. giving directions or instructions, or failing to give them, if that is the primary cause of the injury or damage.

6.15 *Delegation of Professional Design Services*

- A. Contractor will not be required to provide professional design services unless such services are specifically required by the Contract Documents for a portion of the Work or unless such services are required to carry out Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. Contractor shall not be required to provide professional services in violation of applicable law.
- B. If professional design services or certifications by a design professional related to systems, materials or equipment are specifically required of Contractor by the Contract Documents, Owner and Engineer will specify all performance and design criteria that such services must satisfy. Contractor shall cause such services or certifications to be provided by a properly licensed professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings and other submittals prepared by such professional. Shop Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to Engineer.
- C. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy and completeness of the services, certifications or approvals performed by such design professionals, provided Owner and Engineer have specified to Contractor all performance and design criteria that such services must satisfy.
- D. Pursuant to this Paragraph 6.21, Engineer's review and approval of design calculations and design drawings will be only for the limited purpose of checking for conformance with performance and design criteria given and the design concept expressed in the Contract Documents. Engineer's review and approval of Shop Drawings and other submittals (except design calculations and design drawings) will be only for the purpose stated in Paragraph 6.17.D.1.
- E. Contractor shall not be responsible for the adequacy of the performance or design criteria required by the Contract Documents.

ARTICLE 7 – OTHER WORK AT THE SITE

7.01 *Related Work at Site*

- A. Owner may perform other work related to the Project at the Site with Owner's employees, or via other direct contracts therefore, or have other work performed by utility owners. If such other work is not noted in the Contract Documents, then:
 - 1. ~~Written~~ verbal notice thereof will be given to Contractor prior to starting any such other work; and
 - 2. if Owner 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 made therefor as provided in Paragraph 10.05.
- B. Contractor shall afford each other contractor who is a party to such a direct contract, each utility owner and Owner, if Owner is performing other work with Owner's employees, proper and safe access to the Site, a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work, and shall 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 their work and will only cut or alter their 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 Owner and such utility owners and other contractors.
- C. If the proper execution or results of any part of Contractor's Work depends upon work performed by others under this Article 7, 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.

7.02 *Coordination*

- A. If Owner intends to contract with others for the performance of other work on the Project at the Site, the following will be set forth in Supplementary Conditions:
 - 1. the individual or entity who will have authority and responsibility for coordination of the activities among the various contractors will be identified;
 - 2. the specific matters to be covered by such authority and responsibility will be itemized; and
 - 3. the extent of such authority and responsibilities will be provided.
- B. Unless otherwise provided in the Supplementary Conditions, Owner shall have sole authority and responsibility for such coordination.

7.03 *Legal Relationships*

- A. Paragraphs 7.01.A and 7.02 are not applicable for utilities not under the control of Owner.
- B. Each other direct contract of Owner under Paragraph 7.01.A shall provide that the other contractor is liable to Owner and Contractor for the reasonable direct delay and disruption costs incurred by Contractor as a result of the other contractor's actions or inactions.

- C. Contractor shall be liable to Owner and any other contractor for the reasonable direct delay and disruption costs incurred by such other contractor as a result of Contractor's action or inactions.

ARTICLE 8 – OWNER'S RESPONSIBILITIES

8.01 *Communications to Contractor*

- A. Except as otherwise provided in these General Conditions, Owner shall issue all communications to Contractor through Engineer.

8.02 *Replacement of Engineer*

- A. In case of termination of the employment of Engineer, Owner shall appoint an engineer to whom Contractor makes no reasonable objection, whose status under the Contract Documents shall be that of the former Engineer.

8.03 *Furnish Data*

- A. Owner shall promptly furnish the data required of Owner under the Contract Documents.

8.04 *Pay When Due*

- A. Owner shall make payments to Contractor when they are due as provided in Paragraphs 14.02.C and 14.07.C.

8.05 *Change Orders*

- A. Owner is obligated to execute Change Orders as indicated in Paragraph 10.03.

8.06 *Inspections, Tests, and Approvals*

- A. Owner's responsibility in respect to certain inspections, tests, and approvals is set forth in Paragraph 13.03.B.

8.07 *Limitations on Owner's Responsibilities*

- A. The Owner shall not supervise, direct, or have control or authority over, nor be responsible for, Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Owner will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

ARTICLE 9 – ENGINEER'S STATUS DURING CONSTRUCTION

9.01 *Owner's Representative*

- A. Engineer will be Owner's representative during the construction period. The duties and responsibilities and the limitations of authority of Engineer as Owner's representative during construction are set forth in the Contract Documents and will not be changed without written consent of Owner and Engineer.

9.02 *Visits to Site*

- A. Engineer will make visits to the Site at intervals appropriate to the various stages of construction as Engineer deems necessary in order to observe as an experienced and qualified design professional the progress that has been made and the quality of the various aspects of Contractor's executed Work. Based on information obtained during such visits and observations, Engineer, for the benefit of Owner, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or continuous inspections on the Site to check the quality or quantity of the Work. Engineer's efforts will be directed

toward providing for Owner a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.

- B. Engineer's visits and observations are subject to all the limitations on Engineer's authority and responsibility set forth in Paragraph 9.09. Particularly, but without limitation, during or as a result of Engineer's visits or observations of Contractor's Work Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work.

9.03 *Project Representative*

- A. If Owner and Engineer agree, Engineer will furnish a Resident Project Representative to assist Engineer in providing more extensive observation of the Work. The authority and responsibilities of any such Resident Project Representative and assistants will be as provided in the Supplementary Conditions, and limitations on the responsibilities thereof will be as provided in Paragraph 9.09. If Owner designates another representative or agent to represent Owner at the Site who is not Engineer's consultant, agent or employee, the responsibilities and authority and limitations thereon of such other individual or entity will be as provided in the Supplementary Conditions.

9.04 *Authorized Variations in Work*

- A. Engineer 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 Owner and also on Contractor, who shall perform the Work involved promptly. If Owner or Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, or both, and 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 therefor as provided in Paragraph 10.05.

9.05 *Rejecting Defective Work*

- A. Engineer will have authority to reject Work which Engineer believes to be defective, or that Engineer 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. Engineer will also have authority to require special inspection or testing of the Work as provided in Paragraph 13.04, whether or not the Work is fabricated, installed, or completed.

9.06 *Shop Drawings, Change Orders and Payments*

- A. In connection with Engineer's authority, and limitations thereof, as to Shop Drawings and Samples, see Paragraph 6.17.
- B. In connection with Engineer's authority, and limitations thereof, as to design calculations and design drawings submitted in response to a delegation of professional design services, if any, see Paragraph 6.21.
- C. In connection with Engineer's authority as to Change Orders, see Articles 10, 11, and 12.
- D. In connection with Engineer's authority as to Applications for Payment, see Article 14.

9.07 *Determinations for Unit Price Work*

- A. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review with Contractor the Engineer's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). Engineer's written

decision thereon will be final and binding (except as modified by Engineer to reflect changed factual conditions or more accurate data) upon Owner and Contractor, subject to the provisions of Paragraph 10.05.

9.08 *Decisions on Requirements of Contract Documents and Acceptability of Work*

- A. Engineer will be the initial interpreter of the requirements of the Contract Documents and judge of the acceptability of the Work thereunder. All matters in question and other matters between Owner and Contractor arising prior to the date final payment is due relating to the acceptability of the Work, and the interpretation of the requirements of the Contract Documents pertaining to the performance of the Work, will be referred initially to Engineer in writing within 30 days of the event giving rise to the question.
- B. Engineer will, with reasonable promptness, render a written decision on the issue referred. If Owner or Contractor believe that any such decision entitles them to an adjustment in the Contract Price or Contract Times or both, a Claim may be made under Paragraph 10.05. The date of Engineer's decision shall be the date of the event giving rise to the issues referenced for the purposes of Paragraph 10.05.B.
- C. Engineer's written decision on the issue referred will be final and binding on Owner and Contractor, subject to the provisions of Paragraph 10.05.
- D. When functioning as interpreter and judge under this Paragraph 9.08, Engineer will not show partiality to Owner or Contractor and will not be liable in connection with any interpretation or decision rendered in good faith in such capacity.

9.09 *Limitations on Engineer's Authority and Responsibilities*

- A. Neither Engineer's authority or responsibility under this Article 9 or under any other provision of the Contract Documents nor any decision made by Engineer in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by Engineer shall create, impose, or give rise to any duty in contract, tort, or otherwise owed by Engineer to Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.
- B. Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.
- C. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.
- D. Engineer's review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Paragraph 14.07.A will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals that the results certified indicate compliance with the Contract Documents.
- E. The limitations upon authority and responsibility set forth in this Paragraph 9.09 shall also apply to the Resident Project Representative, if any, and assistants, if any.

ARTICLE 10 – CHANGES IN THE WORK; CLAIMS

10.01 *Authorized Changes in the Work*

- A. Without invalidating the Contract and without notice to any surety, Owner may, subject to written approval by Agency at any time or from time to time, order additions, deletions, or revisions in the Work by a Change Order,

or a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved which will be performed under the applicable conditions of the Contract Documents (except as otherwise specifically provided).

- B. If Owner and Contractor are unable to agree on entitlement to, or on the amount or extent, if any, of an adjustment in the Contract Price or Contract Times, or both, that should be allowed as a result of a Work Change Directive, a Claim may be made therefore as provided in Paragraph 10.05.

10.02 *Unauthorized Changes in the Work*

- A. Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents as amended, modified, or supplemented as provided in Paragraph 3.04, except in the case of an emergency as provided in Paragraph 6.16 or in the case of uncovering Work as provided in Paragraph 13.04.B.

10.03 *Execution of Change Orders*

- A. Owner and Contractor shall execute appropriate Change Orders recommended by Engineer covering:
 - 1. changes in the Work which are: (i) ordered by Owner pursuant to Paragraph 10.01.A, (ii) required because of acceptance of defective Work under Paragraph 13.08.A or Owner's correction of defective Work under Paragraph 13.09, or (iii) agreed to by the parties;
 - 2. changes in the Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive; and
 - 3. changes in the Contract Price or Contract Times which embody the substance of any written decision rendered by Engineer pursuant to Paragraph 10.05; provided that, in lieu of executing any such Change Order, an appeal may be taken from any such decision in accordance with the provisions of the Contract Documents and applicable Laws and Regulations, but during any such appeal, Contractor shall carry on the Work and adhere to the Progress Schedule as provided in Paragraph 6.18.A.

10.04 *Notification to Surety*

- A. If notice of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Times) is required by the provisions of any bond to be given to a surety, the giving of any such notice will be Contractor's responsibility. The amount of each applicable bond will be adjusted to reflect the effect of any such change.

10.05 *Claims*

- A. *Engineer's Decision Required:* All Claims, except those waived pursuant to Paragraph 14.09, shall be referred to the Engineer for decision. A decision by Engineer shall be required as a condition precedent to any exercise by Owner or Contractor of any rights or remedies either may otherwise have under the Contract Documents or by Laws and Regulations in respect of such Claims.
- B. *Notice:* Written notice stating the general nature of each Claim shall be delivered by the claimant to Engineer and the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto. The responsibility to substantiate a Claim shall rest with the party making the Claim. Notice of the amount or extent of the Claim, with supporting data shall be delivered to the Engineer and the other party to the Contract within 60 days after the start of such event (unless Engineer allows additional time for claimant to submit additional or more accurate data in support of such Claim). A Claim for an adjustment in Contract Price shall be prepared in accordance with the provisions of Paragraph 12.01.B. A Claim for an adjustment in Contract Time shall be prepared in accordance with the provisions of Paragraph 12.02.B. Each Claim shall be accompanied by claimant's written statement that the adjustment claimed is the entire adjustment to which the claimant believes it

is entitled as a result of said event. The opposing party shall submit any response to Engineer and the claimant within 30 days after receipt of the claimant's last submittal (unless Engineer allows additional time).

- C. *Engineer's Action:* Engineer will review each Claim and, within 30 days after receipt of the last submittal of the claimant or the last submittal of the opposing party, if any, take one of the following actions in writing:
1. deny the Claim in whole or in part,
 2. approve the Claim, or
 3. notify the parties that the Engineer is unable to resolve the Claim if, in the Engineer's sole discretion, it would be inappropriate for the Engineer to do so. For purposes of further resolution of the Claim, such notice shall be deemed a denial.
- D. In the event that Engineer does not take action on a Claim within said 30 days, the Claim shall be deemed denied.
- E. Engineer's written action under Paragraph 10.05.C or denial pursuant to Paragraphs 10.05.C.3 or 10.05.D will be final and binding upon Owner and Contractor, unless Owner or Contractor invoke the dispute resolution procedure set forth in Article 16 within 30 days of such action or denial.
- F. No Claim for an adjustment in Contract Price or Contract Times will be valid if not submitted in accordance with this Paragraph 10.05.

ARTICLE 11 – COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

11.01 *Cost of the Work*

- A. *Costs Included:* The term Cost of the Work means the sum of all costs, except those excluded in Paragraph 11.01.B, necessarily incurred and paid by Contractor in the proper performance of the Work. When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, the costs to be reimbursed to Contractor will be only those additional or incremental costs required because of the change in the Work or because of the event giving rise to the Claim. Except as otherwise may be agreed to in writing by Owner, such costs shall be in amounts no higher than those prevailing in the locality of the Project, shall include only the following items, and shall not include any of the costs itemized in Paragraph 11.01.B.
1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor. Such employees shall include, without limitation, superintendents, foremen, and other personnel employed full time at the Site. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits, which shall include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, bonuses, sick leave, vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, shall be included in the above to the extent authorized by Owner.
 2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts shall accrue to Owner. All trade discounts, rebates and refunds and returns from sale of surplus materials and equipment shall accrue to Owner, and Contractor shall make provisions so that they may be obtained.
 3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, who will then determine, with the advice of Engineer, which bids, if any,

will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee shall be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 11.01.

4. Costs of special consultants (including but not limited to Engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed for services specifically related to the Work.
5. Supplemental costs including the following:
 - a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.
 - b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.
 - c. Rentals of all construction equipment and machinery, and the parts thereof whether rented from Contractor or others in accordance with rental agreements approved by Owner with the advice of Engineer, and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs shall be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts shall cease when the use thereof is no longer necessary for the Work.
 - d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, imposed by Laws and Regulations.
 - e. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.
 - f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of property insurance established in accordance with Paragraph 5.06.D), provided such losses and damages have resulted from causes other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses shall be included in the Cost of the Work for the purpose of determining Contractor's fee.
 - g. The cost of utilities, fuel, and sanitary facilities at the Site.
 - h. Minor expenses such as telegrams, long distance telephone calls, telephone service at the Site, expressages, and similar petty cash items in connection with the Work.
 - i. The costs of premiums for all bonds and insurance Contractor is required by the Contract Documents to purchase and maintain.

B. *Costs Excluded:* The term Cost of the Work shall not include any of the following items:

1. Payroll costs and other compensation of Contractor's officers, executives, principals (of partnerships and sole proprietorships), general managers, safety managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expeditors, timekeepers, clerks, and other personnel employed by Contractor, whether at the Site or in Contractor's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in Paragraph 11.01.A.1 or specifically covered by Paragraph 11.01.A.4, all of which are to be considered administrative costs covered by the Contractor's fee.

2. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.
 3. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.
 4. Costs due to the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.
 5. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraphs 11.01.A and 11.01.B.
- C. **Contractor's Fee:** When all the Work is performed on the basis of cost-plus, Contractor's fee shall be determined as set forth in the Agreement. When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, Contractor's fee shall be determined as set forth in Paragraph 12.01.C.
- D. *Documentation:* Whenever the Cost of the Work for any purpose is to be determined pursuant to Paragraphs 11.01.A and 11.01.B, Contractor will establish and maintain records thereof in accordance with generally accepted accounting practices and submit in a form acceptable to Engineer an itemized cost breakdown together with supporting data.

11.02 Allowances

- A. It is understood that Contractor has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be performed for such sums and by such persons or entities as may be acceptable to Owner and Engineer.
- B. Cash Allowances
1. Contractor agrees that:
 - a. the cash allowances include the cost to Contractor (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and
 - b. Contractor's costs for unloading and handling on the Site, labor, installation, overhead, profit, and other expenses contemplated for the cash allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment on account of any of the foregoing will be valid.
- C. *Contingency Allowance*
1. Contractor agrees that a contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.
- D. Prior to final payment, an appropriate Change Order will be issued as recommended by Engineer to reflect actual amounts due Contractor on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.

11.03 Unit Price Work

- A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.

- B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Determinations of the actual quantities and classifications of Unit Price Work performed by Contractor will be made by Engineer subject to the provisions of Paragraph 9.07.
- C. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.
- D. Owner or Contractor may make a Claim for an adjustment in the Contract Price in accordance with Paragraph 10.05 if:
 - 1. the Bid price of a particular item of Unit Price Work amounts to more than 5 percent of the Contract Price and the variation in the quantity of that particular item of Unit Price Work performed by Contractor differs by more than 25 percent from the estimated quantity of such item indicated in the Agreement; and
 - 2. there is no corresponding adjustment with respect to any other item of Work; and
 - 3. Contractor believes that Contractor is entitled to an increase in Contract Price as a result of having incurred additional expense or Owner believes that Owner is entitled to a decrease in Contract Price and the parties are unable to agree as to the amount of any such increase or decrease.

11.04 *Understanding Scope of Work*

- A. This work is being conducted under Emergency Flooding Conditions. CONTRACTOR agrees to perform all work based on time, as agreed upon with the AGENCY for the accepted unit prices as full compensation for furnishing all materials, performing all work, and fulfilling all obligations hereunder. Such compensation shall cover all expenses, losses, damages, and consequences arising out of the nature of the work during its progress or prior to its acceptance including those for well and faithfully completing the work and the whole thereof in a manner and time specified in the aforesaid contact document; and also including this arising from action of the elements, unforeseen difficulties or obstructions encountered in the prosecution of the work, suspension or discontinuance of the work, and all other unknown or risks of any description connected with the work. Change in unit price or contract time will not be made due to weather condition, poor access, or the need for coordination with other flood fighting procedures/contractors. This *Understanding of Scope of Work* supersedes any article herein when concerning possible change in contact price or time

ARTICLE 12 – CHANGE OF CONTRACT PRICE; CHANGE OF CONTRACT TIMES

12.01 *Change of Contract Price*

- A. 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 Engineer and the other party to the Contract in accordance with the provisions of Paragraph 10.05. *See Article 11.04 Understanding Scope of Work.*
- B. 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 (subject to the provisions of Paragraph 11.03); 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 Paragraph 12.01.C.2); 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 Paragraph 12.01.B.2, on the basis of the Cost of the Work (determined as

provided in Paragraph 11.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 12.01.C).

C. 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 a fee based on the following percentages of the various portions of the Cost of the Work:
 - a. for costs incurred under Paragraphs 11.01.A.1 and 11.01.A.2, the Contractor's fee shall be 15 percent;
 - b. for costs incurred under Paragraph 11.01.A.3, the Contractor's fee shall be five percent;
 - c. where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraph 12.01.C.2.a is that the Subcontractor who actually performs the Work, at whatever tier, will be paid a fee of 15 percent of the costs incurred by such Subcontractor under Paragraphs 11.01.A.1 and 11.01.A.2 and that any higher tier Subcontractor and Contractor will each be paid a fee of five percent of the amount paid to the next lower tier Subcontractor;
 - d. no fee shall be payable on the basis of costs itemized under Paragraphs 11.01.A.4, 11.01.A.5, and 11.01.B;
 - e. the amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in cost will be the amount of the actual net decrease in cost plus a deduction in Contractor's fee by an amount equal to five percent of such net decrease; and
 - f. when both additions and credits are involved in any one change, the adjustment in Contractor's fee shall be computed on the basis of the net change in accordance with Paragraphs 12.01.C.2.a through 12.01.C.2.e, inclusive.

12.02 *Change of Contract Times*

- A. The Contract Times may only be changed by a Change Order. Any Claim for an adjustment in the Contract Times shall be based on written notice submitted by the party making the Claim to the Engineer and the other party to the Contract in accordance with the provisions of Paragraph 10.05.
- B. Any adjustment of the Contract Times covered by a Change Order or any Claim for an adjustment in the Contract Times will be determined in accordance with the provisions of this Article 12.

12.03 *Delays*

- A. Where Contractor is prevented from completing any part of the Work within the Contract Times due to delay beyond the control of Contractor, the Contract Times will be extended in an amount equal to the time lost due to such delay if a Claim is made therefore as provided in Paragraph 12.02.A. Delays beyond the control of Contractor shall include, but not be limited to, acts or neglect by Owner, acts or neglect of utility owners or other contractors performing other work as contemplated by Article 7, ~~fires, floods, epidemics, abnormal weather conditions, or acts of God.~~
- B. If Owner, Engineer, or other contractors or utility owners performing other work for Owner as contemplated by Article 7, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in ~~the Contract Price or the Contract Times, or both.~~ Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.

- C. If Contractor is delayed in the performance or progress of the ~~Work by fire, flood, epidemic, abnormal weather conditions, acts of God, acts or failures to act of utility owners not under the control of Owner, or other causes not the fault of and beyond control of Owner and Contractor~~, then Contractor shall be entitled to an equitable adjustment in Contract Times, if such adjustment is essential to Contractor's ability to complete the Work within the Contract Times. Such an adjustment shall be Contractor's sole and exclusive remedy for the delays described in this Paragraph 12.03.B.
1. delays caused by or within the control of Contractor; or
- D. Owner, Engineer and the Related Entities of each of them shall not be liable to Contractor for any claims, costs, losses, or damages (including but not limited to all fees and charges of Engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Contractor on or in connection with any other project or anticipated project.
- E. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delays within the control of Contractor. Delays attributable to and within the control of a Subcontractor or Supplier shall be deemed to be delays within the control of Contractor.

ARTICLE 13 – TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

13.01 Notice of Defects

- A. Prompt notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor. All defective Work may be rejected, corrected, or accepted as provided in this Article 13.

13.02 Access to Work

- A. Owner, Engineer, their consultants and other representatives and personnel of Owner, independent testing laboratories, and governmental agencies with jurisdictional interests will have access to the Site and the Work at reasonable times for their observation, inspecting, and testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's Site safety procedures and programs so that they may comply therewith as applicable.

13.03 Tests and Inspections

- A. Contractor shall give Engineer timely notice of readiness of the Work for all required inspections, tests, or approvals and shall cooperate with inspection and testing personnel to facilitate required inspections or tests.
- B. Owner shall employ and pay for the services of an independent testing laboratory to perform all inspections, tests, or approvals required by the Contract Documents except:
1. for inspections, tests, or approvals covered by Paragraphs 13.03.C and 13.03.D below;
 2. that costs incurred in connection with tests or inspections conducted pursuant to Paragraph 13.04.B shall be paid as provided in said Paragraph 13.04.C; and
 3. as otherwise specifically provided in the Contract Documents.
- C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.

- D. Contractor shall be responsible for arranging and obtaining and shall pay all costs in connection with any inspections, tests, or approvals required for Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work; or acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work. Such inspections, tests, or approvals shall be performed by organizations acceptable to Owner and Engineer.
- E. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, it must, if requested by Engineer, be uncovered for observation.
- F. Uncovering Work as provided in Paragraph 13.03.E shall be at Contractor's expense unless Contractor has given Engineer timely notice of Contractor's intention to cover the same and Engineer has not acted with reasonable promptness in response to such notice.

13.04 *Uncovering Work*

- A. If any Work is covered contrary to the written request of Engineer, it must, if requested by Engineer, be uncovered for Engineer's observation and replaced at Contractor's expense.
- B. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, Contractor, at Engineer's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as Engineer may require, that portion of the Work in question, furnishing all necessary labor, material, and equipment.
- C. If it is found that the uncovered Work is defective, Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and Owner shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount thereof, Owner may make a Claim therefore as provided in Paragraph 10.05.
- D. If, the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, Contractor may make a Claim therefore as provided in Paragraph 10.05.

13.05 *Owner May Stop the Work*

- A. If the Work is defective, or Contractor fails to supply sufficient skilled workers or suitable materials or equipment, or fails to perform the Work in such a way that the completed Work will conform to the Contract Documents, Owner may order Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of Owner to stop the Work shall not give rise to any duty on the part of Owner to exercise this right for the benefit of Contractor, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

13.06 *Correction or Removal of Defective Work*

- A. Promptly after receipt of notice, Contractor shall correct all defective Work, whether or not fabricated, installed, or completed, or, if the Work has been rejected by Engineer, remove it from the Project and replace it with Work that is not defective. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or removal (including but not limited to all costs of repair or replacement of work of others).
- B. When correcting defective Work under the terms of this Paragraph 13.06 or Paragraph 13.07, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.

13.07 *Acceptance of Defective Work*

- A. If, instead of requiring correction or removal and replacement of defective Work, Owner (and, prior to Engineer's recommendation of final payment, Engineer) prefers to accept it, Owner may do so. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) attributable to Owner's evaluation of and determination to accept such defective Work (such costs to be approved by Engineer as to reasonableness) and the diminished value of the Work to the extent not otherwise paid by Contractor pursuant to this sentence. If any such acceptance occurs prior to Engineer's recommendation of final payment, a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work, and Owner shall be entitled to an appropriate decrease in the Contract Price, reflecting the diminished value of Work so accepted. If the parties are unable to agree as to the amount thereof, Owner may make a Claim therefor as provided in Paragraph 10.05. If the acceptance occurs after such recommendation, an appropriate amount will be paid by Contractor to Owner.

13.08 *Owner May Correct Defective Work*

- A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work or to remove and replace rejected Work as required by Engineer in accordance with Paragraph 13.06.A, or if Contractor fails to perform the Work in accordance with the Contract Documents, or if Contractor fails to comply with any other provision of the Contract Documents, Owner may, after seven days written notice to Contractor, correct or remedy any such deficiency.
- B. In exercising the rights and remedies under this Paragraph 13.09, Owner shall proceed expeditiously. In connection with such corrective or remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor's services related thereto, take possession of Contractor's tools, appliances, construction equipment and machinery at the Site, and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this Paragraph.
- C. All claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 13.09 will be charged against Contractor, and a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and Owner shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount of the adjustment, Owner may make a Claim therefor as provided in Paragraph 10.05. Such claims, costs, losses and damages will include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of Contractor's defective Work.
- D. Contractor shall not be allowed an extension of the Contract Times because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies under this Paragraph 13.09.

ARTICLE 14 – PAYMENTS TO CONTRACTOR AND COMPLETION

14.01 *Schedule of Values*

- A. The Schedule of Values established as provided in Paragraph 2.07.A will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments on account of Unit Price Work will be based on the number of units completed.

14.02 *Progress Payments*

- A. *Applications for Payments*

1. At least 20 days before the date established in the Agreement for each progress payment (but not more often than once a month), Contractor shall submit to Engineer for review an Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment shall also be accompanied by a bill of sale, invoice, or other documentation warranting that Owner has received the materials and equipment free and clear of all Liens and evidence that the materials and equipment are covered by appropriate property insurance or other arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner.
2. Beginning with the second Application for Payment, each Application shall include an affidavit of Contractor stating that all previous progress payments received on account of the Work have been applied on account to discharge Contractor's legitimate obligations associated with prior Applications for Payment.
3. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.

B. *Review of Applications*

1. Engineer will, within ~~40~~-30 days after receipt of each Application for Payment, either indicate in writing a recommendation of payment and present the Application to Owner or return the Application to Contractor indicating in writing Engineer's reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.
2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations on the Site of the executed Work as an experienced and qualified design professional and on Engineer's review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information and belief:
 - a. the Work has progressed to the point indicated;
 - b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, to the results of any subsequent tests called for in the Contract Documents, to a final determination of quantities and classifications for Unit Price Work under Paragraph 9.07, and to any other qualifications stated in the recommendation); and
 - c. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.
3. By recommending any such payment Engineer will not thereby be deemed to have represented that:
 - a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract Documents; or
 - b. that there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.
4. Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:
 - a. to supervise, direct, or control the Work, or
 - b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or

- c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work, or
 - d. to make any examination to ascertain how or for what purposes Contractor has used the moneys paid on account of the Contract Price, or
 - e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.
5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 14.02.B.2. Engineer may also refuse to recommend any such payment or, because of subsequently discovered evidence or the results of subsequent inspections or tests, revise or revoke any such payment recommendation previously made, to such extent as may be necessary in Engineer's opinion to protect Owner from loss because:
- a. the Work is defective, or completed Work has been damaged, requiring correction or replacement;
 - b. the Contract Price has been reduced by Change Orders;
 - c. Owner has been required to correct defective Work or complete Work in accordance with Paragraph 13.09; or
 - d. Engineer has actual knowledge of the occurrence of any of the events enumerated in Paragraph 15.02.A.

C. Payment Becomes Due

1. Ten days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended will (subject to the provisions of Paragraph 14.02.D) become due, and when due will be paid by Owner to Contractor.

D. Reduction in Payment

1. Owner may refuse to make payment of the full amount recommended by Engineer because:
- a. claims have been made against Owner on account of Contractor's performance or furnishing of the Work;
 - b. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens;
 - c. the Contractor's performance or furnishing of the Work is inconsistent with funding Agency requirements;
 - d. there are other items entitling Owner to a set-off against the amount recommended; or
 - e. Owner has actual knowledge of the occurrence of any of the events enumerated in Paragraphs 14.02.B.5.a through 14.02.B.5.c or Paragraph 15.02.A.
2. If Owner refuses to make payment of the full amount recommended by Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and promptly pay Contractor any amount remaining after deduction of the amount so withheld. Owner shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by Owner and Contractor, when Contractor corrects to Owner's satisfaction the reasons for such action.
3. If it is subsequently determined that Owner's refusal of payment was not justified, the amount wrongfully withheld shall be treated as an amount due as determined by Paragraph 14.02.C.1.

14.03 *Contractor's Warranty of Title*

- A. Contractor warrants and guarantees that title to all Work, materials, and equipment covered by any Application for Payment, whether incorporated in the Project or not, will pass to Owner no later than the time of payment free and clear of all Liens.

14.04 *Substantial Completion*

- A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete (except for items specifically listed by Contractor as incomplete) and request that Engineer issue a certificate of Substantial Completion.
- B. Promptly after Contractor's notification, Owner, Agency, Contractor, and Engineer shall make a prefinal inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving the reasons therefor.
- C. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a tentative certificate of Substantial Completion which shall fix the date of Substantial Completion. There shall be attached to the certificate a tentative list of items to be completed or corrected before final payment. Owner shall have seven days after receipt of the tentative certificate during which to make written objection to Engineer as to any provisions of the certificate or attached list. If, after considering such objections, Engineer concludes that the Work is not substantially complete, Engineer will within 14 days after submission of the tentative certificate to Owner notify Contractor in writing, stating the reasons therefor. If, after consideration of Owner's objections, Engineer considers the Work substantially complete, Engineer will within said 14 days execute and deliver to Owner and Contractor a definitive certificate of Substantial Completion (with a revised tentative list of items to be completed or corrected) reflecting such changes from the tentative certificate as Engineer believes justified after consideration of any objections from Owner.
- D. At the time of delivery of the tentative certificate of Substantial Completion, Engineer will deliver to Owner and Contractor a written recommendation as to division of responsibilities pending final payment between Owner and Contractor with respect to security, operation, safety, and protection of the Work, maintenance, heat, utilities, insurance, and warranties and guarantees. Unless Owner and Contractor agree otherwise in writing and so inform Engineer in writing prior to Engineer's issuing the definitive certificate of Substantial Completion, Engineer's aforesaid recommendation will be binding on Owner and Contractor until final payment.
- E. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to complete or correct items on the tentative list.

14.05 *Partial Utilization*

- A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by Owner for its intended purpose without significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions.
 - 1. Owner at any time may request Contractor in writing to permit Owner to use or occupy any such part of the Work which Owner believes to be ready for its intended use and substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor will certify to Owner and Engineer that such part of the Work is substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.
 - 2. Contractor at any time may notify Owner and Engineer in writing that Contractor considers any such part of the Work ready for its intended use and substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.

3. Within a reasonable time after either such request, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Paragraph 14.04 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.
4. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 5.10 regarding property insurance.

14.06 *Final Inspection*

- A. Upon written notice from Contractor that the entire Work or an agreed portion thereof is complete, Engineer will promptly make a final inspection with Owner, Agency, and Contractor and will notify Contractor in writing of all particulars in which this inspection reveals that the Work is incomplete or defective. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

14.07 *Final Payment*

A. *Application for Payment*

1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance certificates of inspection, and other documents, Contractor may make application for final payment following the procedure for progress payments.
2. The final Application for Payment shall be accompanied (except as previously delivered) by:
 - a. all documentation called for in the Contract Documents, including but not limited to the evidence of insurance required by Paragraph 5.04.B.7;
 - b. consent of the surety, if any, to final payment;
 - c. a list of all Claims against Owner that Contractor believes are unsettled; and
 - d. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of or Liens filed in connection with the Work.
3. In lieu of the releases or waivers of Liens specified in Paragraph 14.07.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (i) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (ii) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner or Owner's property might in any way be responsible have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien.

B. *Engineer's Review of Application and Acceptance*

1. If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract Documents have been fulfilled, Engineer will, within ten days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of payment and present the Application for Payment to Owner for payment. At the same time Engineer will also give written notice to Owner and Contractor that the Work is acceptable subject to the provisions of Paragraph 14.09. Otherwise,

Engineer will return the Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application for Payment.

C. *Payment Becomes Due*

1. Thirty days after the presentation to Owner of the Application for Payment and accompanying documentation, the amount recommended by Engineer, less any sum Owner is entitled to set off against Engineer's recommendation, including but not limited to liquidated damages, will become due and will be paid by Owner to Contractor.

14.08 *Final Completion Delayed*

- A. If, through no fault of Contractor, final completion of the Work is significantly delayed, and if Engineer so confirms, Owner shall, upon receipt of Contractor's final Application for Payment (for Work fully completed and accepted) and recommendation of Engineer, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed and accepted. If the remaining balance to be held by Owner for Work not fully completed or corrected is less than the retainage stipulated in the Agreement, and if bonds have been furnished as required in Paragraph 5.01, the written consent of the surety to the payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by Contractor to Engineer with the Application for such payment. Such payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of Claims. The remaining balance of any sum included in the final Application for Payment but held by OWNER for Work not fully completed and accepted will become due when the Work is fully completed and accepted.

14.09 *Waiver of Claims*

- A. The making and acceptance of final payment will constitute:
 1. a waiver of all Claims by Owner against Contractor, except Claims arising from unsettled Liens, from defective Work appearing after final inspection pursuant to Paragraph 14.06, from failure to comply with the Contract Documents or the terms of any special guarantees specified therein, or from Contractor's continuing obligations under the Contract Documents; and
 2. a waiver of all Claims by Contractor against Owner other than those previously made in accordance with the requirements herein and expressly acknowledged by Owner in writing as still unsettled.

ARTICLE 15 – SUSPENSION OF WORK AND TERMINATION

15.01 *Owner May Suspend Work*

- A. At any time and without cause, Owner may suspend the Work or any portion thereof for a period of not more than 90 consecutive days by notice in writing to Contractor and Engineer which will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be granted an adjustment in the Contract Price or an extension of the Contract Times, or both, directly attributable to any such suspension if Contractor makes a Claim therefor as provided in Paragraph 10.05.

15.02 *Owner May Terminate for Cause*

- A. The occurrence of any one or more of the following events will justify termination for cause:
 1. Contractor's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the Progress Schedule established under Paragraph 2.07 as adjusted from time to time pursuant to Paragraph 6.04);

2. Contractor's disregard of Laws or Regulations of any public body having jurisdiction;
 3. Contractor's disregard of the authority of Engineer; or
 4. Contractor's violation in any substantial way of any provisions of the Contract Documents.
- B. If one or more of the events identified in Paragraph 15.02.A occur, Owner may, after giving Contractor (and surety) **6 hours written** notice of its intent to terminate the services of Contractor:
1. exclude Contractor from the Site, and take possession of the Work and of all Contractor's tools, appliances, construction equipment, and machinery at the Site, and use the same to the full extent they could be used by Contractor (without liability to Contractor for trespass or conversion),
 2. incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere, and
 3. complete the Work as Owner may deem expedient.
- C. If Owner proceeds as provided in Paragraph 15.02.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Owner arising out of or relating to completing the Work, such excess will be paid to Contractor. If such claims, costs, losses, and damages exceed such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by Owner will be reviewed by Engineer as to their reasonableness and, when so approved by Engineer, incorporated in a Change Order. When exercising any rights or remedies under this Paragraph Owner shall not be required to obtain the lowest price for the Work performed.
- D. Notwithstanding Paragraphs 15.02.B and 15.02.C, Contractor's services will not be terminated if Contractor begins **within 6 hours** of receipt of notice of intent to terminate to correct its failure to perform and proceeds diligently to cure such failure within no more than **8 hours** of receipt of said notice.
- E. Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue. Any retention or payment of moneys due Contractor by Owner will not release Contractor from liability.
- F. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 5.01.A, the termination procedures of that bond shall supersede the provisions of Paragraphs 15.02.B, and 15.02.C.

15.03 *Owner May Terminate For Convenience*

- A. Upon seven days written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):
1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;
 2. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses;
 3. all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) incurred in settlement of terminated contracts with Subcontractors, Suppliers, and others; and

4. reasonable expenses directly attributable to termination.

B. Contractor shall not be paid on account of loss of anticipated profits or revenue or other economic loss arising out of or resulting from such termination.

15.04 *Contractor May Stop Work or Terminate*

A. If, through no act or fault of Contractor, (i) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (ii) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (iii) Owner fails for 30 days to pay Contractor any sum finally determined to be due, then Contractor may, upon seven days written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the Contract and recover from Owner payment on the same terms as provided in Paragraph 15.03.

B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or Owner has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, seven days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The provisions of this Paragraph 15.04 are not intended to preclude Contractor from making a Claim under Paragraph 10.05 for an adjustment in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to Contractor's stopping the Work as permitted by this Paragraph.

ARTICLE 16 – DISPUTE RESOLUTION

16.01 *Methods and Procedures*

A. Owner and Contractor may mutually request mediation of any Claim submitted to Engineer for a decision under Paragraph 10.05 before such decision becomes final and binding. The mediation will be governed by the Construction Industry Mediation Rules of the American Arbitration Association in effect as of the Effective Date of the Agreement. The request for mediation shall be submitted in writing to the American Arbitration Association. Timely submission of the request shall stay the effect of Paragraph 10.05.E.

B. Owner and Contractor shall participate in the mediation process in good faith. The process shall be concluded within 60 days of filing of the request. The date of termination of the mediation shall be determined by application of the mediation rules referenced above.

C. If the claim is not resolved by mediation, Engineer's action under Paragraph 10.05.C or a denial pursuant to Paragraphs 10.05.C.3 or 10.05.D shall become final and binding 30 days after termination of the mediation unless, within that time period, Owner or Contractor:

1. elects in writing to invoke any dispute resolution process provided for in the Supplementary Conditions, or
2. agrees with the other party to submit the Claim to another dispute resolution process, or
3. gives written notice to the other party of their intent to submit the Claim to a court of competent jurisdiction.

ARTICLE 17 – MISCELLANEOUS

17.01 *Giving Notice*

A. Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if:

1. delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended, or

2. delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the giver of the notice.

17.02 *Computation of Times*

- A. Due to the nature of this contract any period of time referred to in this contract by days will mean calendar days and will include Saturdays, Sundays, and legal holiday's

17.03 *Cumulative Remedies*

- A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee, or by other provisions of the Contract Documents. The provisions of this Paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right, and remedy to which they apply.

17.04 *Survival of Obligations*

- A. All representations, indemnifications, warranties, and guarantees made in, required by, or given in accordance with the Contract Documents, as well as all continuing obligations indicated in the Contract Documents, will survive final payment, completion, and acceptance of the Work or termination or completion of the Contract or termination of the services of Contractor.

17.05 *Controlling Law*

- A. This Contract is to be governed by the law of the state in which the Project is located.

17.06 *Headings*

- A. Article and paragraph headings are inserted for convenience only and do not constitute parts of these General Conditions.

ARTICLE 18 – FEDERAL REQUIREMENTS

18.01 *Conflict of Interest*

- A. Contractor may not knowingly contract with a supplier or manufacturer if the individual or entity who prepared the plans and specifications has a corporate or financial affiliation with the supplier or manufacturer.
- B. Owner's officers, employees, or agents shall not engage in the award or administration of this Contract if a conflict of interest, real or apparent, would be involved. Such a conflict would arise when: (i) the employee, officer or agent; (ii) any member of their immediate family; (iii) their partner or (iv) an organization that employs, or is about to employ, any of the above, has a financial interest in Contractor. Owner's officers, employees, or agents shall neither solicit nor accept gratuities, favors or anything of monetary value from Contractor or subcontractors.

18.02 *Gratuities*

- A. If Owner finds after a notice and hearing that Contractor, or any of Contractor's agents or representatives, offered or gave gratuities (in the form of entertainment, gifts, or otherwise) to any official, employee, or agent of Owner or Agency in an attempt to secure this Contract or favorable treatment in awarding, amending, or making any determinations related to the performance of this Contract, Owner may, by written notice to Contractor, terminate this Contract. Owner may also pursue other rights and remedies that the law or this Contract provides. However, the existence of the facts on which Owner bases such findings shall be an issue and may be reviewed in proceedings under the dispute resolution provisions of this Contract.

- B. In the event this Contract is terminated as provided in paragraph 18.04.A, Owner may pursue the same remedies against Contractor as it could pursue in the event of a breach of this Contract by Contractor. As a penalty, in addition to any other damages to which it may be entitled by law, Owner may pursue exemplary damages in an amount (as determined by Owner) which shall not be less than three nor more than ten times the costs Contractor incurs in providing any such gratuities to any such officer or employee.

18.03 *Audit and Access to Records*

- A. For all negotiated contracts and negotiated modifications (except those of \$10,000 or less), Owner, Agency, the Comptroller General, or any of their duly authorized representatives, shall have access to any books, documents, papers, and records of the Contractor, which are pertinent to the Contract, for the purpose of making audits, examinations, excerpts and transcriptions. Contractor shall maintain all required records for three years after final payment is made and all other pending matters are closed.

18.04 *Anti-Kickback*

- A. Contractor shall comply with the Copeland Anti-Kickback Act (18 USC 874 and 40 USC 276c) as supplemented by Department of Labor regulations (29 CFR Part 3, “Contractors and Subcontractors on Public Buildings or Public Works Financed in Whole or in Part by Loans or Grants of the United States”). The Act provides that Contractor or subcontractor shall be prohibited from inducing, by any means, any person employed in the construction, completion, or repair of public facilities, to give up any part of the compensation to which they are otherwise entitled. Owner shall report all suspected or reported violations to Agency.

18.05 *Environmental Requirements*

- A. When constructing a project involving trenching and/or other related earth excavations, Contractor shall comply with the following environmental constraints:
 - 1. Wetlands – When disposing of excess, spoil, or other construction materials on public or private property, Contractor shall not fill in or otherwise convert wetlands.
 - 2. Floodplains – When disposing of excess, spoil, or other construction materials on public or private property, Contractor shall not fill in or otherwise convert 100 year floodplain areas delineated on the latest Federal Emergency Management Agency Floodplain Maps, or other appropriate maps, i.e., alluvial soils on NRCS Soil Survey Maps.
 - 3. Historic Preservation – Any excavation by Contractor that uncovers an historical or archaeological artifact shall be immediately reported to Owner and a representative of Agency. Construction shall be temporarily halted pending the notification process and further directions issued by Agency after consultation with the State Historic Preservation Officer (SHPO).
 - 4. Endangered Species – Contractor shall comply with the Endangered Species Act, which provides for the protection of endangered and/or threatened species and critical habitat. Should any evidence of the presence of endangered and/or threatened species or their critical habitat be brought to the attention of Contractor, Contractor will immediately report this evidence to Owner and a representative of Agency. Construction shall be temporarily halted pending the notification process and further directions issued by Agency after consultation with the U.S. Fish and Wildlife Service.

Part 4. Special Provisions

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GENERAL CONTRACT CONDITIONS

The contract requirements of the *Standard General Conditions of the Construction Contract, 2002*, published by the National Society of Professional Engineers (hereinafter referred to as the "General Conditions"), shall govern this entire improvement, except as amended by the Special Provisions in this Project Manual. In case of conflict between the Special Provisions and any part or parts of the General Conditions, said Special Provisions shall take precedence and shall govern the terms of this contract.

For purposes of administering this contract, the authorized representative of the City of Quincy will be the Director of Utilities & Engineering.

EMPLOYMENT PRACTICES

In addition to all other labor requirements set forth in this proposal and in the General Conditions, during the performance of this contract, the Contractor for itself, its assignees, and successors in interest (hereinafter referred to as the "Contractor") agrees as follows:

SELECTION OF LABOR

The Contractor shall comply with all Illinois statutes pertaining to the selection of labor.

EQUAL EMPLOYMENT OPPORTUNITY

In the event of the Contractor's non-compliance with the provisions of the Equal Employment Opportunity Clause, the Illinois Human Rights' Act, or the Rules and Regulations of the Illinois Department of Human Rights ("Department"), the Contractor may be declared ineligible for future contracts or subcontracts with the State of Illinois or any of its political subdivisions or municipal corporations, and the contract may be cancelled or voided in whole or in part, and such other sanctions or penalties may be imposed or remedies invoked as provided by statute or regulation.

During the performance of this contract, the Contractor agrees as follows:

- (1) That it will not discriminate against any employee or applicant for employment because of race, color, religion, sex, national origin, ancestry, age, marital status, physical or mental handicap unrelated to ability, or unfavorable discharge from military service, and further that it will examine all job classifications to determine if minority persons or women are underutilized and will take appropriate affirmative action to rectify any such under utilization.
- (2) That, if it hires additional employees in order to perform this contract or any portion hereof, it will determine the availability of minorities and women in the area(s) from which it may reasonably recruit and it will hire for each job classification for which employees are hired in such a way that minorities and women are not underutilized.
- (3) That, in all solicitations or advertisements for employees placed by it or on its behalf, it will state that all applicants will be afforded equal opportunity without discrimination because of race, color, religion, sex, national origin, ancestry, age, marital status, physical or mental handicap unrelated to ability or unfavorable discharge from military service.

- (4) That it will send to each labor organization or representative of workers with which it has or is bound by a collective bargaining or other agreement or understanding, a notice advising such labor organization or representative of the Contractor's obligations under the Illinois Human Rights Act and the Department's Rules and Regulations. If any such labor organization or representative fails or refuses to cooperate with the Contractor in its efforts to comply with such Act and Rules and Regulations, the Contractor will promptly so notify the Illinois Department of Human Rights and the City of Quincy and will recruit employees from other sources when necessary to fulfill its obligations thereunder.
- (5) That it will submit reports as required by the Department of Human Rights Rules and Regulations, furnish all relevant information as may from time to time be requested by the Department or the City of Quincy, and in all respects comply with the Illinois Human Rights Act and the Department's Rules and Regulations.
- (6) That it will permit access to all relevant books, records, accounts and work sites by personnel of the City of Quincy and the Illinois Department of Human Rights for purposes of investigation to ascertain compliance with the Illinois Human Rights Act and the Department's Rules and Regulations.
- (7) That it will include verbatim or by reference the provision of this clause in every subcontract so that such provisions will be binding upon every such subcontractor. In the same manner as with other provisions of this contract, the Contractor will be liable for compliance with applicable provisions of this clause by all its subcontractors; and further it will promptly notify the City of Quincy and the Illinois Department of Human Rights in the event any subcontractor fails or refuses to comply therewith. In addition, the Contractor will not utilize any subcontractor declared by the Illinois Human Rights Commission to be ineligible for contracts or subcontracts with the State of Illinois or any of its political subdivisions or municipal corporations.

EMPLOYMENT PRACTICES

The following Special Provision with its requirements shall be considered as part of this contract and shall apply to all work performed on this project including authorized extra work, extensions of the project limits, and all subcontracts.

A. Article I of Chapter 13 of the Municipal Code of the City of Quincy

13.121 Employment of city residents - At least 50% of all of a Contractor's employees working on any construction project involving the use of city funds shall be residents of Adams County, Illinois, unless this requirement shall be waived by the Quincy City Council, and all construction contracts involving the use of city funds, entered into between the City and a Contractor, shall so provide. Any Contractor found to be in violation of the provisions of this Ordinance shall, in addition to other penalties prescribed, be barred from bidding upon construction projects using City funds for a period of two (2) years.

B. For purposes of administrating this ordinance, the following is required:

- (1) Submission of monthly work records for all laborers working under this project, including subcontractors, is required.
- (2) The 50% requirement is determined by totaling the number of man-hours worked for all laborers, including subcontractors, at the end of the project. Compliance will be determined by the number of man-hours worked on the project and NOT by taking 50% of the total wage rates paid.
- (3) Subcontractors may or may not meet the 50% resident requirement, but it will be the responsibility of the Prime Contractor to insure that the final total of all man-hours worked by his forces in combination with all subcontractors does meet the 50% resident requirements.
- (4) Hours worked by truck drivers delivering material to the jobsite shall not be included in the submission of the monthly work records unless said truck drivers are directly employed by the Contractor or subcontractor.
- (5) All monthly work records submitted shall contain the following minimum information:
 - a) Laborer's Name and Legal Address of Residence
 - b) Job Classification
 - c) Hours worked during the reporting month
 - d) A completed statement of certificationAny form containing the required information may be used.
- (6) Hours worked by laborers off-site, such as at an asphalt or concrete plant, shall not be included in the monthly work record submission.
- (7) Failure to report all laborers working on the project and their correct number of man-hours worked shall constitute a violation of this ordinance, as will the supplying of any false information.
- (8) Laborers on this project is hereby defined to include all labor, whether skilled, semi-skilled or unskilled, and whether manual or non-manual.

SUBSTANCE ABUSE PREVENTION PROGRAM

In addition to any and all other labor requirements set forth in this request, the State of Illinois requires:

Before any contractor commences work on a public works program, the contractor shall have in place a written program that meets or exceeds the requirements in "Public Act 095-0635, Substance Abuse Prevention on Public Works Projects Act", or shall have a collective bargaining agreement in effect dealing with the subject matter in the above Act.

The prime contractor and all subcontractors shall file with the Director of Purchasing, City of Quincy, 730 Maine Street, Quincy, Illinois 62301, a copy of the "Substance Abuse Prevention Program" along with a cover letter certifying their program meets or exceeds the requirements of the Act, or a letter

certifying that the prime contractor and subcontractors have a collective bargaining agreement in effect dealing with the subject matter of the above Act.

With reference to the above, all programs and letters received shall be retained on file in the office of the Director of Purchasing, and shall be available for public inspection.

PREVAILING WAGE

The successful Bidder and his subcontractors will be required to pay not less than the Prevailing Wage Rate for workers engaged in work under this contract, with the provisions of an act of the General Assembly of the State of Illinois entitled "An Act Regulating the Wage of Laborers, Mechanics, and other workmen employed in any public works by the State, County, City or any Public Body, or any Political Subdivision or by anyone under contract for public works," by act approved July 11, 1957, as amended. Attached to and made part of these contract documents is the current prevailing wage rate decision.

It shall be the responsibility of the Contractor and his subcontractors to allow the City of Quincy, the Illinois Department of Labor, and any authorized representative of any government agency involved in the funding of this project, access to and the right to examine all records, books, papers, payrolls, or documents related to this construction project. This right shall extend from the time of execution of the contract through the entire time period of the work, and ending three (3) years after the final pay estimate is disbursed.

The submission of weekly payroll certifications from both the prime contractor and all subcontractors will be required for this project. Submissions shall be made to the city of Quincy Resident Inspector/Engineer managing the project. Computer generated forms or other state and/or federal forms listing the appropriate information are acceptable for use as long as a signed certification statement is also on the form signed by a responsible company official. Monthly submittals of payroll certifications are acceptable if said submittals report the required information on a weekly basis and if said submittals are received within ten days of the end of a month. Applications for Payment will not be processed until the Contractor has provided payroll certifications covering the period of the Application for Payment and all previous applications.

Failure to submit the required information may, in addition to such other penalties as may be prescribed by contract or law, may be grounds for being barred from bidding upon construction projects using city funds for a period of two years.

If the Illinois Department of Labor revises during the term of this contract the prevailing rate of hourly wages to be paid by the City of Quincy in Adams County, the revised rate as provided by the Department of Labor shall apply to this contract.

Adams County Prevailing Wage Rates posted on 10/3/2019

Trade Title	Rg	Type	C	Base	Foreman	Overtime				H/W	Pension	Vac	Trng	Other Ins
						M-F	Sa	Su	Hol					
ASBESTOS ABT-GEN	All	BLD		26.18	27.93	1.5	1.5	2.0	2.0	9.50	12.38	0.00	0.80	
ASBESTOS ABT-MEC	All	BLD		31.75	32.75	1.5	1.5	2.0	2.0	8.00	6.25	2.00	0.55	
BOILERMAKER	All	BLD		36.54	39.04	1.5	1.5	2.0	2.0	7.07	24.08	1.50	1.05	
BRICK MASON	All	BLD		30.79	32.33	1.5	1.5	2.0	2.0	9.35	11.40	0.00	0.88	
CARPENTER	All	BLD		32.83	35.08	1.5	1.5	2.0	2.0	8.65	18.25	0.00	0.55	
CARPENTER	All	HWY		34.25	36.00	1.5	1.5	2.0	2.0	8.65	18.25	0.00	0.52	
CEMENT MASON	All	BLD		30.00	31.50	1.5	1.5	2.0	2.0	9.35	13.01	0.00	0.58	
CEMENT MASON	All	HWY		30.00	31.25	1.5	1.5	2.0	2.0	9.35	13.37	0.00	0.59	
CERAMIC TILE FINISHER	All	BLD		31.65	31.65	1.5	1.5	2.0	2.0	9.35	10.40	0.00	0.20	
ELECTRIC PWR EQMT OP	All	ALL		46.47	55.07	1.5	1.5	2.0	2.0	7.39	13.01	0.00	0.69	
ELECTRIC PWR GRNDMAN	All	ALL		31.69	55.07	1.5	1.5	2.0	2.0	6.95	8.87	0.00	0.48	
ELECTRIC PWR LINEMAN	All	ALL		51.67	55.07	1.5	1.5	2.0	2.0	7.55	14.47	0.00	0.78	
ELECTRIC PWR TRK DRV	All	ALL		33.25	55.07	1.5	1.5	2.0	2.0	7.00	9.31	0.00	0.50	
ELECTRICIAN	All	BLD		31.00	33.50	1.5	1.5	2.0	2.0	7.55	10.05	0.00	0.80	
ELECTRONIC SYSTEM TECH	All	BLD		29.90	31.90	1.5	1.5	2.0	2.0	7.45	12.55	0.00	0.40	
ELEVATOR CONSTRUCTOR	All	BLD		46.21	51.99	2.0	2.0	2.0	2.0	15.57	17.51	3.70	0.62	
GLAZIER	All	BLD		35.91	37.91	1.5	1.5	2.0	2.0	6.25	11.23	0.00	0.68	
HEAT/FROST INSULATOR	All	BLD		38.86	39.96	1.5	1.5	2.0	2.0	10.50	12.86	0.00	0.75	0.05
IRON WORKER	All	ALL		26.60	28.85	1.5	1.5	2.0	2.0	8.71	14.61	0.00	0.68	
LABORER	All	BLD		24.68	26.43	1.5	1.5	2.0	2.0	9.50	12.38	0.00	0.80	
LABORER	All	HWY		29.00	30.50	1.5	1.5	2.0	2.0	9.50	14.75	0.00	0.80	
LATHER	All	BLD		32.83	35.08	1.5	1.5	2.0	2.0	8.65	18.25	0.00	0.55	
MACHINIST	All	BLD		48.93	51.43	1.5	1.5	2.0	2.0	7.68	8.95	1.85	1.32	
MARBLE FINISHER	All	BLD		31.65	31.65	1.5	1.5	2.0	2.0	9.35	10.40	0.00	0.20	
MARBLE MASON	All	BLD		33.15	33.15	1.5	1.5	2.0	2.0	9.35	10.40	0.00	0.20	
MILLWRIGHT	All	BLD		32.53	34.78	1.5	1.5	2.0	2.0	8.65	19.01	0.00	0.55	
MILLWRIGHT	All	HWY		35.51	37.26	1.5	1.5	2.0	2.0	8.65	19.77	0.00	0.52	
OPERATING ENGINEER	All	BLD	1	37.71	39.32	1.5	1.5	2.0	2.0	11.50	11.00	0.00	2.05	
OPERATING ENGINEER	All	BLD	2	35.18	39.32	1.5	1.5	2.0	2.0	11.50	11.00	0.00	2.05	
OPERATING ENGINEER	All	BLD	3	31.30	39.32	1.5	1.5	2.0	2.0	11.50	11.00	0.00	2.05	
OPERATING ENGINEER	All	BLD	4	39.32	39.32	1.5	1.5	2.0	2.0	11.50	11.00	0.00	2.05	

OPERATING ENGINEER	All	HWY	1	44.07	44.07	1.5	1.5	2.0	2.0	11.50	11.00	0.00	2.05
OPERATING ENGINEER	All	HWY	2	39.34	39.34	1.5	1.5	2.0	2.0	11.50	11.00	0.00	2.05
OPERATING ENGINEER	All	HWY	3	32.06	32.06	1.5	1.5	2.0	2.0	11.50	11.00	0.00	2.05
OPERATING ENGINEER	All	HWY	4	45.57	45.57	1.5	1.5	2.0	2.0	11.50	11.00	0.00	2.05
PAINTER	All	ALL		31.78	33.28	1.5	1.5	2.0	2.0	6.20	11.78	0.00	0.65
PAINTER OVER 30 FT.	All	ALL		32.78	34.28	1.5	1.5	2.0	2.0	6.20	11.78	0.00	0.65
PAINTER PWR EQMT	All	ALL		32.78	34.28	1.5	1.5	2.0	2.0	6.20	11.78	0.00	0.65
PILEDRIVER	All	BLD		33.83	36.08	1.5	1.5	2.0	2.0	8.65	18.25	0.00	0.55
PILEDRIVER	All	HWY		34.25	36.00	1.5	1.5	2.0	2.0	8.65	18.25	0.00	0.52
PIPEFITTER	All	ALL		39.85	43.84	1.5	1.5	2.0	2.0	7.25	14.60	0.00	1.39
PLASTERER	All	BLD		32.90	34.65	1.5	1.5	2.0	2.0	8.75	14.02	0.00	0.90
PLUMBER	All	ALL		39.85	43.84	1.5	1.5	2.0	2.0	7.25	14.60	0.00	1.39
ROOFER	All	BLD		31.26	33.91	1.5	1.5	2.0	2.0	10.40	9.81	0.00	0.56
SHEETMETAL WORKER	All	BLD		30.38	32.48	1.5	1.5	2.0	2.0	7.14	12.21	0.00	0.73
SPRINKLER FITTER	All	BLD		44.26	47.01	1.5	1.5	2.0	2.0	10.02	12.39	0.00	0.52
STONE MASON	All	BLD		30.79	32.33	1.5	1.5	2.0	2.0	9.35	11.40	0.00	0.88
TERRAZZO FINISHER	All	BLD		31.65	31.65	1.5	1.5	2.0	2.0	9.35	10.40	0.00	0.20
TERRAZZO MASON	All	BLD		33.15	33.15	1.5	1.5	2.0	2.0	9.35	10.40	0.00	0.20
TILE LAYER	All	BLD		29.10	31.35	1.5	1.5	2.0	2.0	7.35	12.50	0.00	0.42
TILE MASON	All	BLD		33.15	33.15	1.5	1.5	2.0	2.0	9.35	10.40	0.00	0.20
TRUCK DRIVER	All	ALL	1	38.17	42.29	1.5	1.5	2.0	2.0	13.00	6.60	0.00	0.25
TRUCK DRIVER	All	ALL	2	38.71	42.29	1.5	1.5	2.0	2.0	13.00	6.60	0.00	0.25
TRUCK DRIVER	All	ALL	3	39.01	42.29	1.5	1.5	2.0	2.0	13.00	6.60	0.00	0.25
TRUCK DRIVER	All	ALL	4	39.34	42.29	1.5	1.5	2.0	2.0	13.00	6.60	0.00	0.25
TRUCK DRIVER	All	ALL	5	40.39	42.29	1.5	1.5	2.0	2.0	13.00	6.60	0.00	0.25
TRUCK DRIVER	All	O&C	1	30.54	33.83	1.5	1.5	2.0	2.0	13.00	6.60	0.00	0.25
TRUCK DRIVER	All	O&C	2	30.97	33.83	1.5	1.5	2.0	2.0	13.00	6.60	0.00	0.25
TRUCK DRIVER	All	O&C	3	31.21	33.83	1.5	1.5	2.0	2.0	13.00	6.60	0.00	0.25
TRUCK DRIVER	All	O&C	4	31.47	33.83	1.5	1.5	2.0	2.0	13.00	6.60	0.00	0.25
TRUCK DRIVER	All	O&C	5	32.31	33.83	1.5	1.5	2.0	2.0	13.00	6.60	0.00	0.25
TUCKPOINTER	All	BLD		30.79	32.33	1.5	1.5	2.0	2.0	9.35	11.40	0.00	0.88

Legend

Rg Region

Type Trade Type - All,Highway,Building,Floating,Oil & Chip,Rivers

C Class

Base Base Wage Rate

OT M-F Unless otherwise noted, OT pay is required for any hour greater than 8 worked each day, Mon through Fri. The number listed is the multiple of the base wage.

OT Sa Overtime pay required for every hour worked on Saturdays

OT Su Overtime pay required for every hour worked on Sundays

OT Hol Overtime pay required for every hour worked on Holidays

H/W Health/Welfare benefit

Vac Vacation

Trng Training

Other Ins Employer hourly cost for any other type(s) of insurance provided for benefit of worker.

Explanations ADAMS COUNTY

The following list is considered as those days for which holiday rates of wages for work performed apply: New Years Day, Memorial Day, Fourth of July, Labor Day, Thanksgiving Day, Christmas Day and Veterans Day in some classifications/counties. Generally, any of these holidays which fall on a Sunday is celebrated on the following Monday. This then makes work performed on that Monday payable at the appropriate overtime rate for holiday pay. Common practice in a given local may alter certain days of celebration. If in doubt, please check with IDOL.

Oil and chip resealing (O&C) means the application of road oils and liquid asphalt to coat an existing road surface, followed by application of aggregate chips or gravel to coated surface, and subsequent rolling of material to seal the surface.

EXPLANATION OF CLASSES

ASBESTOS - GENERAL - removal of asbestos material/mold and hazardous materials from any place in a building, including mechanical systems where those mechanical systems are to be removed. This includes the removal of asbestos materials/mold and hazardous materials from ductwork or pipes in a building when the building is to be demolished at the time or at some close future date.

ASBESTOS - MECHANICAL - removal of asbestos material from mechanical systems, such as pipes, ducts, and boilers, where the mechanical systems are to remain.

CERAMIC TILE FINISHER, MARBLE FINISHER, TERRAZZO FINISHER

Assisting, helping or supporting the tile, marble and terrazzo mechanic by performing their historic and traditional work assignments required to complete the proper installation of the work covered by said crafts. The term "Ceramic" is used for naming the classification only and is in no way a limitation of the product handled. Ceramic takes into consideration most hard tiles.

ELECTRONIC SYSTEMS TECHNICIAN

Installation, service and maintenance of low-voltage systems which utilizes the transmission and/or transference of voice, sound, vision, or digital for commercial, education, security and entertainment purposes for the following: TV monitoring and surveillance, background/foreground music, intercom and telephone interconnect, field programming, inventory control systems, microwave transmission, multi-media, multiplex, radio page, school, intercom and sound burglar alarms and low voltage master clock systems.

Excluded from this classification are energy management systems, life safety systems, supervisory controls and data acquisition systems not intrinsic with the above listed systems, fire alarm systems, nurse call systems and raceways exceeding fifteen feet in length
TRUCK DRIVER - BUILDING, HEAVY AND HIGHWAY CONSTRUCTION

Class 1. Drivers on 2 axle trucks hauling less than 9 ton. Air compressor and welding machines and brooms, including those pulled by separate units, truck driver helpers, warehouse employees, mechanic helpers, greasers and tiremen, pickup trucks when hauling materials, tools, or workers to and from and on-the-job site, and fork lifts up to 6,000 lb. capacity.

Class 2. Two or three axle trucks hauling more than 9 ton but hauling less than 16 ton. A-frame winch trucks, hydrolift trucks, vactor trucks or similar equipment when used for transportation purposes. Fork lifts over 6,000 lb. capacity, winch trucks, four axle combination units, and ticket writers.

Class 3. Two, three or four axle trucks hauling 16 ton or more. Drivers on water pulls, articulated dump trucks, mechanics and working forepersons, and dispatchers. Five axle or more combination units.

Class 4. Low Boy and Oil Distributors.

Class 5. Drivers who require special protective clothing while employed on hazardous waste work.

TRUCK DRIVER - OIL AND CHIP RESEALING ONLY.

This shall encompass laborers, workers and mechanics who drive contractor or subcontractor owned, leased, or hired pickup, dump, service, or oil distributor trucks. The work includes transporting materials and equipment (including but not limited to, oils, aggregate supplies, parts, machinery and tools) to or from the job site; distributing oil or liquid asphalt and aggregate; stock piling material when in connection with the actual oil and chip contract. The Truck Driver (Oil & Chip Resealing) wage classification does not include supplier delivered materials.

OPERATING ENGINEERS - BUILDING

CLASS 1. Asphalt Screed Man; Aspco Concrete Spreaders; Asphalt Pavers; Asphalt Plant Engineer; Asphalt Rollers on Bituminous Concrete; Athey Loaders; Backfillers, Crane Type; Backhoes; Barber Green Loaders; Bulldozers; Cableways; Cherry Pickers; Clam Shells; C.M.I. & similar type autograde formless paver, autograde placer & finisher; Concrete Breakers; Concrete Pumps; Derricks; Derrick Boats; Draglines; Earth Auger or Boring Machines; Elevating Graders; Engineers on Dredges; Gravel Processing Machines; Head Equipment Greaser; High Lifts or Fork Lifts; Hoists with two or more drums or two or more load lines; Locomotives, All; Mechanics; Motor Graders or Auto Patrols; Operators or Leverman on Dredges; Operators, Power Boat; Operators, Pug Mill (Asphalt Plants); Orange Peels; Overhead Cranes; Paving Mixers; Piledrivers; Pipe Wrapping and Painting Machines; Pushdozers, or Push Cats; Robotic Controlled Equipment in this Classification; Rock Crushers; Ross Carrier or Similar Machines; Rotomill; Scoops, Skimmer, two cu. yd. capacity and under; Scoops, All or Tournapull; Sheep-Foot Roller (Self Propelled); Shovels; Skid Steer; Skimmer Scoops; Temporary Concrete Plant Operators; Test Hole Drilling Machines; Tower Machines; Tower Mixers; Track Type End Loaders; Track Type Fork Lifts or High Lifts; Track Jacks and Tampers; Tractors, Sideboom; Trenching or Ditching Machine; Tunnelluggers; Vermeer Type Saws; Water Blaster Cutting Head; Wheel Type End Loaders; Winch Cat.

CLASS 2. Air Compressors (six to eight)*; Asphalt Boosters and Heaters; Asphalt Distributors; Asphalt Plant Fireman; Oiler on Two Paving Mixers When Used in Tandem; Boom or Winch Trucks; Bull Floats or Flexplanes; Concrete Finishing Machine; Concrete Saws, Self-Propelled; Concrete Spreading Machines; Conveyors (six to eight)*; Generators (six to eight)*; Gravel or Stone Spreader, Power Operated; Hoist (with One Drum and One Load Line); Light Plants (six to eight)*; Mechanical Heaters (six to eight)*; Mud Jacks; Post Hole Digger, Mechanical; Pug Mills when used for other than Asphalt operation; Robotic Controlled Equipment in this Classification; Road or Street Sweeper, Self Propelled; Rollers (except bituminous concrete); Seaman Tiller; Straw Machine; Vibratory Compactor; Water Blaster, Power Unit; Welding Machines (six to eight)*; Well Drill Machines.

CLASS 3. Air Compressors(one to five)*; Air Compressors, Track or Self-Propelled; Automatic Hoist; Building Elevators; Bulk Cement Batching Plants; Conveyors (one to five)*; Concrete Mixers (Except Plant, Paver, or Tower); Firemen; Generators (one to five)*; Greasers; Helper on Single Paving Mixer; Hoist, Automatic; Light Plants (one to five)*; Mechanic Helpers; Mechanical Heaters (one to five)*; Oilers; Power Form Graders; Power Sub-Graders; Robotic Controlled Equipment in this Classification;

Scissors Hoist; Tractors without power attachments regardless of size or type; Truck Crane Oiler and Driver (1 man); Vibratory Hammer (power source); Water Pumps (one to five)*; Welding Machines (1/300 Amp. or over)*; Welding machines (one to five)*

CLASS 4. Lattice Boom Crawler Cranes; Lattice Boom Truck Cranes; Telescopic Truck-Mounted Cranes; Tower Cranes.

* Combinations of one to eight of any Air Compressors, Conveyors, Welding Machines, Water Pumps, Light Plants, or Generators shall be in batteries or within 400 feet and shall be paid as per the Classification Schedule contained in this Article.

OPERATING ENGINEERS - HIGHWAY

CLASS 1. Asphalt Screed Man; Asphco Concrete Spreaders; Asphalt Pavers; Asphalt Plant Engineer; Asphalt Rollers on Bituminous Concrete; Athey Loaders; Backhoes; Barber Green Loaders; Bulldozers; Cableways; Carry Deck Pickers; Cherry Pickers (Rough Terrain); C.M.I. & similar type-autograde formless paver, autograde placer & finisher; Concrete Breakers; Concrete Plant Operators; Concrete Pumps; Derricks; Derrick Boats; Dewatering Systems; Earth Auger or Boring Machines; Elevating Graders; Engineers on Dredges; Gravel Processing Machines; Grout Pump; Head Equipment Greaser; High Lifts or Fork Lifts; Hoists with two or more drums or two or more load lines; Hydro Jet or Hydro Laser; Locomotives, All; Mechanics; Motor Graders or Auto Patrols; Multi-Point Power Lifting Equipment; Operators or Leverman on Dredges; Operators, Power Boat; Operators, Pug Mill (Asphalt Plants); Overhead Cranes; Paving Mixers; Piledrivers; Pipe Wrapping and Painting Machines; Push-dozers, or Push Cats; Robotic Controlled Equipment in this Classification; Rock Crushers; Ross Carrier or Similar Machines; Roto-Mill; Scoops, Skimmer, two cu. yd. capacity and under; Sheep-Foot Roller (Self Pro-pelled); Shovels; Skid Steer; Skimmer Scoops; Test Hole Drilling Machines; Tower Machines; Tower Mixers; Track Type End Loaders; Track Type Fork Lifts or High Lifts; Track Jacks and Tampers; Tractors, Side-boom; Trenching or Ditching Machine; Tunnelluggers; Vermeer-Type Saws; Wheel Type End Loaders; Winch Cat; Scoops, All or Tournapull.

CLASS 2. Air Compressors (six to eight)*; Articulated Dumps; Asphalt Boosters and Heaters; Asphalt Distributors; Asphalt Plant Fireman; Boom or Winch Trucks; Building Elevators; Bull Floats or Flexplanes; Concrete Finishing Machine; Concrete Saws, Self-Propelled; Concrete Spreading Machines; Conveyors (six to eight)*; Generators (six to eight)*; Gravel or Stone Spreader, Power Operated; Hoist, Automatic; Hoist with One Drum and One Load Line; Light Plants (six to eight)*; Mechanical Heaters (six to eight)*; Mud Jacks; Off Road Water Wagons; Oiler on Two Paving Mixers When Used in Tandem; Post Hole Digger, Mechanical; Robotic Controlled Equipment in This Classification; Road or Street Sweeper, Self-Propelled; Rollers (except bituminous concrete); Scissor Hoist; Sea-man Tiller; Straw Machine; Vibratory Compactor; Water Pumps (six to eight)*; Well Drill Machines.

CLASS 3. Air Compressors (one to five)*; Air Compressors, Track or Self-Propelled; Bulk Cement Batching Plants; Conveyors (one to five)*; Concrete Mixers (Except Plant, Paver, or Tower); Firemen; Generators (one to five)*; Greasers; Helper on Single Paving Mixer; Light Plants (one to five)*; Mechanic Helpers; Mechanical Heaters (one to five)*; Oilers; Power Form Graders; Power Sub-Graders; Pug Mills when used for other than Asphalt operation; Robotic Controlled Equipment in This Classification; Tractors without power attachments, regardless of size or type; Truck Crane Oiler and Driver (1 man); Vibratory Hammer (power source); Water Pumps (one to five)*; Welding Machines (one 300 Amp. or over)*; Welding Machines (one to five)*.

CLASS 4. Lattice Boom Crawler Crane; Lattice Boom Truck Crane; Telescopic Truck-Mounted Crane; Tower Crane.

*Combinations of one to eight of any Air Compressors, Conveyors, Welding Machines, Water Pumps, Light Plants or Generators shall be in batteries or within 400 feet and shall be paid as per the Classification Schedule contained in this Article.

Other Classifications of Work:

For definitions of classifications not otherwise set out, the Department generally has on file such definitions which are available. If a task to be performed is not subject to one of the classifications of pay set out, the Department will upon being contacted state which neighboring county has such a classification and provide such rate, such rate being deemed to exist by reference in this document. If no neighboring county rate applies to the task, the Department shall undertake a special determination, such special determination being then deemed to have existed under this determination. If a project requires these, or any

classification not listed, please contact IDOL at 217-782-1710 for wage rates or clarifications.

LANDSCAPING

Landscaping work falls under the existing classifications for laborer, operating engineer and truck driver. The work performed by landscape plantsman and landscape laborer is covered by the existing classification of laborer. The work performed by landscape operators (regardless of equipment used or its size) is covered by the classifications of operating engineer. The work performed by landscape truck drivers (regardless of size of truck driven) is covered by the classifications of truck driver.

INSURANCE

The minimum amounts of insurance shall be as follows:

1. Automobile – Including coverage for owned, non-owned, and hired automobiles.
 - a. \$1,000,000 Bodily Injury per Person
 - b. \$1,000,000 Bodily Injury per Occurrence
 - c. \$1,000,000 Property Damage per Occurrence
 - d. Or \$1,000,000 Combined Single Limit
2. WORKER'S COMPENSATION - Statutory
3. Commercial General Liability – Policy shall include coverage for bodily injury and property damage arising out of an occurrence and shall include:
 - a. Premises and Operations
 - b. Products/Completed Operations
 - c. Personal and Advertising Injury
 - d. Contractual Liability
 - e. X,C,U Coverage
 - f. Per Project Aggregate Endorsement
 - g. Additional Insureds - OWNER & ENGINEER
 - i. \$2,000,000 General Aggregate
 - ii. \$1,000,000 Products/Completed Operations Aggregate
 - iii. \$1,000,000 Personal & Advertising Injury
 - iv. \$1,000,000 each occurrence:

End of Part 4.

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Part 5. Technical Specifications

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SECTION 031000
CONCRETE FORMS AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Formwork for cast-in place concrete.
2. Shoring, bracing, and anchorage.
3. Form accessories.
4. Form stripping.

B. Related Sections:

1. Section 032000 - Concrete Reinforcing.
2. Section 033000 - Cast-In-Place Concrete.

1.2 SYSTEM DESCRIPTION

- A. Design, engineer and construct formwork, shoring and bracing in accordance with ACI 318 to conform to design and International Building Code requirements.
- B. Vapor Retarder Permeance: Maximum 1 perm when tested according to ASTM E96.

1.3 REFERENCES

A. American Concrete Institute:

1. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials.
2. ACI 301 - Specifications for Structural Concrete.
3. ACI 318 - Building Code Requirements for Structural Concrete.
4. ACI 347 - Guide to Formwork for Concrete.

B. American Forest and Paper Association:

1. AF&PA - National Design Specifications for Wood Construction.

C. The Engineered Wood Association:

1. APA/EWA PS 1 - Voluntary Product Standard for Construction and Industrial Plywood.

D. American Society of Mechanical Engineers:

1. ASME A17.1 - Safety Code for Elevators and Escalators.

E. ASTM International:

1. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).
2. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials.

F. West Coast Lumber Inspection Bureau:

1. WCLIB - Standard Grading Rules for West Coast Lumber.

1.4 SUBMITTALS

- A. Manufacturer and type of void forms including compressive strengths.

1.5 QUALITY ASSURANCE

- A. Perform Work according to ACI 347, ACI 318 and ACI 301
- B. For wood products, comply with ANSI/AF&PA National Design Specification (NDS).

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver void forms and installation instructions in manufacturer's packaging.
- B. Store off ground in ventilated and protected manner to prevent deterioration from moisture.

1.7 COORDINATION

- A. Coordinate this Section with other sections of work, requiring attachment of components to formwork.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Forms for Surfaces Exposed to View:

1. Wood forms:
 - a. New 5/8 or 3/4 IN 5-ply structural plywood of concrete form grade.
 - b. Built-in-place or prefabricated type panel.
 - c. 4 x 8 FT sheets for built-in-place type except where smaller pieces will cover entire 40 area.
 - d. When approved, plywood may be reused.
2. Metal forms:
 - a. Metal forms excluding aluminum may be used.
3. Forms to be tight to prevent leakage, free of rust and straight without dents to provide 45 members of uniform thickness.

B. Forms for Surfaces Not Exposed to View:

1. Wood or metal sufficiently tight to prevent leakage.
2. Do not use aluminum forms.

C. Or as approved by Engineer.

2.2 PREFABRICATED FORMS

- A. Preformed Steel Forms: Minimum 16 gage matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.
- B. Glass Fiber Fabric Reinforced Plastic Forms: Matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished concrete surfaces.
- C. Pan Type: Steel or Glass fiber and of size and profile required.
- D. Tubular Column Type: Round, spirally wound laminated fiber, wood, or glass fiber material, surface treated with release agent, non-reusable.
- E. Void Forms: Moisture resistant treated paper faces, biodegradable, structurally sufficient to support weight of wet concrete mix until initial set.
- F. Steel Forms: Sheet steel, suitably reinforced, and designed for particular use indicated on Drawings.
- G. Framing, Studding and Bracing: Stud or No. 3 structural light framing grade.

2.3 FORMWORK ACCESSORIES

- A. Form Ties: Removable or Snap-off type, galvanized metal, fixed or adjustable length, free of defects capable of leaving holes larger than 1 inch in concrete surface.
- B. Spreaders: Standard, non-corrosive metal form clamp assembly, of type acting as spreaders and leaving no metal within 1 inch of concrete face. Wire ties, wood spreaders or through-bolts not permitted.
- C. Form Anchors and Hangers:
 1. Do not use anchors and hangers exposed concrete leaving exposed metal at concrete surface.
 2. Symmetrically arrange hangers supporting forms from structural steel members to minimize twisting or rotation of member.
 3. Penetration of structural steel members is not permitted.
- D. Form Release Agent: Colorless mineral oil that will not stain concrete, or absorb moisture or impair natural bonding or color characteristics of coating intended for use on concrete.
- E. Corners: Chamfer, rigid plastic or wood strip type; 3/4 x 3/4 inch size; maximum possible lengths.
- F. Dovetail Anchor Slot: Galvanized steel, 22 gage thick, release tape sealed slots, anchors for securing to concrete formwork.

- G. Flashing Reglets: Galvanized steel or Rigid PVC, 22 gage thick, longest possible lengths, with alignment splines for joints, release tape sealed slots, anchors for securing to concrete formwork.
- H. Vapor Retarder: Where indicated on Drawings, 8 mil thick polyethylene sheet.
- I. Bituminous Joint Filler: ASTM D1751.
- J. Nails, Spikes, Lag Bolts, Through-bolts, Anchorages: Size, strength and character to maintain formwork in place while placing concrete.
- K. Waterstops:
 - 1. Swellable, one-component, polyurethane-based waterstop for joints in concrete construction.
 - 2. Rubber or Polyvinyl chloride, minimum 1,750 psi tensile strength, minimum 50 degrees F to plus 175 degrees F working temperature range, 6 inch wide, maximum possible lengths, ribbed profile, preformed corner sections, heat welded jointing.
 - 3. Flexible strip of bentonite waterproofing compound in coil form for joints in concrete construction.

2.4 COATINGS

- A. Coatings for Aluminum: Polyamide epoxy finish coat with paint manufacturer's recommended primer for aluminum substrate. Apply one coat primer and one coat finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify lines, levels, and centers before proceeding with formwork. Verify dimensions agree with Drawings.
- B. When formwork is placed after reinforcement resulting in insufficient concrete cover over reinforcement before proceeding, request instructions from Engineer.

3.2 INSTALLATION

- A. Formwork - General:
 - 1. Construct forms to correct shape and dimensions, mortar-tight, braced, and of sufficient strength to maintain shape and position under imposed loads from construction operations.
 - 2. Camber forms where necessary to produce level finished soffits unless otherwise shown on Drawings.
 - 3. Carefully verify horizontal and vertical positions of forms. Correct misaligned or misplaced forms before placing concrete.
 - 4. Complete wedging and bracing before placing concrete.
- B. Forms for Smooth Finish Concrete:
 - 1. Use steel, plywood or lined board forms.

2. Use clean and smooth plywood and form liners, uniform in size, and free from surface and edge damage capable of affecting resulting concrete finish.
3. Install form lining with close-fitting square joints between separate sheets without springing into place.
4. Use full size sheets of form lines and plywood wherever possible.
5. Tape joints to prevent protrusions in concrete.
6. Use care in forming and stripping wood forms to protect corners and edges.
7. Level and continue horizontal joints.
8. Keep wood forms wet until stripped.

C. Framing, Studding and Bracing:

1. Space studs at 16 inches o.c. maximum for boards and 12 inches on center maximum for plywood.
2. Size framing, bracing, centering, and supporting members with sufficient strength to maintain shape and position under imposed loads from construction operations.
3. Construct beam soffits of material minimum of 2 inches thick.
4. Distribute bracing loads over base area on which bracing is erected.
5. When placed on ground, protect against undermining, settlement or accidental impact.

D. Erect formwork, shoring, and bracing to achieve design requirements, in accordance with requirements of ACI 301 and ACI 318.

E. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.

F. Obtain Engineer's approval before framing openings in structural members not indicated on Drawings.

G. Install chamfer strips on exposed corners.

H. Install void forms in accordance with manufacturer's recommendations.

I. Do not patch formwork.

3.3 APPLICATION - FORM RELEASE AGENT

A. Apply form release agent on formwork in accordance with manufacturer's recommendations.

B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.

C. Do not apply form release agent where concrete surfaces are indicated to receive special finishes or applied coverings that are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

D. Reuse and Coating of Forms: Thoroughly clean forms and reapply form coating before each reuse. For exposed work, do not reuse forms with damaged faces or edges. Apply form coating to forms in accordance with manufacturer's specifications. Do not coat forms for concrete indicated to receive "scored finish." Apply form coatings before placing reinforcing steel.

3.4 INSTALLATION - INSERTS, EMBEDDED PARTS, AND OPENINGS

A. Install formed openings for items to be embedded in or passing through concrete Work.

- B. Locate and set in place items required to be cast directly into concrete.
- C. Coordinate with Work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other Work.
- D. Install accessories straight, level, and plumb. Ensure items are not disturbed during concrete placement.
- E. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.
- F. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.
- G. Form Ties:
 - 1. Use sufficient strength and sufficient quantity to prevent spreading of forms.
 - 2. Place ties at least 1 inch away from finished surface of concrete.
 - 3. Leave inner rods in concrete when forms are stripped.
 - 4. Space form ties equidistant, symmetrical and aligned vertically and horizontally unless otherwise shown on Drawings.
- H. Arrangement: Arrange formwork to allow proper erection sequence and to permit form removal without damage to concrete.
- I. Construction Joints:
 - 1. Install surfaced pouring strip where construction joints intersect exposed surfaces to provide straight line at joints.
 - 2. Just prior to subsequent concrete placement, remove strip and tighten forms to conceal shrinkage.
 - 3. Show no overlapping of construction joints. Construct joints to present same appearance as butted plywood joints.
 - 4. Arrange joints in continuous line straight, true and sharp.
- J. Embedded Items:
 - 1. Make provisions for pipes, sleeves, anchors, inserts, reglets, anchor slots, nailers, water stops, and other features.
 - 2. Do not embed wood or uncoated aluminum in concrete.
 - 3. Obtain installation and setting information for embedded items furnished under other Specification sections.
 - 4. Securely anchor embedded items in correct location and alignment prior to placing concrete.
 - 5. Verify conduits and pipes, including those made of coated aluminum, meet requirements of ACI 318 for size and location limitations.
- K. Openings for Items Passing Through Concrete:
 - 1. Frame openings in concrete where indicated on Drawings. Establish exact locations, sizes, and other conditions required for openings and attachment of work specified under other sections.
 - 2. Coordinate work to avoid cutting and patching of concrete after placement.
 - 3. Perform cutting and repairing of concrete required as result of failure to provide required openings.

L. Screeds:

1. Set screeds and establish levels for tops of concrete slabs and levels for finish on slabs.
2. Slope slabs to drain where required or as indicated on Drawings.
3. Before depositing concrete, remove debris from space to be occupied by concrete and thoroughly wet forms. Remove freestanding water.

M. Screed Supports:

1. For concrete over waterproof membranes and vapor retarder membranes, use cradle, pad or base type screed supports which will not puncture membrane.
2. Staking through membrane is not permitted.

N. Cleanouts and Access Panels:

1. Provide removable cleanout sections or access panels at bottoms of forms to permit inspection and effective cleaning of loose dirt, debris and waste material.
2. Clean forms and surfaces against which concrete is to be placed. Remove chips, saw dust and other debris. Thoroughly blow out forms with compressed air just before concrete is placed.

3.5 FORM CLEANING

- A. Clean forms as erection proceeds, to remove foreign matter within forms.
- B. Clean formed cavities of debris prior to placing concrete.
- C. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.
- D. During cold weather, remove ice and snow from within forms. Do not use de-icing salts. Do not use water to clean out forms, unless formwork and concrete construction proceed within heated enclosure. Use compressed air or other means to remove foreign matter.

3.6 FORM REMOVAL

- A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads and removal has been approved by Architect/Engineer.
- B. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.
- C. Store removed forms in manner that surfaces to be in contact with fresh concrete will not be damaged. Discard damaged forms.
- D. Leave forms in place for minimum number of days as specified in ACI 347.

3.7 FORMWORK

- A. Cleaning:

1. Clean forms as erection proceeds.
2. Clean formed cavities of debris.
3. Flush with water or use compressed air.
4. During cold weather:
 - a. Remove ice and snow from within forms.
 - b. Do not use de-icing salts.
 - c. Do not use water
 - d. Use compressed air to remove foreign matter.

B. Removal:

1. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads.
2. Loosen forms carefully. Do not wedge tools against finish concrete surfaces.
3. Leave forms in place for minimum number of days according to ACI 347.

3.8 ERECTION TOLERANCES

- A. Tolerances: Construct formwork to produce completed concrete surfaces within construction tolerances according to ACI 117.
- B. Camber slabs and beams 1/4 inch per 10 feet in accordance with ACI 301.

END OF SECTION 031000

SECTION 032000 CONCRETE REINFORCING

PART 1 - GENERAL

1.1 SUMMARY

A. Work includes

1. Provide complete, in place, all concrete reinforcement required for all cast-in-place concrete work for the project, as shown or noted on the drawings and as specified herein.

B. Related work

1. Specified elsewhere
 - a. Concrete forming specified in Section 031100.
 - b. Concrete accessories specified in Section 031500.
 - c. Cast-in-place concrete specified in Section 033000.

1.2 SUBMITTALS

A. Shop drawings

1. Submit for Architect's approval:
 - a. Complete fabrication and layout drawings covering all details of concrete reinforcement, including bar schedules, stirrup spacing, diagrams of bent bars, and arrangements and assemblies.
2. Detail shop drawings in accordance with ACI 315.

1.3 QUALITY ASSURANCE

A. Standards

1. Any procedure, material, or operation specified by reference to the following standards, specifications, or codes shall comply with the current or most recent issue.
2. Work of this section shall comply with all pertinent provisions of the following:
 - a. American Society for Testing and Materials (ASTM) Specifications as listed elsewhere for various materials required.
 - b. Concrete Reinforcing Steel Institute (CRSI) "Manual of Standard Practice".
 - c. American Concrete Institute (ACI) ACI 318.

1.4 PRODUCT HANDLING

- A. Deliver reinforcement to job site bundled, tagged, and marked. Use metal tags indicating bar size, lengths, and other information corresponding to markings shown on shop drawings.

- B. Store reinforcement at job site in a manner to prevent damage and accumulation of dirt and excessive rust.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Bar Reinforcing - ASTM A 615, Grade 60, sizes as detailed or noted on the drawings.
 - 1. Mat fabrication - ASTM A 184.
- B. Supports for Reinforcement - Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcement in place:
 - 1. Use wire bar type supports complying with CRSI recommendations, unless otherwise indicated on the drawings.
 - 2. Do not use wood, brick, or other unacceptable materials.
 - 3. For slabs on grade, use supports with sand plates or horizontal runners where base material will not support chair legs.
 - 4. For exposed to view concrete surfaces, where legs of supports are in contact with forms, provide supports with either hot-dipped galvanized or plastic protected legs.

2.2 FABRICATION

- A. General - Fabricate reinforcing bars to conform to required shapes and dimensions, with fabrication tolerances complying with CRSI Manual. In case of fabrication errors, do not straighten bars in a manner that will injure or weaken the material.
- B. Bars shall be bent cold. Bend & hooks shall conform to ACI 318.
- C. Unacceptable materials - reinforcement with any of the following defects will not be permitted in the work:
 - 1. Bar lengths, depths, and bends exceeding specified fabrication tolerances.
 - 2. Bends or kinks not indicated on drawings or final shop drawings.
 - 3. Bars with reduced cross-section due to excessive rusting or other cause.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine the substrate, formwork, and the conditions under which concrete reinforcement is to be placed. Do not proceed with the work until all unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General - Comply with the specified standards for details and methods of reinforcement placement and supports, and as herein specified.

- B. Clean reinforcement to remove loose rust and mill scale, earth, and other materials which reduce or destroy bond with concrete.
 - 1. At time concrete is placed, metal reinforcement shall be free from rust, scale, oil, grease, dirt or other foreign material.

- C. Reinforcement shall be accurately positioned and firmly secured against displacement.
 - 1. Arrange, space, and securely tie bars and bar supports together to hold accurately in position during concrete operation.
 - a. Wire tie or clip at all intersections.
 - 2. Provide spacers, support bars, chairs and bolsters in accordance with CRSI-75. All such items in areas of exposed concrete shall be galvanized or plastic covered.

- D. During placement of concrete the position and condition of all reinforcement shall be constantly monitored by qualified workmen to assure compliance with specified clearances.

- E. Clearances (face of concrete to near edge of rebar):
 - 1. Footings: 3 inches.
 - 2. Walls: 1-1/2 inches.
 - 3. Beams & Columns: 1-1/2 inches.
 - 4. Slabs on Grade: Center of slab unless noted otherwise on drawings.
 - 5. Backfill surfaces: 2 inches.

END OF SECTION 032000

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SECTION 033000 CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes cast-in-place concrete for the following:

1. Foundations.
2. Slabs on grade.
3. Control, expansion and contraction joint devices.
4. Equipment pads.
5. Concrete Toppings.
6. Other items as indicated on drawings.

B. Related Sections:

1. Section 031000 - Concrete Forming and Accessories
2. Section 032000 - Concrete Reinforcing.

1.2 REFERENCES

A. American Concrete Institute:

1. ACI 301 - Specifications for Structural Concrete.
2. ACI 305 - Hot Weather Concreting.
3. ACI 306.1 - Standard Specification for Cold Weather Concreting.
4. ACI 308.1 - Standard Specification for Curing Concrete.
5. ACI 318 - Building Code Requirements for Structural Concrete.

B. ASTM International:

1. ASTM C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
2. ASTM C33 - Standard Specification for Concrete Aggregates.
3. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
4. ASTM C42 - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
5. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
6. ASTM C143 - Standard Test Method for Slump of Hydraulic Cement Concrete.
7. ASTM C150 - Standard Specification for Portland Cement.
8. ASTM C172 - Standard Practice for Sampling Freshly Mixed Concrete.
9. ASTM C173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
10. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
11. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
12. ASTM C330 - Standard Specification for Lightweight Aggregates for Structural Concrete.
13. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete.

14. ASTM C595 - Standard Specification for Blended Hydraulic Cements.
15. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete.
16. ASTM C685 - Standard Specification for Concrete Made By Volumetric Batching and Continuous Mixing.
17. ASTM C845 - Standard Specification for Expansive Hydraulic Cement.
18. ASTM C989 - Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars.
19. ASTM C1017 - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
20. ASTM C1064 - Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
21. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
22. ASTM C1116 - Standard Specification for Fiber-Reinforced Concrete and Shotcrete.
23. ASTM C1157 - Standard Performance Specification for Hydraulic Cement.
24. ASTM C1218 - Standard Test Method for Water-Soluble Chloride in Mortar and Concrete.
25. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures.
26. ASTM D994 - Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
27. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
28. ASTM D1752 - Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
29. ASTM D6690 - Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.
30. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
31. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
32. ASTM E1643 - Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill under Concrete Slabs.
33. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.

1.3 SUBMITTALS

- A. Product Data: Submit data on joint devices, attachment accessories and admixtures.
- B. Design Data:
 1. Submit concrete mix design for each concrete strength. Submit separate mix designs when admixtures are required for the following:
 - a. Hot and cold weather concrete work.
 - b. Air entrained concrete work.
 2. Identify mix ingredients and proportions, including admixtures.
 3. Identify chloride content of admixtures and whether or not chloride was added during manufacture.
- C. Manufacturer's Installation Instructions: Submit installation procedures and interface required with adjacent Work.

1.4 QUALITY ASSURANCE.

- A. Perform Work in accordance with ACI 301 and ACI 318.
- B. Conform to ACI 305 when concreting during hot weather.
- C. Conform to ACI 306.1 when concreting during cold weather.
- D. Acquire cement and aggregate from one source for Work.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Maintain concrete temperature after installation at minimum 50 degrees F for minimum 7 days.
- B. Maintain high early strength concrete temperature after installation at minimum 50 degrees F for minimum 3 days.

1.6 COORDINATION

- A. Coordinate placement of joint devices with erection of concrete formwork and placement of form accessories.

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

- A. Cement: ASTM C150; Portland Type: **Type I - Normal, Type IA - Air Entraining**
- B. Normal Weight Aggregates: ASTM C33.
 - 1. Coarse Aggregate Maximum Size: 3/4 inches, In accordance with ACI 318.
- C. Water: ACI 318; potable, without deleterious amounts of chloride ions.

2.2 ADMIXTURES

- A. Air Entrainment: ASTM C260.
- B. Chemical: ASTM C494.
 - 1. Type A - Water Reducing.
 - 2. Type B - Retarding.
 - 3. Type C - Accelerating.
 - 4. Type D - Water Reducing and Retarding.
 - 5. Type E - Water Reducing and Accelerating.
 - 6. Type F - Water Reducing, High Range.
 - 7. Type G - Water Reducing, High Range and Retarding.
- C. Fly Ash: ASTM C618 Class C or F.

- D. Silica Fume: ASTM C1240
- E. Slag: ASTM C989; ground granulated blast furnace slag
- F. Plasticizing: ASTM C1017/C1017M.
 - 1. Type I, plasticizing.
 - 2. Type II, plasticizing and retarding.

2.3 ACCESSORIES

- A. Bonding Agent:
 - 1. Manufactures:
 - a. Sika – Sikadur 32 High-Mod.
 - b. Euclid – Duralbond.
 - c. Substitutions: Permitted upon approval of Engineer
- B. Vapor Retarder: ASTM E1745 Class A 15 vapor barrier; type recommended for below grade application. Furnish joint tape recommended by manufacturer.
 - 1. Manufactures:
 - a. Stego Industries, LLC, Stego Wrap Vapor Barrier.
 - b. Substitutions: Permitted upon approval of Engineer
 - c. W.R. Meadows Perminator – 15 mil.
 - d. Poly-America Husky Yellow Guard – 15 mil.
- C. Non-Shrink Grout: ASTM C1107/C1107M; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 2,400 psi in 48 hours and 7,000 psi in 28 days.

2.4 JOINT DEVICES AND FILLER MATERIALS

- A. Joint Filler Type A: ASTM D1751 or ASTM D994; Asphalt impregnated fiberboard or felt, 1/4 inch thick; tongue and groove profile.
- B. Joint Filler Type B: ASTM D1752; recycled PVC.
- C. Joint Filler Type C: ASTM D1752; Premolded sponge rubber.

2.5 CONCRETE MIX

- A. Provide concrete to the following criteria for interior concrete:

Material and Property	Measurement
Compressive Strength (7 day)	3000 psi
Compressive Strength (28 day)	4000 psi

Cement Type	ASTM C150
Aggregate Type	Normal weight
Min. Cementitious Content	564 lb/cu yd
Water-Cement Ratio (maximum)	0.45 by weight
Aggregate Size (maximum)	1 inch
Aggregate Size (minimum)	1/2 inch
Air Content	0 to 3 percent entrapped
Fly Ash Content:	20 percent of cementitious materials by weight, maximum
Slump	4 inches plus or minus 1 inch

B. Provide concrete to the following criteria for concrete exposed to weather:

Material and Property	Measurement
Compressive Strength (7 day)	3000 psi
Compressive Strength (28 day)	4000 psi
Cement Type	ASTM C150
Aggregate Type	Normal weight
Min. Cementitious Content	564 lb/cu yd
Water-Cement Ratio (maximum)	0.45 by weight
Aggregate Size (maximum)	1 inch
Aggregate Size (minimum)	1/2 inch
Air Content	6 percent plus or minus 1.5 percent
Fly Ash Content:	20 percent of cementitious materials by weight, maximum
Slump	4 inches plus or minus 1 inch

C. Admixtures: Include admixture types and quantities indicated in concrete mix designs only when approved by Architect/Engineer.

1. Use accelerating admixtures in cold weather. Use of admixtures will not relax cold weather placement requirements.
2. Do not use calcium chloride nor admixtures containing calcium chloride.
3. Use set retarding admixtures during hot weather.
4. Add air entrainment admixture to concrete mix for work exposed to freezing and thawing or deicing chemicals

D. Average Compressive Strength Reduction: Not permitted.

- E. Ready Mixed Concrete: Mix and deliver concrete in accordance with ASTM C94 and ASTM C685.
- F. Site Mixed Concrete: Mix concrete in accordance with ACI 318.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify requirements for concrete cover over reinforcement.
- B. Verify anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with placing concrete.

3.2 PREPARATION

- A. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent. Remove laitance, coatings, and unsound materials.
- B. In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout.
- C. Remove debris and ice from formwork, reinforcement, and concrete substrates.
- D. Remove water from areas receiving concrete before concrete is placed.
- E. Concrete can be place under water using tremie as approved by engineer.

3.3 PLACING CONCRETE

- A. Place concrete in accordance with ACI 301 and ACI 318.
- B. Notify testing laboratory and Engineer minimum 24 hours prior to commencement of operations.
- C. Ensure reinforcement, inserts, embedded parts, formed expansion and contraction joints, and are not disturbed during concrete placement.
- D. Install vapor retarder under interior slabs on grade in accordance with ASTM E1643; place sheets in position with longest dimension parallel with direction of pour.
 - 1. Level and compact base material.
 - 2. Extend vapor barrier to the perimeter of the slab. If practicable, terminate it at the top of the slab, otherwise (a) at a point acceptable to the structural engineer or (b) where obstructed by impediments (such as dowels, water-stops, or any other site condition requiring early termination of the vapor barrier). At the point of termination, seal vapor barrier to the foundation wall, grade beam or slab itself.
 - 3. Lap joints minimum 6 inches and seal watertight by taping edges and ends.
 - 4. Apply seam tape to a clean and dry vapor barrier.
 - 5. Seal all penetrations (including pipes) per manufacturer's instructions.
 - 6. Avoid the use of non-permanent stakes driven through vapor retarder.

7. If non-permanent stakes are driven through vapor retarder, repair as recommended by vapor retarder manufacturer.
 8. Repair vapor retarder damaged during placement of concrete reinforcing. Repair with vapor retarder material of similar (or better) permeance, puncture, and tensile; lap over damaged areas minimum 6 inches and seal watertight.
- E. Separate slabs on grade from vertical surfaces with 1/2 inch thick joint filler unless otherwise shown on drawings.
 - F. Deposit concrete at final position. Prevent segregation of mix.
 - G. Place concrete in continuous operation for each panel or section determined by predetermined joints.
 - H. Consolidate concrete.
 - I. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.
 - J. Place concrete continuously between predetermined expansion, control, and construction joints.
 - K. Do not interrupt successive placement; do not permit cold joints to occur.
 - L. Place floor slabs in saw cut pattern indicated.
 - M. Saw cut joints within 12 hours after placing. Use 3/16 inch thick blade, cut into 1/4 depth of slab thickness.
 - N. Screed floors and slabs on grade level, maintaining surface flatness of maximum 1/8 inch in 10 ft.
 - O. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains at 1/8 inch per foot nominal unless otherwise indicated on drawings. Areas that have floor drains shall not be required to meet the levelness tests.
- 3.4 SEPARATE FLOOR TOPPINGS
- A. Prior to placing floor topping, roughen substrate concrete surface and remove deleterious material. Broom and vacuum clean.
 - B. Place required reinforcing and other items to be cast in.
 - C. Apply bonding agent to substrate.
 - D. Place concrete floor toppings to required lines and levels.
 - E. Screed toppings level, maintaining surface flatness maximum 1/8 inch in 10 ft.
- 3.5 CONCRETE FINISHING
- A. Provide formed concrete surfaces as follows:

1. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - a. Apply to concrete surfaces not exposed to public view.
 2. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - a. Apply to concrete surfaces exposed to public view.
 3. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.
- B. Finish concrete floor surfaces in accordance with ACI 301 and ACI 311.
- C. Wood float surfaces receiving quarry tile, ceramic tile or terrazzo with full bed setting system.
- D. Steel trowel surfaces receiving carpeting, resilient flooring, seamless flooring, thin set quarry tile or thin set ceramic tile.
- E. Steel trowel surfaces which are indicated to be exposed.
- 3.6 CURING AND PROTECTION
- A. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
 - B. Protect concrete footings from freezing for minimum 5 days.
 - C. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
 - D. Cure concrete in accordance with ACI 308.1.
 - E. Cure floor surfaces in accordance with ACI 301 and ACI 318.

END OF SECTION 033000

SECTION 051200 STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Structural shapes.
 2. Channels and angles.
 3. Hollow structural sections.
 4. Structural pipe.
 5. Structural plates and bars.
 6. Floor plates.
 7. Bolts, connectors, and anchors.
 8. Grout.

1.2 SUBMITTALS

- A. Shop Drawings: Indicate sizes, spacing, and locations of structural members, openings, connections, cambers, loads, and welded connections.
- B. Manufacturer's Mill Certificate: Certify products meet or exceed specified requirements.
- C. Mill Test Reports: Submit indicating structural strength, destructive and non-destructive test analysis.
- D. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

1.3 QUALITY ASSURANCE

- A. Perform Work in accordance with the following:
1. Structural Steel: AISC 303 and AISC 360.
 2. Architecturally Exposed Structural Steel: AISC 303, Section 10.
 3. High Strength Bolted Connections: Specifications for Structural Joints Using ASTM A325 or A490 Bolts, prepared by RCSC Committee A.1.

1.4 QUALIFICATIONS

- A. Fabricator: Company specializing in performing Work of this section with minimum 10 years documented experience.
- B. Erector: Company specializing in performing Work of this section with minimum 5 years documented experience.
- C. Welders and Welding Procedures: AWS D1.1 qualified within previous 12 months.

PART 2 - PRODUCTS

2.1 STRUCTURAL STEEL

- A. Structural W-Shapes: ASTM A992, Grade 50.
- B. Structural M-Shapes: ASTM A36.
- C. Structural S-Shapes: ASTM A36.
- D. Structural T-Shapes: Cut from structural W-shapes.
- E. Channels and Angles: ASTM A36.
- F. Round Hollow Structural Sections: ASTM A500, Grade B.
- G. Square and Rectangular Hollow Structural Sections: ASTM A500, Grade B.
- H. Stainless Steel Square and Rectangular Tubes: ASTM A554, Grade MT-316.
- I. Structural Pipe: ASTM A53, Grade B.
- J. Structural Plates and Bars: ASTM A36.
- K. Floor Plates: ASTM A786; raised pattern.

2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. Bolts: Heavy hex, structural type.
 - 1. ASTM A325; Type 1, hot dipped galvanized.
- B. Nuts: ASTM A563 heavy hex type.
 - 1. Finish: Hot dipped galvanized.
- C. Washers: ASTM F436; Type 1, circular.
 - 1. Finish: Hot dipped galvanized.
- D. Shear Connectors: ASTM A108; Grades 1015 through 1020, headed, unfinished and in accordance with AWS D1.1; Type B.
- E. Anchor Rods: ASTM F1554; Grade 36.
 - 1. Shape: Straight.
- F. Threaded Rods: ASTM A36.
 - 1. Finish: Hot dipped galvanized.

2.3 WELDING MATERIALS

- A. Welding Materials: AWS D1.1; type required for materials being welded.

2.4 FABRICATION

- A. Continuously seal joined members by continuous welds. Grind exposed welds smooth.
- B. Fabricate connections for bolt, nut, and washer connectors.

2.5 FINISHES

- A. Structural Steel shall be cleaned and primed, as indicated on design drawings, per Specification 099100.
- B. Galvanizing for Bolts, Connectors, and Anchors:
 - 1. Hot-Dipped Galvanizing:
 - a. Bolts, Nuts, and Washers: ASTM F2329.
 - b. Connectors and Anchors: ASTM A153/A153M.

2.6 ACCESSORIES

- A. Grout: Non-shrink type, pre-mixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing additives, capable of developing minimum compressive strength of 7,000 psi at 28 days.
- B. Shop Primer: SSPC Paint 15, Type 1, red oxide.
- C. Touch-Up Primer: Match shop primer.
- D. Touch-Up Primer for Galvanized Surfaces: SSPC Paint 20 Type II Organic.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify bearing surfaces are at correct elevation.
- B. Verify anchors rods are set in correct locations and arrangements with correct exposure for steel attachment.

3.2 PREPARATION

- A. Furnish templates for installation of anchor rods and embedments in concrete and masonry work.

3.3 ERECTION

- A. Allow for erection loads, and for sufficient temporary bracing to maintain structure safe, plumb, and in alignment until completion of erection and installation of permanent bracing.
- B. Field weld components and shear connectors indicated on Drawings.
- C. Field connect members with threaded fasteners; torque to required resistance, tighten to snug tight for bearing type connections.
- D. Do not field cut or alter structural members without approval of Engineer.
- E. After erection, touch up welds and abrasions to match shop finishes.

3.4 GROUT INSTALLATION

- A. Shim bearing plates and equipment supports to proper elevation, snug tighten anchor bolts.
- B. Fill void under bearing surface with grout. Install and pack grout to remove air pockets.
- C. Moist cure grout.
- D. Remove forms after grout is set. Trim grout edges to smooth surface, splayed 45 degrees.
- E. Tighten anchor bolts after grout has cured for a minimum of 3 days.

3.5 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
- B. Maximum Offset From Alignment: 1/4 inch.

END OF SECTION 051200

SECTION 074100
PREFORMED METAL STANDING SEAM ROOFING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. This section covers the pre-finished, pre-fabricated Architectural standing seam roof system to be installed over existing steel roof purlins. All metal trim, accessories, fasteners, insulation and sealants indicated on the drawings as part of this section.
- B. Drawings and general provisions of the Contract, including general and Supplementary Conditions and Division 01 Specifications, apply to this section.

1.2 SUMMARY

- A. Section Includes
 - 1. Factory formed Standing Seam metal roof panels

1.3 DEFINITIONS

- A. Metal Roof Panel Assembly: Metal roof panels, attachment system components, miscellaneous metal framing, and accessories necessary for a complete weathertight roofing system.
- B. References:
 - 1. American Society for Testing and Materials (ASTM)
 - a. ASTM A 653: Steel Sheet, Zinc Coated by the Hot Dip Process
 - b. ASTM A 792: Steel Sheet, Aluminum-Zinc Alloy Coated by the Hot Dip Process
 - c. ASTM B 209: Aluminum and Aluminum Alloy Sheet and Plate
 - d. ASTM B370 Standard Specification for Copper Sheet and Strip for Building Construction
 - 2. Sheet Metal and Air Conditioning Contractors National Association (SMACNA)
 - a. SMACNA Architectural Sheet Metal Manual, 1993 edition
 - 3. American Iron and Steel Institute (AISI)
 - a. AISI Cold Formed Steel Design Manual
 - 4. Aluminum Association
 - a. Aluminum Design Manual
 - 5. Metal Construction Association

- a. Preformed metal Wall Guidelines

6. Code References

- a. ASCE, Minimum Loads for Buildings and Other Structures
- b. BOCA National Building Codes
- c. UBC Uniform Building Code
- d. SBC Standard Building Code

1.4 PERFORMANCE REQUIREMENTS

- A. General: Provide installed standing seam metal panels and base flashings that remain watertight; do not permit the passage of water; and resist specified uplift pressures, thermally induced movement, and exposure to weather without failure.
- B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by roofing manufacturer based on testing and field experience.
- C. Contractor to provide a complete roof system: An omission of system component in drawings or in specifications does not preclude the contractor from providing all components as required for a complete warranted roof system.

1.5 QUALITY ASSURANCE

- A. Manufacturer and erector shall demonstrate experience of a minimum of five (5) years in this type of project.
- B. Panels shall be factory-produced only. No portable, installer-owned or installer-rented machines will be permitted.

1.6 SUBSTITUTIONS

- A. The material, products and equipment specified in this section establish a standard for required function, dimension, appearance and quality to be met by any proposed substitution.

1.7 SYSTEM DESCRIPTION

- A. Material to comply with:
 - 1. ASTM B209 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

1.8 ROOF SYSTEM PERFORMANCE TESTING

- A. General Performance: Metal roof panels shall comply with performance requirements without failure due to defective manufacture, fabrication, installation or other defects in construction.

- B. Roof System shall be designed to meet Standard Building Code Wind Load requirements.
- C. Panels to meet:
 - 1. Water Penetration: When tested per ASTM E-283/1680 and ASTM E-331/1646 there shall be no uncontrolled water penetration or air infiltration through the panel joints.
 - 2. Roof System shall be designed to meet a UL Class 90 wind uplift in accordance with UL standard 580 and panel system shall be ASTM 1592 Tested and approved
 - 3. UL 2218 - Impact Resistance rated.

1.9 WARRANTIES

- A. Finish warranty: Manufacturer's standard form in which manufacturer agrees to repair finish or replace standing seam metal roof panels that show evidence of deterioration of factory-applied finish within specified warranty period.
 - 1. Exposed Panels Finish - deterioration includes the following:
 - a. Color fading more than 5 hunter units when tested according to ASTM D 2244
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214
 - c. Cracking, checking, peeling or failure of a paint to adhere to a bare metal.
 - 2. Warranty Period: 20 Years from the date of substantial completion
- B. Applicator shall furnish written warranty for a two (2) year period from date of substantial completion of building covering repairs required to maintain roof and flashings in watertight condition.

1.10 SUBMITTALS

- A. Furnish detailed drawings showing profile and gauge of exterior sheets, location and type of fasteners, location, gauges, shape and method of attachment of all trim locations and types of sealants, and any other details as may be required for a weather-tight installation.
- B. Provide finish samples of all colors specified.
- C. Shop drawings: Show fabrication and installation layouts of metal roof panels, metal wall panels or metal soffit panels, details of edge conditions, side-seam joints, panel profiles, corners, anchorages, trim, flashings, closures and accessories, and special details. Distinguish between factory and field-assembled work
- D. Coordination Drawings: Roof plans, drawn to scale, on which the following are shown and coordinated with each other, based on input from installer of the items involved
 - 1. Roof panels and attachments
 - 2. Metal trusses, bracings and supports
 - 3. Roof-mounted items including snow guards and items mounted on roof curbs
- E. LEED Submittals
 - 1. Product Test reports for Credit SS 7.2. For roof panels, indicating that the panels comply with Solar Reflective Index requirement

2. Product data for Credit MR 4.1 and credit MR 4.2: Indicating the percentages by weight of post-consumer and pre-consumer recycled content for products having recycled content.

1.11 DELIVERY, STORAGE AND HANDLING

- A. Ordering: Comply with manufacturer's ordering instruction and lead time requirements to avoid construction delays.
- B. Deliver components, sheets, metal roof panels and other manufactured items so as not to be damaged or deformed. Package metal roof panels for protection during transportation and handling.
- C. Unload, store and erect metal roof panels in a manner to prevent bending, warping, twisting and surface damage.
- D. Stack metal roof panels on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal roof panels to ensure dryness. Do not store metal roof panels in contact with other materials that might cause staining, denting or other surface damage.
- E. Protect strippable protective coating on any metal coated product from exposure to sunlight and high humidity, except to the extent necessary for material installation.

1.12 PROJECT CONDITIONS

- A. Weather Limitations: proceed with installation only when existing and forecasted weather conditions permit metal roof panel work to be performed.
- B. Field Measurements: Verify actual dimensions of construction contiguous with metal roof panels by field measurements before fabrication.

1.13 COORDINATION

- A. Coordinate sizes and locations of roof curbs, equipment supports and roof penetrations with actual equipment provided.
- B. Coordinate metal roof panels with rain drainage work, flashing, trim and construction of decks, parapet walls and other adjoining work to provide a leakproof, secure and noncorrosive installation

PART 2 - PRODUCTS

2.1 PANEL DESIGN

- A. General: Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, bearing plates and accessories required for a weathertight installation.

- B. Basis of design: Petersen Aluminum Corporation "Tite-Loc" aluminum roof panels in 16" widths with 2" high seams that are mechanically seamed together @ 90 degrees.
- C. Panels to be produced with Factory supplied hot melt mastic in the seams.
- D. Panels to be produced Smooth - Factory Standard.
- E. Panels to be designed for attachment with concealed fastener clips, spaced as required by the manufacturer to provide for both positive and negative design loads, while allowing for the expansion and contraction of the entire roof system resulting from variations in temperature.
- F. Forming: Use continuous end rolling method. No end laps on panels. No portable roll-forming machines will be permitted on this project, no installer-owned or installer- rented machines will be permitted. It is the intent of the Architect to provide Factory-Manufactured panel systems only for this project.

2.2 ACCEPTABLE MANUFACTURERS

- A. This project is detailed around the roofing product of Petersen Aluminum Corporation Petersen Aluminum Corp, Elk Grove Village, IL, 800-323-1960, Tite-Loc.

2.3 MATERIALS AND FINISHES

- A. Preformed roofing panels shall be fabricated of .040 Aluminum
- B. Color shall be Colonial Red
- C. Finish shall be Kynar 500 or Hylar 5000 Fluorocarbon coating with a top side film thickness of 0.70 to 0.90 mil over a 0.25 to 0.3 mil prime coat to provide a total dry film thickness of 0.95 to 1.25 mil, to meet AAMA 621. Bottom side shall be coated with a primer with a dry film thickness of 0.25 mil. Finish shall conform to all tests for adhesions, flexibility and longevity as specified by Kynar 500 or Hylar 5000 finish supplier.
- D. If Strippable coating to be applied on the pre-finished panels to the top side to protect the finish during fabrication, shipping and handling, film shall be removed before installation.
- E. Trim: Trim shall be fabricated of the same material and finish to match the profile, and will be press broken in lengths of 10 to 12 feet. Trim shall be formed only by the manufacturer of their approved dealer. Trim to be erected in overlapped condition. Use lap strips only as indicated on drawings. Miter conditions shall be factory welded material to match the sheeting.
- F. Closures: use composition or metal profiled closures at the top of each elevation to close ends of the panels. Metal closures to be made in the same material and finish as face sheet.
- G. Fasteners: Fasteners shall be of type, material, size, corrosion resistance, holding power and other properties required to fasten miscellaneous framing members to substrates.
- H. Bearing Plates: standard as provided by roof panel manufacturer.
- I. Sealants
 - 1. Provide two-part polysulfide class B non-sag type for vertical and horizontal joints or
 - 2. one part polysulfide not containing pitch or phenolic extenders or

3. Exterior grade silicone sealant recommended by roofing manufacturer or
4. One part non-sag, gun grade exterior type polyurethane recommended by the roofing manufacturer.

2.4 FABRICATION

- A. Comply with dimensions, profile limitations, gauges and fabrication details shown and if not shown, provide manufacturer's standard product fabrication.
- B. Fabricate components of the system in factory, ready for field assembly.
- C. Fabricate components and assemble units to comply with fire performance requirements specified.
- D. Apply specified finishes in conformance with manufacturer's standard, and according to manufacturer's instructions.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine alignment of structural steel and related supports, primary and secondary roof framing, prior to installation.
- B. For the record, prepare written report, endorsed by installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FASTENERS

- A. Secure clips over manufacturer supplied bearing plates to existing purlins.
- B. Place fasteners as indicated in manufacturer's standards.

3.3 INSTALLATION

- A. Panels shall be installed plumb and true in a proper alignment and in relation to the structural framing. The erector must have at least five years successful experience with similar applications.
- B. Install metal panels, fasteners, trim and related sealants in accordance with approved shop drawings and as may be required for a weather-tight installation.
- C. Remove all strippable coating and provide a dry-wipe down cleaning of the panels as they are erected.

3.4 DAMAGED MATERIAL

- A. Upon determination of responsibility, repair or replace damaged metal panels and trim to the satisfaction of the Architect and Owner.

END OF SECTION 007410

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**SECTION 099000
PAINTING AND COATING**

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Painting requirements for new and existing steel members.
- B. Related Sections:
 - 1. Section 051200 - Structural Steel Framing.

1.2 SYSTEM DESCRIPTION

- A. Epoxy Prime Coat with two component Polysiloxane Finish Coat.

PART 2 - PRODUCTS

2.1 Epoxy Prime Coat

- A. Sherman Williams B58W610 Macropoxy 646 Fast Cure Epoxy, or approved equal.

2.2 Finish Coat

- A. Sherman Williams B80W501 SHER-LOXANE 800, or approved equal.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

- A. Pressure wash to remove all existing chalk, dirt, and surface contaminates.
- B. Sand to degloss any existing painted surfaces that are higher than an egg-shell sheen to create a surface profile.
- C. On ferrous metal surfaces, remove all loose existing paint and corrosion by using SSPC-SP2 Hand Tool Cleaning and SSPC-SP3 Power Tool Cleaning.

3.2 COATING APPLICATION

- A. Apply Full Prime Coating and Finish Coating, per paint manufacturer.
- B. Protect all surfaces that are not to be painted.

END OF SECTION 099000

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SECTION 230500
COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
1. Mechanical sleeve seals.
 2. Sleeves.
 3. Concrete bases.
 4. Supports and anchorages.

1.2 SUBMITTALS

- A. Submit product information for all materials used for the various mechanical systems.

1.3 REFERENCES

- A. Standards:
1. ASME American Society of Mechanical Engineers.
 2. AWWA American Water Works Association.
 3. UL Underwriters Laboratories, Inc.
 4. MCA Mechanical Contractors Association.
 5. IBR Institute of Boiler and Radiators Manufacturers AISE Association of Iron & Steel Engineers.
 6. SAE Society of Automotive Engineers.
 7. NEMA National Electric Manufacturers Association ASTM American Society for Testing and Materials.
 8. ANSI American National Standard Institute.
 9. AWS American Welding Society.

1.4 QUALITY ASSURANCE

- A. All equipment and materials shall be new and of first quality. Manufactured products shall be Manufacturer's standard product with specified options but shall not be field or factory modified unless specified. All materials and equipment shall bear the Manufacturer's nameplate or marking with type, size, catalog numbers and ratings as appropriate.
- B. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Acceptance (at site): Take delivery of all items delivered to site. Be responsible for inspection of materials and equipment to detect transit damage.
- B. Protection (prior to application or installation):
 - 1. Materials shall be stored inside building. Piping may be stored outside.
 - 2. Be responsible for all damage to materials stored on site.

1.6 PROJECT CONDITIONS

- A. When existing conditions prohibit the proper installation as shown on the Drawings or as specified herein, the Contractor shall notify the Engineer/Architect, in writing, requesting a solution.
- B. Contractor is responsible for the verification of new and existing conditions on the site before that particular phase of installation begins.

1.7 WARRANTY

- A. Contractors and manufacturers warranty shall be 1 year after substantial completion.

PART 2 - PRODUCTS

2.1 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between duct and sleeve.
- B. Sealing Elements: NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
- C. Pressure Plates: Stainless steel. Include two for each sealing element.
- D. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.2 SLEEVES

- A. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.2 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
 - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 - 7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

3.3 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.4 ADJUST AND CLEAN

- A. Protection of Completed Work:
 - 1. When work is completed it shall, when it is subject to damage by ongoing construction, be protected from this damage.

2. As work is being installed, equipment and piping shall be protected from other ongoing construction or from its own construction. Exposed piping ends should not be temporarily covered; hanger shall be supplied in sufficient number to prevent warping or bending of pipe.

END OF SECTION 230500

SECTION 230593
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes TAB to produce design objectives for the following:
 - 1. Air Systems:
 - a. Constant-volume air systems.
 - 2. Reporting results of activities and procedures specified in this Section.

1.2 SUBMITTALS

- A. Strategies and Procedures Plan: Within 60 days from Contractor's Notice to Proceed, submit 5 copies of TAB strategies and step-by-step procedures as specified in Part 3 "Preparation" Article. Include a complete set of report forms intended for use on this Project.
- B. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.
- C. Warranties specified in this Section.

1.3 QUALITY ASSURANCE

- A. **TAB Firm Qualifications: (TAB firm must meet all of the qualifications listed)**
 - 1. **Certified by AABC, NEBB, TABB, or balancer must have completed 40 hours (minimum) of TAB training.**
 - 2. **Work performed under the direct supervision of a Licensed Professional Engineer.**
 - 3. **Minimum TAB experience of 5 years.**
- B. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:
 - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 - 2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.

1.4 COORDINATION

- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.

- B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
- B. Examine approved submittal data of HVAC systems and equipment.
- C. Examine Project Record Documents described in Division 01 Section "Project Record Documents."
- D. Examine equipment performance data including fan and pump curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.
- E. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.
- F. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- G. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
- H. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- I. Examine equipment for installation and for properly operating safety interlocks and controls.
- J. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.
- K. Verify that all instruments are accurately calibrated and maintained.

3.2 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system readiness checks and prepare system readiness reports. Verify the following:
 - 1. Permanent electrical power wiring is complete.
 - 2. Equipment and duct access doors are securely closed.
 - 3. Balance, smoke, and fire dampers are open.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or SMACNA's TABB "HVAC Systems - Testing, Adjusting, and Balancing" and this Section.
- B. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
- C. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- D. Verify that motor starters are equipped with properly sized thermal protection.
- E. Check for airflow blockages.

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure fan static pressures to determine actual static pressure as follows:
 - a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 - 2. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers, under final balanced conditions.

3. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
4. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.

3.6 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 1. Manufacturer, model, and serial numbers.
 2. Motor horsepower rating.
 3. Motor rpm.
 4. Efficiency rating.
 5. Nameplate and measured voltage, each phase.
 6. Nameplate and measured amperage, each phase.
 7. Starter thermal-protection-element rating.

3.7 TOLERANCES

- A. Set HVAC system airflow and water flow rates within the following tolerances:
 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus 5 to plus 10 percent.
 2. Air Outlets and Inlets: 0 to minus 10 percent.

3.8 FINAL REPORT

- A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.
- B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
 1. Include a list of instruments used for procedures, along with proof of calibration.
- C. Final Report Contents: In addition to certified field report data, include the following:
 1. Fan curves.
 2. Manufacturers' test data.
 3. Field test reports prepared by system and equipment installers.
 4. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.
- D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:

1. Title page.
 2. Name and address of TAB firm.
 3. Project name.
 4. Project location.
 5. Architect's name and address.
 6. Engineer's name and address.
 7. Contractor's name and address.
 8. Report date.
 9. Signature of TAB firm who certifies the report.
 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 12. Nomenclature sheets for each item of equipment.
 13. Data for terminal units, including manufacturer, type size, and fittings.
 14. Notes to explain why certain final data in the body of reports varies from indicated values.
 15. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outside-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Inlet vane settings for variable-air-volume systems.
 - g. Settings for supply-air, static-pressure controller.
 - h. Other system operating conditions that affect performance.
- E. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outside, supply, return, and exhaust airflows.
 2. Water and steam flow rates.
 3. Duct, outlet, and inlet sizes.
 4. Pipe and valve sizes and locations.
 5. Terminal units.
 6. Balancing stations.
 7. Position of balancing devices.

END OF SECTION 230593

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SECTION 233113 METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Rectangular ducts and fittings.
 - 2. Round ducts and fittings.
 - 3. Sheet metal materials.
 - 4. Sealants and gaskets.
 - 5. Hangers and supports.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Delegated-Design Submittal:
 - 1. Sheet metal thicknesses.
 - 2. Joint and seam construction and sealing.
 - 3. Reinforcement details and spacing.
 - 4. Materials, fabrication, assembly, and spacing of hangers and supports.
 - 5. Design Calculations: Calculations for selecting hangers and supports.
- C. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
 - 2. Structural members to which duct will be attached.
 - 3. Penetrations of smoke barriers and fire-rated construction.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated.
 - 1. Static-Pressure Classes:
 - a. Exhaust Ducts (Negative Pressure): 2-inch wg.
- B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"

1.4 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
 3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

PART 2 - PRODUCTS

2.1 ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Lindab Inc.
 - b. McGill AirFlow LLC.
 - c. SEMCO Incorporated.
 - d. Sheet Metal Connectors, Inc.
 - e. Spiral Manufacturing Co., Inc.
 - B. Transverse Joints: **Flanged.** fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - C. Longitudinal Seams: Spiral duct or butt-welded longitudinal seams. Fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
- C. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

2.4 HANGERS AND SUPPORTS

- A. Hanger Rods: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."
- C. Trapeze and Riser Supports:
 - 1. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Dimensions on drawings indicated inside dimensions of air flow area. Outside duct dimensions must be increased for internally lined ducts to allow for liner thickness.
- D. Install round ducts in maximum practical lengths.
- E. Install ducts with fewest possible joints.
- F. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- G. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- H. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- I. Where ducts pass through exterior walls install link seal between sleeve and duct.

- J. Protect duct interiors from moisture, construction debris and dust, and other foreign materials.

3.2 SEAM AND JOINT SEALING

- A. Seal duct seams and joints for duct static-pressure and leakage classes specified in "Performance Requirements" Article, according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 1-2, "Standard Duct Sealing Requirements," unless otherwise indicated.
- B. Seal Classes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 1-2, "Standard Duct Sealing Requirements."

3.3 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.4 DUCT SCHEDULE

- A. All Ductwork: Aluminum sheet steel.
- B. Elbow Configuration:
 - 1. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."

- a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows."
 - 1) 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
- b. Round Elbows, Standing seam.

3.5 INSPECTION

- A. Inspect ductwork before insulating. Repair or replace damaged duct materials. Seal visible holes. Do not rely on insulation to seal holes.

END OF SECTION 233113

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SECTION 233416 CENTRIFUGAL HVAC FANS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Backward-inclined centrifugal fans.

1.2 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.
- C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA 1.

PART 2 - PRODUCTS

2.1 BACKWARD-INCLINED CENTRIFUGAL FANS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - 1. Acme Engineering & Mfg. Corp.
 - 2. Loren Cook Company.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install centrifugal fans level and plumb.

- B. Install floor-mounting units on concrete bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."
- C. Install units with clearances for service and maintenance.

3.2 CONNECTIONS

- A. Install ducts adjacent to fans to allow service and maintenance.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Verify that shipping, blocking, and bracing are removed.
 - 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 3. Verify that cleaning and adjusting are complete.
 - 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 - 5. Adjust belt tension.
 - 6. Verify lubrication for bearings and other moving parts.
 - 7. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.
 - 8. Remove and replace malfunctioning units and retest as specified above.
- B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

END OF SECTION 233416

SECTION 238239
UNIT HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Class 1, Division 1 ceiling heaters with propeller fans and electric-resistance heating coils.

1.3 SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each product indicated.
- B. Operation and Maintenance Data: For cabinet unit heaters to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 - PRODUCTS

2.1 WALL AND CEILING HEATERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - 1. Chromalox, Inc.; a division of Emerson Electric Company.
 - 2. Markel Products; a division of TPI Corporation.
 - 3. QMark Electric Heating; a division of Marley Engineered Products.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in for electrical connections to verify actual locations before unit heater installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install propeller unit heaters level and plumb.

END OF SECTION 238239

**SECTION 260500
COMMON WORK RESULTS FOR ELECTRICAL**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The Contractor for this work is referred to the Drawings, Bidding Requirements, General Conditions, Special Conditions, Temporary Services and other pertinent Sections of these Specifications. These sections describe work which is a part of this Contract. The following General Provisions amplify and supplement these Sections of Specifications. In cases of conflicting requirements, the stipulations set forth in Division 1 supersede and must be satisfied by the Contractor.

1.2 SUMMARY

- A. Section Includes:
 - 1. Electrical equipment coordination and installation.
 - 2. Common electrical installation requirements.

1.3 COORDINATION

- A. Contractor must read the entire Specifications covering other branches of Work. Contractor is responsible for coordination of his (her) work with work performed by other trades.
- B. Consult all Contract Documents which may affect the location of any equipment or apparatus furnished under this Work and make minor adjustments in location as necessary to secure coordination.
- C. System layout is schematic and exact locations shall be determined by structural and other conditions. This shall not be construed to mean that the design of the system may be arbitrarily changed. The equipment layout is to fit into the building as constructed and to coordinate with equipment included under other Divisions of Work.
- D. Contractor shall contact the Owner's Representative immediately if he (she) notices any discrepancies or omissions in either the Drawings or Specifications, or if there are any questions regarding the meaning or intent thereof.
- E. Submit all changes, other than minor adjustments, to the Engineer/Architect for approval before proceeding with the work.
- F. The Contractor is required to visit the site and fully familiarize himself or herself concerning all conditions affecting the scope of work. Failure to visit the site shall not relieve the Contractor from any responsibility in the performance of his or her Work.
- G. All workmanship to be of the highest quality in accordance with the best practices of the trade by craftsmen/ craftswomen skilled in this particular work.
- H. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 3. To allow right of way for piping and conduit installed at required slope.
 4. To ensure connecting raceways, cables, wireways, cable trays, and busways are clear of obstructions and of the working and access space of other equipment.
- I. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed.
- J. Coordinate sleeve selection and application with selection and application of firestopping.
- K. Where thermostat locations are shown, the electrical contractor shall provide a recessed wall box with conduit to an accessible location. In areas where surface mounted boxes are required, a surface mounted box and conduit to 10' AFF shall be provided (or to the equipment location, whichever is closer). Thermostat installation and the corresponding low voltage thermostat wiring shall be by the mechanical contractor.
- 1.4 PERMITS, INSPECTIONS AND CODES
- A. File all drawings, pay all fees, and obtain permits and certificate of inspection relative to this Work.
- B. Complete installation shall conform with all applicable Federal, State and Local laws, Codes and Ordinances including, but not limited to the latest approved editions of the following:
1. State Building Codes.
 2. Specific Construction Safety Requirements, State Industrial Commission.
 3. National Electrical Code (NFPA-70).
 4. Life Safety Code, NFPA-101.
 5. Occupational Safety and Health Act (OSHA) of 1971 and all amendments thereto.
- C. Nothing contained in the drawings and specifications shall be construed to conflict with these laws, codes, and ordinances and they are hereby included in these specifications.
- 1.5 RECORD DRAWINGS
- A. Record all deviations from the Drawings, on a set of prints and deliver them to the Owner and Owner's Representative upon completion of the work. Special attention to record the location of concealed boxes, service runs shall be made at the point of installation to maintain accuracy.
1. Sufficient dimensional tie points to permanent building features shall be provided for all buried conduits to facilitate future location.
- 1.6 INSPECTION
- A. Contractor shall arrange for and include in his (her) bid, inspection of this work by the appropriate state or local code authority having jurisdiction.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Furnish new, undeteriorated materials of a quality not less than what is specified.
- B. Contractor to furnish and install only those brands of equipment mentioned specifically or accepted as substitutes.

2.2 EQUIPMENT SELECTION AND APPROVAL

- A. The selection of materials and equipment to be furnished shall be governed by the following:
 - 1. Where trade names, brands of manufacturer of equipment or materials are listed in the specification, the exact equipment listed shall be used in the bid or the contractor shall submit the necessary literature to show the alternative product meets the performance characteristics of that which has been called for. Where more than one name is listed, Contractor may select any one of the various brands specified.

2.3 SUBSTITUTIONS

- A. Contractor must base his (her) bid on furnishing the brands of material and equipment listed in the Specifications or their approved equals.
- B. The Contractor is entitled to bid on any other equal or similar brands of material and equipment he (she) may desire to substitute. In order to be considered, the Contractor must request approval to bid the substitution in writing no later than ten (10) days prior to the Bid Date. If permitted the substitutes will be approved by addendum.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Furnish all materials, labor, tools, transportation, incidentals, and appurtenances to complete in every detail and leave in working order all items of work called for herein or shown on the accompanying Drawings.
- B. Include any minor items of work necessary to provide a complete and fully operative electrical system which meets all required codes.
- C. Comply with NECA 1.
- D. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- E. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

- F. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- G. Right of Way: Give to piping systems installed at a required slope.

3.2 PROTECTION AND CLEANING

- A. Protect all fixtures and equipment against damage from leaks or abuse and pay the cost of repair or replacement of fixtures or equipment made necessary by failure to provide suitable safeguards or protection.
- B. After all fixtures and equipment have been set, thoroughly clean all fixtures and equipment with manufacturers recommended cleaning agents, removing stickers and other foreign matter and leave every part in acceptable condition, clean and ready for use.
- C. Repair all dents and scratches in factory prime or finish coats on all electrical equipment. If damage is excessive, replacement may be required.

END OF SECTION 260500

SECTION 260519
LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Building wires and cables rated 600 V and less.
 - 2. Connectors, splices, and terminations rated 600 V and less.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 STANDARDS

- A. Insulation types, ratings and usage shall be in accordance with the National Electrical Code requirements.
- B. All conductors shall be copper
- C. Unless otherwise noted, minimum wire size for lighting and power branch circuits shall be No. 12 AWG. For control and auxiliary systems, the minimum size shall be No. 14 AWG.
- D. Conductors for emergency power and exit wiring shall be a minimum No. 12 AWG.

2.2 CONDUCTORS AND CABLES

- A. All wire and cable shall be UL listed.
- B. Copper Conductors: Comply with NEMA WC 70.
- C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN, XHHW, and SO.
 - 1. THHN-THWN and XHHW: 90°C temperature rating in dry or wet locations.

2.3 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.
- B. All components used at wiring terminations, connections and splices shall be UL listed.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN-THWN single conductors in raceway.
- B. Feeders and Branch Circuits: Type THHN-THWN single conductors in raceway.
- C. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
- D. Class 1 Control Circuits: Type THHN-THWN, in raceway.
- E. Class 2 Control Circuits: Power-limited cable, concealed in building finishes.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- E. Support cables according to Division 26 Sections "Hangers and Supports for Electrical Systems."

- F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."
- G. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- H. Install and make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than un-spliced conductors.
 - 1. Use oxide inhibitor at each splice, tap conductor and equipment termination for aluminum conductors.
- I. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

END OF SECTION 260519

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SECTION 260526
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes methods and materials for grounding systems and equipment.
- B. Grounding system shall be in compliance with all requirements of the National Electrical Code.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field Quality Report
 - 1. Photo Report
 - 2. Dimensioned as-built locations of grounding features

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.
 - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.

5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

2.2 BONDING TERMINATIONS

- A. Grounding Bus: Rectangular bars of annealed copper, 1/4 by 2 inches in cross section, unless otherwise indicated; with insulators.
- B. Intersystem Bonding Termination:
 1. Lay-in connection clamp sized for connected grounding electrode conductor
 2. Minimum of (5) bonding conductor terminals (#14 AWG- #4 AWG)
 3. UV stabilized base and housing with stainless steel mounting hardware
 4. UL listed as an intersystem bonding termination

2.3 CONNECTORS

- A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
 1. Pipe Connectors: Clamp type, sized for pipe.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.4 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; 5/8 inch in diameter by 10 feet or as noted on the Drawings.
- B. Ground Loop: Repair existing ground loop as noted on the drawings.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare tinned copper conductor. Bury at least 24 inches below grade.
- C. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Exothermically welded connections except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.2 EQUIPMENT GROUNDING

- A. A separate equipment grounding conductor, minimum size per NEC, shall be installed in each feeder, branch circuit, and control circuit conduit. Conductor insulation shall be green. DO NOT use conduit as a means for grounding of receptacles or any other such devices.
- B. Conduit system shall be electrically continuous. All enclosures and non-current carrying metals to be grounded. All locknuts must cut through enameled or painted surfaces on enclosures. Where enclosures and non-current carrying metals are isolated from the conduit system, use bonding jumpers with approved clamps.
- C. All new receptacles shall be bonded to a ground conductor using a #12 AEG min. bonding jumper between receptacle terminal and ground conductor. Metal-to-metal contact between the device yoke and the outlet box is not acceptable for either surface mounted boxes or flush type boxes.
- D. Junction boxes and pull boxes shall be bonded by the use of UL listed ground screws or lugs.
- E. Lighting fixtures shall be grounded by the use of a pigtail fastened on bare metal that is free of paint.
- F. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
 1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch grounding bus.
 2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
- G. Metal Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.3 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade, unless otherwise indicated.
 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.

- C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.

- D. Grounding and Bonding for Piping:
 - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 - 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 - 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

- E. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

END OF SECTION 260526

**SECTION 260529
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS**

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Hangers and supports for electrical equipment and systems.

1.2 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.3 QUALITY ASSURANCE

- A. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Aluminum Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. ERICO International Corporation.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut; Tyco International, Ltd.
 - g. Wesanco, Inc.
 - 1. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 2. Channel Dimensions: Selected for applicable load criteria.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

- C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; galvanized.
- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 - 1. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - 2. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
 - 3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
 - 4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 - 5. Toggle Bolts: All-steel springhead type.
 - 6. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as scheduled in NECA 1, where its Table 1 lists maximum spacings less than stated in NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 - 1. Secure raceways and cables to these supports with two-bolt conduit clamps.

- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To New Concrete: Expansion anchor fasteners.
 - 2. To Existing Concrete: Expansion anchor fasteners.
 - 3. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
 - 4. To Light Steel: Sheet metal screws.
 - 5. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 PAINTING

- A. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

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SECTION 260533
RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.3 SUBMITTALS

- A. Product Data: For surface raceways.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

- A. RAC: Rigid Aluminum Conduit

2.2 NONMETALLIC CONDUIT AND TUBING

- A. PVC conduit shall be heavy wall, Schedule 80 ultra-violet resistant, UL listed under Standard 651. Conduit shall be suitable for use with 90°C insulated wire. Conduit fittings and cement shall be of the same manufacturer.
- B. Fittings for Schedule 80 PVC: Match to conduit or tubing type and material.

2.3 BOXES AND ENCLOSURES

- A. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.

2.4 SEALS FOR RACEWAYS

- A. Install seals for all conduits routed to the lower level. Seals shall be installed per the NEC Article 501 – Class 1 Locations.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Apply raceway products as specified below, unless otherwise indicated:
 - 1. Exposed Conduit: Rigid Aluminum Conduit.
 - 2. Underground Conduit: Schedule 80 PVC, direct buried.
 - 3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 - 4. Boxes and Enclosures, Aboveground: NEMA 4X.
- B. Minimum Raceway Size: 3/4-inch trade size Raceway Fittings: Compatible with raceways and suitable for use and location.
 - 1. Rigid Aluminum Conduit: Use threaded rigid aluminum conduit fittings, unless otherwise indicated.

3.2 INSTALLATION

- A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.
- B. Install conduit parallel or perpendicular to building lines (except where run in or below floor slabs). Keep conduit runs as closed to underside of structure as possible.
- C. Exercise necessary precautions to prevent accumulation of water, dirt, or concrete in conduits during execution of electrical work. Conduit in which water or foreign material has been permitted to accumulate shall be thoroughly cleaned or replaced where such accumulations cannot be removed.
- D. Complete raceway installation before starting conductor installation.
- E. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.
- G. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
- H. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 240-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.
- I. Raceways for Optical Fiber and Communications Cable: Install as follows:

1. 3/4-Inch Trade Size and Smaller: Install raceways in maximum lengths of 50 feet.
 2. 1-Inch Trade Size and Larger: Install raceways in maximum lengths of 75 feet.
 3. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless. Separate lengths with pull/junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
- J. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 2. Where otherwise required by NFPA 70.
- K. Covers for all junction boxes containing emergency circuits shall be red and labeled according to "260553 Identification for Electrical Systems."
- L. Flexible Conduit Connections: Use maximum of 72 inches of flexible conduit for recessed and semi-recessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
- M. Set metal floor boxes level and flush with finished floor surface.
- N. Metal boxes cast in concrete shall be designed for concrete installation.
- O. Weather-proof boxes shall be die cast aluminum.
- P. Boxes for exposed work in finished area to be Type FS with threaded hubs and rigid conduit risers.
- Q. Secure rigid conduit at cabinets and boxes using insulated throat type grounding and bonding bushings. Locknuts shall be tightened to cut through painted surfaces.
- R. Where a number of conduits are to be run exposed and parallel, one with another, they shall be grouped and supported by trapeze hangers or unistrut racks tight to the building structure.
- S. Mount junction and pull boxes securely to building structure in a location that meets the requirements of the National Electrical Code for accessibility and work space clearance. Coordinate exact locations of work with other trades. Unless noted otherwise, mounting heights shall be (all measurements are to the top of the box):

Switches, receptacles, or telephone/data shown above a countertop	12" above countertop
Dedicated receptacles (i.e. refrigerator, microwave, etc.)	To suit equipment (see equipment/cabinetry elevation drawings where applicable)
Other interior receptacles	16" AFF
Exterior receptacles	20" above finished grade
Other switches	48" AFF
Telephone/data shown next to a doorway	56" AFF
Other telephone/data	16" AFF

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit (not concrete encased):

1. Install direct buried conduit according to Division 31 requirements for conduit installation.
2. Absent Division 31 requirements or if the following is more stringent, install direct buried conduit as follows:
 - a. Excavate by open cut unless otherwise directed on the Drawings.
 - b. Excavate to the depths necessary to provide at least the NEC required minimum burial depths upon project completion.
 - c. Over-excavate organic, soft, spongy, or otherwise unsuitable soils found at or below the bottom of the trench as needed to meet firm subsoil.
 - d. Trenches in non-pavement and non-structure areas:
 - 1) After installing conduit, backfill and compact utilizing native backfill material. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction leaving a mound on the surface to accommodate future settling.
 - e. Trenches under pavement or structures and within 5'-0" of same:
 - 1) After installing conduit, backfill with compacted aggregate to 95% standard proctor density in 8" maximum lifts. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling.
3. Buried Warning Identification Tape: Provide 6 wide plastic detectable tape with foil backing 12 inches minimum below grade, and 12 inches minimum above conduits.

3.4 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Extend sleeves installed in floors 2 inches above finished floor level.
- D. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway unless sleeve seal is to be installed.
- E. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

END OF SECTION 260533

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SECTION 260553
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Identification for conductors and communication and control cable.
 - 2. Data/Telephone outlet labels
 - 3. Receptacle labels
 - 4. Underground-line warning tape.
 - 5. Warning labels and signs.
 - 6. Instruction signs.
 - 7. Equipment identification labels.
 - 8. Miscellaneous identification products.

1.3 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Comply with 29 CFR 1910.145.

1.4 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

PART 2 - PRODUCTS

2.1 CONDUCTOR, COMMUNICATION, AND CONTROL CABLE IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- B. Marker Tape: Vinyl or vinyl -cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.2 DATA/TELEPHONE OUTLET LABELS

- A. Machine printed paper insert with black filled lettering located under clear label cover on face of plate and durable wire markers on inside of outlet box.

2.3 RECEPTACLE LABELS

- A. Hot stamped or engraved machine printing with black filled lettering under clear label on face of plate and durable wire markers on inside of outlet box.

2.4 UNDERGROUND-LINE WARNING TAPE

- A. Description: Permanent, bright-colored, continuous-printed, polyethylene tape.
 - 1. Not less than 6 inches wide by 4 mils thick.
 - 2. Compounded for permanent direct-burial service.
 - 3. Embedded continuous metallic strip or core.
 - 4. Printed legend shall indicate type of underground line.

2.5 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.
- C. Color Scheme
 - 1. Emergency Warning labels: White background with red letters
 - 2. All other warning labels: Yellow background with black letters
- D. Warning label and sign shall include, but are not limited to, the following legends:
 - 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
 - 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."
 - 3. Service Equipment emergency sources warning: "CAUTION – TWO SOURCES OF SUPPLY- EMERGENCY POWER SOURCE LOCATED IN GENERATOR ROOM 207 ON NORTH SIDE OF BUILDING."
 - 4. Generator Warning Label: "EMERGENCY GENERATOR"
 - 5. Automatic Transfer Switch Warning Label: "EMERGENCY TRANSFER SWITCH"
 - 6. Emergency Panel Warning Label: "EMERGENCY PANEL"
 - 7. Junction boxes containing emergency circuits: "EMERGENCY CIRCUITS- PANEL *insert name*"

8. As noted on drawings.

2.6 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. in. and 1/8 inch thick for larger sizes.
 1. Engraved legend with black letters on white face. (White letters on red background for emergency information)
 2. Punched or drilled for mechanical fasteners.
 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.7 EQUIPMENT IDENTIFICATION LABELS

- A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for fasteners, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch.
- B. Fasteners for Labels: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.
- B. Covers for all junction boxes containing emergency circuits shall be red.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Auxiliary Electrical Systems Conductor and Cable Identification: Use marker tape to identify field-installed alarm, control, signal, sound, intercommunications, voice, and data wiring connections.
 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and cable pull points. Identify by system and circuit designation.
 2. Use system of designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
- B. Data/Telephone Outlet Identification: Use outlet labels to identify each outlet connection. Use system of designation that is uniform and consistent with cable identification. Label face of plate and wire markers inside of box,
- C. Receptacle Identification: Use labels to identify panelboard and circuit number from which served. Label face of plate and wire markers inside of box,

- D. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable. Install underground-line warning tape for both direct-buried cables and cables in raceway.
- E. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply self-adhesive warning labels. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.
 - 1. Equipment with Multiple Power or Control Sources: Apply to door or cover of equipment including, but not limited to, the following:
 - a. Power transfer switches.
 - b. Controls with external control power connections.
 - 2. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.
- F. Instruction Signs:
 - 1. Emergency Operating Instructions: Install instruction signs with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for emergency shut down of generator or remote operation of main switch.
- G. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
 - 1. Labeling Instructions:
 - a. Indoor Equipment: Engraved, laminated acrylic or melamine label, drilled for screw attachment. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where 2 lines of text are required, use labels 2 inches high.
 - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label, drilled for screw attachment.
 - c. Elevated Components: Increase sizes of labels and legend to those appropriate for viewing from the floor.
 - 2. Equipment to Be Labeled:
 - a. Panelboards, electrical cabinets, and enclosures.
 - b. Electrical switchgear and switchboards.
 - c. Transformers.
 - d. Generators
 - e. Disconnect switches.
 - f. Power transfer equipment.
 - g. Contactors.
 - h. Timeclocks
 - i. Fire alarm control panel and annunciators
 - j. Motor control switches including Hand/Off/Auto (H-O-A) and Hand/Off (H-O) switches.

3.2 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach non-adhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.
- F. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded feeder, and branch-circuit conductors.
 - 1. Color shall be factory applied or for sizes larger than No. 10 AWG field applied
 - 2. Colors for 208/120-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - 3. Colors for 480/277-V Circuits:
 - a. Phase A: Brown.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.
 - 4. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- G. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches overall.

END OF SECTION 260553

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SECTION 260574
FAULT CURRENT, OVERCURRENT PROTECTIVE DEVICE COORDINATION, AND ARC FLASH
HAZARD STUDIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes computer-based, fault-current, overcurrent protective device coordination, and arc flash hazard studies.
- B. The fault current study shall be completed prior to ordering equipment to verify the adequacy of the equipment to meet the available fault current conditions.
- C. Protective devices shall be set based on results of the protective device coordination study.
- D. Arc flash warning labels shall be installed on equipment based on the results of the arc flash hazard study.

1.3 SUBMITTALS

- A. Study Reports: Submit (3) hard copies and a digital copy of each report.
 - 1. Coordination-study input data, including completed computer program input data sheets.
 - 2. Study and Equipment Evaluation Reports.
 - 3. Coordination-Study Report.
 - 4. Arc flash hazard report

1.4 QUALITY ASSURANCE

- A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.
- B. Coordination-Study Specialist Qualifications: An entity experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
- C. Comply with IEEE 242 for short-circuit currents and coordination time intervals.
- D. Comply with IEEE 399 for general study procedures.
- E. Comply with IEEE 1584 and NFPA 70E for arc flash hazard calculations

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE PROGRAM REQUIREMENTS

- A. Comply with IEEE 399 and IEEE1584.
- B. Analytical features of fault-current-study computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.

PART 3 - EXECUTION

3.1 POWER SYSTEM DATA

- A. Gather and tabulate the following input data to support coordination study:
 - 1. Product Data for overcurrent protective devices specified in other Division 26 Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
 - 2. Impedance of utility service entrance.
 - 3. Electrical Distribution System Diagram: In hard-copy and electronic-copy formats, showing the following:
 - a. Circuit-breaker and fuse-current ratings and types.
 - b. Relays and associated power and current transformer ratings and ratios.
 - c. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.
 - d. Generator kilovolt amperes, size, voltage, and source impedance.
 - e. Cables: Indicate conduit material, sizes of conductors, conductor material, insulation, and length.
 - f. Busway ampacity and impedance.
 - g. Motor horsepower and code letter designation according to NEMA MG 1.
 - 4. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:
 - a. Special load considerations, including starting inrush currents and frequent starting and stopping.
 - b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
 - c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
 - d. Generator thermal-damage curve.
 - e. Ratings, types, and settings of utility company's overcurrent protective devices.
 - f. Special overcurrent protective device settings or types stipulated by utility company.

- g. Time-current-characteristic curves of devices indicated to be coordinated.
- h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
- i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
- j. Panelboards, switchboards, motor-control center ampacity, and interrupting rating in amperes rms symmetrical.

3.2 FAULT-CURRENT STUDY

- A. Calculate the maximum available short-circuit current in amperes rms symmetrical at circuit-breaker positions of the electrical power distribution system. The calculation shall be for a current immediately after initiation and for a three-phase bolted short circuit at each of the following:
 - 1. Electric utility's supply termination point(s)
 - 2. Main switchboard(s)
 - 3. Generators and transfer switch(es)
 - 4. Distribution panelboard(s)
 - 5. Branch circuit panelboard(s)
 - 6. Local motor disconnect(s)
- B. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.
- C. Calculate momentary and interrupting duties on the basis of maximum available fault current.
- D. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with IEEE 241 and IEEE 242.
 - 1. Transformers:
 - a. ANSI C57.12.22.
 - b. IEEE C57.12.00.
 - c. IEEE C57.96.
 - 2. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.20.1.
 - 3. Low-Voltage Fuses: IEEE C37.46.
- E. Study Report:
 - 1. Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram.
- F. Equipment Evaluation Report:
 - 1. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
 - 2. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.

3. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
4. Equipment evaluation report shall be completed prior to ordering electrical equipment and devices to ensure that the interrupting ratings of the equipment are sufficient for the available fault currents.

3.3 COORDINATION STUDY

- A. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399.
 1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.
- B. Comply with IEEE 241 recommendations for fault currents and time intervals.
- C. Transformer Primary Overcurrent Protective Devices:
 1. Device shall not operate in response to the following:
 - a. Inrush current when first energized.
 - b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
 - c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
 2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.
- D. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.
- E. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:
 1. Tabular Format of Settings Selected for Overcurrent Protective Devices:
 - a. Device tag.
 - b. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.
 - c. Fuse-current rating and type.
 2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:
 - a. Device tag.
 - b. Voltage and current ratio for curves.

- c. Three-phase and single-phase damage points for each transformer.
 - d. No damage, melting, and clearing curves for fuses.
 - e. Cable damage curves.
 - f. Transformer inrush points.
 - g. Maximum fault-current cutoff point.
- F. Completed data sheets for setting of overcurrent protective devices.

3.4 ARC FLASH HAZARD ANALYSIS

- A. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2004, Annex D.
- B. The flash protection boundary and the incident energy shall be calculated at all equipment locations shown on the one-line diagram.
- C. Safe working distances shall be based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm².
- D. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations
- E. The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum and will assume a minimum motor contribution (all motors off). Conversely, the maximum calculation will assume a maximum contribution from the utility and will assume the maximum amount of motors to be operating. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable.
- F. The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators should be decremented as follows:
 - 1. Fault contribution from induction motors should not be considered beyond 3-5 cycles.
 - 2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g. contributions from permanent magnet generators will typically decay from 10 per unit to 3 per unit after 10 cycles).
- G. For each equipment location with a separately enclosed main device (where there is adequate separation between the line side terminals of the main protective device and the work location), calculations for incident energy and flash protection boundary shall include both the line and load side of the main breaker.
- H. When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.

- I. Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.
- J. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584-2002 section B.1.2. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.
- K. Prepare a written report indicating the following results of the incident energy and flash protection boundary calculations including:
 - 1. Arcing fault magnitude
 - 2. Protective device clearing time
 - 3. Duration of arc
 - 4. Arc flash boundary
 - 5. Working distance
 - 6. Incident energy
 - 7. Hazard Risk Category
 - 8. Recommendations for arc flash energy reduction
 - 9. Tabular Format of Settings Selected for Overcurrent Protective Devices:
- L. Arc Flash Warning Labels
 - 1. The contractor of the Arc Flash Hazard Analysis shall provide and install a 4 in. x 6 in. thermal transfer type label of high adhesion polyester for each work location analyzed. Label shall be waterproof and UV-resistant.
 - 2. All labels will be based on recommended overcurrent device settings and will be provided after the results of the analysis have been presented to the owner and after any system changes, upgrades or modifications have been incorporated in the system.
 - 3. The label shall include the following information, at a minimum:
 - a. Location designation
 - b. Nominal system voltage
 - c. Arc Flash boundary
 - d. Available incident energy and the corresponding working distance
 - e. Engineering report number, revision number and issue date.
 - 4. Labels shall be machine printed, with no field markings.
 - 5. One arc flash label shall be provided for each piece of equipment shown on the one-line diagram.

END OF SECTION 260573

SECTION 262200 LOW VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:
 - 1. Distribution transformers.

1.3 SUBMITTALS

- A. Product Data: For each product indicated.
- B. Shop Drawings: Indicate dimensions and weights.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain each transformer type through one source from a single manufacturer.
- B. Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

1.5 COORDINATION

- A. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Products.

2. General Electric Company.
3. Square D; Schneider Electric.

2.2 GENERAL TRANSFORMER REQUIREMENTS

- A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.
- B. Cores: Grain-oriented, non-aging silicon steel.
- C. Coils: Continuous windings without splices except for taps.
 1. Internal Coil Connections: Brazed or pressure type.
 2. Coil Material: Aluminum

2.3 DISTRIBUTION TRANSFORMERS

- A. Comply with NEMA ST 20 and list and label as complying with UL 1561.
- B. Cores: One leg per phase.
- C. Enclosure: Ventilated, NEMA 4X.
 1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.
- D. Taps for Transformers Smaller Than 3 kVA: None.
- E. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity
- F. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.
- G. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 150 deg C rise above 40 deg C ambient temperature.
- H. Energy Efficiency for Transformers Rated 15 kVA and Larger:
 1. Complying with NEMA TP 1, Class 1 efficiency levels.
 2. Tested according to NEMA TP 2.

2.4 SOURCE QUALITY CONTROL

- A. Test and inspect transformers according to IEEE C57.12.91.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Upon delivery to the project site, inspect transformer(s) in a clean and dry location for damage upon receipt. Note and take photos of any loose or broken connections, damaged or displaced parts, cracked insulators, dirt or foreign material and evidence of free water or moisture. Perform corrective measures as necessary after consulting with the owner and engineer.
- B. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.
- C. Inspect transformer grounding for compliance with contract drawings and specifications.
- D. Inspect anchorage, alignment, grounding and clearances.

3.2 CONNECTIONS

- A. Comply with NEC 450.10(A), and not installed on or over any vented portion of the enclosure.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 TESTING

- A. Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method.
- B. Perform specific inspections and mechanical tests as recommended by manufacturer.
- C. Verify proper secondary voltage phase-to-phase and phase-to-neutral after energization and prior to loading.
- D. Perform resistance measurements through all bolted connections with low-resistance ohmmeter, if applicable.
- E. Perform an insulation-resistance test on each arrestor and phase terminal-to-ground.

END OF SECTION 262200

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SECTION 262416 PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes:
 - 1. Distribution panelboards.
 - 2. Lighting and appliance branch-circuit panelboards.

1.3 SUBMITTALS

- A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 5. Retain first subparagraph below if series rating of overcurrent protective devices is used.
 - 6. Include evidence of NRTL listing for series rating of installed devices.
 - 7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 8. Include wiring diagrams for power, signal, and control wiring.
 - 9. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency and marked for intended location and application.
- C. Comply with NEMA PB 1.

- D. Comply with NFPA 70.

1.5 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Enclosures: Flush- and surface-mounted cabinets.
 - 1. Rated for environmental conditions at installed location.
 - a. All: NEMA 250, Type 4.
 - 2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
 - 3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
 - 4. Finishes:
 - a. Panels and Trim: Steel and galvanized steel factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b. Back Boxes: Galvanized steel.
 - 5. Directory Card: Provide typewritten circuit directory card inside panelboard door, mounted in transparent card holder.
- B. Incoming Mains Location: Top and bottom.
- C. Phase, Neutral, and Ground Buses:
 - 1. Hard-drawn copper, 98 percent conductivity.
 - 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
- D. Conductor Connectors: Suitable for use with conductor material and sizes.
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
 - 2. Main and Neutral Lugs: Mechanical type.
 - 3. Ground Lugs and Bus Configured Terminators: Mechanical type.
 - 4. Feed-Through Lugs (When required): Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

5. Subfeed (Double) Lugs (When required): Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
- E. Service Equipment Label (When applicable): NRTL labeled for use as service equipment for panelboards with one or more main service disconnecting and overcurrent protective devices.
- F. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- G. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.2 DISTRIBUTION PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Square D; a brand of Schneider Electric.
- B. Panelboards: NEMA PB 1, power and feeder distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
- D. Mains: Circuit breaker or main lugs only as noted on Drawings.
- E. Branch Overcurrent Protective Devices: For Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
- F. Branch Overcurrent Protective Devices: For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Square D; a brand of Schneider Electric.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: Circuit breaker or main lugs only as noted on Drawings
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Square D; a brand of Schneider Electric.
- B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 2. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
 3. AFCI Circuit Breakers: Single pole configurations for 15A and 20A circuits per NFPA 70 Article. 210.12.
 4. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 - c. Shunt Trip (When indicated): 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
 - d. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.
 - e. Handle Padlocking Device (When indicated): Fixed attachment, for locking circuit-breaker handle in on or off position.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Receive, inspect, handle, store and install panelboards and accessories according to NEMA PB 1.1.
- B. Mount top of trim 90 inches Insert height above finished floor unless otherwise required keep the distance from the floor to top most circuit breaker within the height limitation contained in the NEC.
- C. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

- D. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.
- E. Install filler plates in unused spaces.
- F. Arrange conductors in gutters into groups and bundle and wrap with wire ties.
- G. Comply with NECA 1.

3.2 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads and incorporating Owner's final room designations. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

END OF SECTION 262416

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SECTION 262726 WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
 - 2. Twist-locking receptacles.
 - 3. Snap switches.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

1.5 COORDINATION

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
 - 1. Cord and Plug Sets: Match equipment requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:

1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
3. Leviton Mfg. Company Inc. (Leviton).
4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2.2 GFCI RECEPTACLES

- A. General Description: Straight blade, feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.

- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; GF20.
 - b. Pass & Seymour; 2084.

2.3 TWIST-LOCKING RECEPTACLES

- A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; L520R.
 - b. Hubbell; HBL2310.
 - c. Leviton; 2310.
 - d. Pass & Seymour; L520-R.

2.4 SNAP SWITCHES

- A. Comply with NEMA WD 1 and UL 20.

- B. Switches, 120/277 V, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

- a. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
- b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
- c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
- d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).

2.5 WALL PLATES

- A. Single and combination types to match corresponding wiring devices.
 1. Plate-Securing Screws: Metal with head color to match plate finish.
 2. Material for Finished Spaces: Steel with white baked enamel, suitable for field painting
 3. Material for Unfinished Spaces: Galvanized steel.
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum with lockable cover.

2.6 FINISHES

- A. Color: Coordinate with Architect and Owner
 1. Wiring Devices Connected to Normal Power System: White, unless otherwise indicated or required by NFPA 70 or device listing.
 2. Wiring Devices Connected to Emergency Power System: Red.

PART 3 - EXECUTION

3.1 RECEPTACLE APPLICATION

- A. Where required by the most recent version of the NEC and as indicated on the plan sheets: GFCI receptacles

3.2 INSTALLATION

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- B. Conductors:
 1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.

3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.

C. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

D. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.

E. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

F. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multi-gang wall plates.

G. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

END OF SECTION 262726

SECTION 262816 ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following individually mounted, enclosed switches and circuit breakers:
 - 1. Fusible switches.
 - 2. Nonfusible switches.
 - 3. Enclosures.

1.3 SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current rating.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

1.5 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 FUSIBLE AND NONFUSIBLE SWITCHES

- A. Manufacturers:
 - 1. Eaton Corporation; Cutler-Hammer Products.
 - 2. General Electric Co.; Electrical Distribution & Control Division.
 - 3. Square D/Group Schneider.
- B. Fusible Switch, 600 A and Smaller: NEMA KS 1, 480/277V Type Heavy Duty three pole, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept two padlocks interlocked with cover in closed position.
- C. Non-fusible Switch, 600 A and Smaller: NEMA KS 1, 480/277V Type Heavy Duty three pole lockable handle with capability to accept two padlocks interlocked with cover in closed position.
- D. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; and labeled for copper and aluminum neutral conductors.

2.3 ENCLOSURES

- A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.
 - 1. All Locations: NEMA 4X

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.
- B. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated.

- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

3.2 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs and enclosure nameplates as specified in Division 26 Section "Identification for Electrical Systems."

3.3 CLEANING

- A. On completion of installation, vacuum dirt and debris from interiors; do not use compressed air to assist in cleaning.
- B. Inspect exposed surfaces and repair damaged finishes.

END OF SECTION 262816

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SECTION 262923
VARIABLE FREQUENCY MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Scope: Provide labor, material, related services, and supervision required, including, but not limited to, mounting, and installation for adjustable or Variable Frequency Drives (VFDs) as required for the complete performance of the work, and as shown on the Drawings and as herein specified.
- B. Section Includes: The work specified in this Section includes, but shall not be limited to, Variable Frequency Drives (VFDs) rated 600 V and less for the speed control of three-phase squirrel-cage induction motors, and synchronous motors as specified herein and where shown on the associated schedules and the Drawings.
- C. Related Sections: Related sections include, but shall not be limited to, the following:
 - 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
 - 2. Applicable general requirements for electrical Work specified within Division 26 Specification Sections, apply to this Section.
 - 3. Refer to the specifications sections for the VFD driven equipment for additional requirements.
 - 4. [Section 26 24 19 – Motor Control Centers, for VFDs installed in motor-control centers.]
- D. Enclosures: NEMA 4X
- E. Integral disconnect with lock-out tag-out capabilities.
- F. Voltage test station: Safeside model P-S11S21-M3RX

1.2 REFERENCES

- A. General, Publications: The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only. The edition/revision of the referenced publications shall be the latest date as of the date of the Contract Documents, unless otherwise specified.
 - 1. ANSI®/NFPA® 70 – National Electrical Code® (NEC®)
 - 2. CSA® C22.2 No. 14-M91 – Industrial Control Equipment
 - 3. IEC 61000 – Electromagnetic Compatibility
 - 4. NEMA
 - a. NEMA 250 – Enclosures for Electrical Equipment
 - b. NEMA ICS7 – Industrial Control and Systems Adjustable Speed Drives
 - c. NEMA ICS 7.1 – Safety Standards for Construction and Guide for Selection Installation and Operation of Adjustable Speed Drives
 - 5. UL
 - a. UL® 50 – Enclosures for Electrical Equipment
 - b. UL 98 – Disconnect Switches
 - c. UL 507 – Electric Fans
 - d. UL 508 – Industrial Control Equipment

- e. UL 508C or UL 61800-5-1 – Power Conversion Equipment
 - f. UL 991 – Safety Tests for Safety Related Controls Employing Solid State Devices
6. OSHA® 1910.95 – AC Drive Controller Acoustical Noise
 7. IBC® – International Building Code®
 8. ASCE/SEI 7® – Seismic Performance Requirements
 9. ICC ES AC156 – Shake-Table Test Acceptance Criteria
 10. IEEE519 – “IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems”
- B. General, Definitions: Unless specifically defined within the Contract Documents, the words or acronyms contained within this specification shall be as defined by the references listed within this specification, the Contract Documents, or, if not listed by either, by common industry practice.

1.3 SUBMITTALS

- A. General: Submit sufficient information to determine compliance with the Contract Documents. Identify submittal data with the specific equipment tags and/or service descriptions to which they pertain. Submittal data shall be clearly marked to identify the specific model numbers, options, and features of equipment and Work proposed.
1. Refer to [Section 01 33 00 - Submittal Procedures] [Section 01300 - Submittals].
 2. All deviations from the Contract Documents shall be indicated within a submittal. Each deviation shall reference the corresponding drawing or specification number, show the contract document requirement text and/or illustration, and shall be accompanied by a detailed written justification for the deviation.
- B. Product Data: Submit product data specific to each type and rating of VFD proposed to include the following:
1. Manufacturer, supplier, and proposal specific contact information.
 2. Manufacturer's catalog data indicating model numbers, equipment specifications and construction features including all furnished options, and accessories.
 3. VFD assembly rated input KVA and output KVA, percent efficiency, operating characteristics, and electrical characteristics.
 4. Maximum Btu heat release data and ambient cooling requirements.
 5. Enclosure type, NEMA 1/12 rating, material and finishes.
 6. Certification of UL conformity
 7. Electronic 2D dimensional drawing and 3D model CAD files for standard units shall be provided upon request if not available from the manufacturer's website.
- C. Shop Drawings: Submit shop drawings for each product and accessory required. Include information not fully detailed in manufacturer's standard product data. Shop drawings shall include, but not be limited to the following:
1. Equipment assembly. Indicate dimensions, shipping section dimensions, weights, foundation requirements, required clearances, location and size of each field connection, and mounting and installation instructions.
 2. Include elementary and interconnection diagrams for power, signal, control, and communications wiring. Diagrams shall provide the minimum detail as shown for drawings in the appendix of NFPA

79. All field terminals shall be identified and updated later within the O&M data to include actual field connection information. Drawings shall not be typical, but be provided for each VFD furnished.

- D. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Required working clearances and required area above and around VFDs.
 - 2. Show VFD layout and relationships between electrical components and adjacent structural and mechanical elements.
 - 3. Show support locations, type of support, and weight on each support.
 - 4. Indicate field measurements.
- E. Harmonic Analysis Report: Provide project-specific calculations and manufacturer's statement of compliance with IEEE 519, latest revision. Owner shall supply detailed electrical power system characteristics to support harmonic calculations.
- F. Operation & Maintenance (O&M) Manuals: Submit installation, operation and maintenance data to be included within operation and maintenance manuals. O&M data shall include but not be limited to the following:
 - 1. O&M manuals shall be submitted prior to arrival of equipment on site.
 - 2. Manufacturer, supplier, support, and repair center specific contact information.
 - 3. Manufacturer's standard operation and maintenance data assembled for each size and type of equipment furnished.
 - 4. All construction, installation, schematic, and wiring diagrams updated to an as-installed and commissioned state.
 - 5. All configured settings/parameters for adjustable components updated to an as-installed and commissioned state if different from the factory default. Electronic copies of configuration files shall be provided, on media acceptable to the Owner (e.g. CD, USB stick, etc.), where these configurations can be saved as an electronic file for future upload into replaced or repaired components.
 - 6. List of furnished and recommended spare parts.
 - 7. Statement of standard Warranty.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer shall be a firm engaged in the manufacture of VFDs of types and sizes required, and whose products have been in satisfactory use in similar service for a minimum of five years.
 - 1. The VFD manufacturer shall have a valid ISO 9001 certification and an applicable quality assurance system.
 - 2. The VFD manufacturer shall have the Environment Certification ISO 14001 for EcoDesign.
- B. Commissioning and Training: VFDs shall be inspected and commissioned by a factory trained representative of the VFD manufacturer. VFD operation and maintenance training shall be conducted by a factory-trained representative of the VFD manufacturer trained in the installation, operation, and maintenance of the VFD.
- C. Regulatory Requirements: Comply with applicable requirements of the laws, codes, ordinances, and regulations of Federal, State, and local authorities having jurisdiction. Obtain necessary approvals from such authorities.

1. Without limiting the generality of other requirements of this Section, all work specified herein shall conform to or exceed the applicable requirements of the following standards; provided, that wherever the provisions of said publications are in conflict with the requirements specified herein, the more stringent requirements shall apply:
 - a. ANSI/NFPA 70: National Electrical Code
 - b. EN61800-5: Electronic equipment for use in power installation
 - c. CSA C22.2 No. 14-M91: Industrial Control Equipment
 - d. IEC 68 Part 2-3: Basis Environmental Testing Procedures Part 2: Tests – Test Ca: Damp Heat
 - e. IEC 146.1: Semiconductor Converters – General Requirements and Line Commutated Converters Part 1-1: - Specifications of Basic Requirements
 - f. IEC 664: Insulation Co-ordination for Equipment within Low-Voltage Systems
 - g. IEC 447: Man-Machine Interface Actuating Principles
 - h. IEC 439 Part 1: Low Voltage Switch gear and Control gear Components
 - i. IEC 364: Electrical Installation of Buildings
 - j. IEC 204/NFPA 79: Electrical Equipment of Industrial Machines/Industrial Machinery
 - k. IEC 106: Guide for Specifying Environmental Conditions for Equipment Performance Rating
 - l. IEC 529: Degrees of protection provided by enclosure
 - m. IEC 1000: Electromagnetic Compatibility
 - n. IEC 1800: Adjustable speed Electrical power drive systems
 - o. IEC 721: Classification of Environmental Conditions
 - p. IEC 255-8: Overload Relays
 - q. IEC 801-2,-3,-4,-5: Immunity Tests
 - r. NEMA ICS Part 4: Overload Relays
 - s. NEMA ICS7: Industrial Control and Systems Variable Speed Drives
 - t. UL 508C, UL 61800-5-1: UL Standard for Safety Power Conversion Equipment
 - D. Single Source Responsibility: Obtain VFDs and required accessories from a single source with resources to produce products of consistent quality in appearance and physical properties without delaying the work. Any materials which are not produced by the manufacturer shall be acceptable to and approved by the manufacturer.
 - E. All VFDs shall be functionally tested by the manufacturer, and configured and tested for the application by the Control and SCADA System Supplier.
- 1.5 DELIVERY, STORAGE, AND HANDLING
- A. Prior to delivery to the Project site, ensure that suitable storage space is available to store materials in a well ventilated area protected from weather, moisture, soiling, extreme temperatures, humidity, and corrosive atmospheres. Materials shall be protected during delivery and storage and shall not exceed the manufacturer stated storage requirements.
 - B. Deliver materials to the Project site in supplier's or manufacturer's original wrappings and containers, labeled with supplier's or manufacturer's name, material or product brand name, and lot number, if any.
 - C. Inspect and report any concealed damage or violation of delivery storage, and handling requirements to the Engineer.
- 1.6 WARRANTY
- A. General: Refer to Section 017700 - Closeout Procedures.
 - B. Additional Owner Rights: The warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

- C. Warranty shall be at least one year beginning with the date of substantial completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Products: VFDs specified herein shall be the product of a single manufacturer. Products and manufacturers specified are to establish a standard of quality for design, function, materials, and appearance. Products shall be modified as necessary by the manufacturer for compliance with requirements. Provide the following specified product and manufacturer without exception, unless approved as a substitute by addendum to the Contract Documents prior to the bid date:
 - 1. Toshiba
- B. The VFD manufacturer shall provide for repair and service of the drive components with worldwide support. The VFD manufacturer shall provide remote diagnostic services in conjunction with the VFD's user interface to provide QR code, or equivalent, linked access to worldwide web based enhanced diagnostics, documentation, and customer service.

2.2 SYSTEM REQUIREMENTS

- A. Variable Frequency Drives (VFDs) shall provide for the starting and speed control of standard IEC or NEMA B, design AC inverter duty asynchronous motors and synchronous motors with permanent magnets by the adjustment of output voltage and frequency.
- B. The VFD manufacturer shall design the device with more than 70% of recyclability rate.
- C. The VFD Manufacturer shall design the device according to the IEC 62635 guidelines to reduce the carbon footprint. The materials used in the VFD shall be recyclable, non-toxic and flame retardant. The VFD manufacturer shall provide the carbon foot print of the devices.
- D. The VFDs shall be built to comply with the UL standard and shall be marked in accordance with to UL 508 or UL 61800-5-1.
- E. The VFD shall be compliant with the "Green" Premium label (REACH, RoHS-2, EOL, and PEP).

2.3 Variable Frequency Drives

- A. The VFD shall be a digitally controlled drive, using Pulse Width Modulation (PWM).
- B. Environment and Construction
 - 1. The VFD shall be rated to withstand the following environmental conditions while able to give a 100% output current continuously. Where derating is necessary to meet on site environmental conditions, the manufacturer shall submit the VFDs de-rated performance. The derating factor shall be specified so that neither the lifetime of the VFD nor the unit's performance, overload capability included, nor the reliability of the VFD shall suffer.
 - a. Storage Temperature: -40°C to 70°C,
 - b. Operating Temperature for UL Type 1 VFDs: -15°C to 50°C without derating, up to 60°C with derating of power stage (UL Type 1)
 - c. Operating Temperature for enclosed VFDs: 0°C to 40°C without derating, down to -10°C with enclosure heater, up to 55°C with derating of power stage
 - d. Relative Humidity: ≤95% relative humidity without condensation per IEC 60068-2-3

- e. Operating Altitude: $\leq 1000\text{m}$ without derating, up to 4800m with derating.
 - f. Corrosion Protection Level: Class 3C3 according to IEC 60721-3-3 for cooling air and chemical gases
 - g. Biological Protection Level: Class 3B1 according IEC 60721-3-3
 - h. Dust Protection Level: Class 3S3 according to IEC 60721-3-3
 - i. Vibration and Shock Protection Level: Class 3M3 according to IEC 60721-3-3
2. The seismic rating of the enclosed VFD shall meet the site-specific requirements of the installed location as determined by the IBC, NFPA 5000, ASCE/SEI 7 and local governing codes.
 - a. Seismic code compliance testing shall be in accordance with ICC ES AC156 Shake-Table Test Acceptance Criteria protocol with an importance factor of at least 1.5.
 - b. All anchorage, lateral bracing, and mounting guidelines shall be specified with drive instruction documentation and/or markings. The VFD shall exhibit a seismic qualification label stating compliance.
 - c. A certificate of compliance shall be provided to the seismic provisions of the IBC (International Building Code) and ASCE/SEI 7 (American Society of Civil Engineers/Structural Engineering Institute Seismic Performance Requirements).
 3. The VFDs shall have an integral enclosure that shall protect from ingress of dirt and water in accordance with UL Type 12, or as shown on drawings. The user interface terminal shall be rated UL Type 12, mounted on front face of enclosure, and accessible for programming and controls with the main door closed.
 4. VFD enclosures shall be front cabinet accessible and constructed in conformance with IEC 60439-1. Conduit entry shall be bottom entry as standard to allow for top mounted cooling components. The VFD enclosure shall have a forced air and heat sink cooling system that does not require liquid or air condition cooling components for ambient temperatures within the drives stated ambient temperature operating range.

C. Application Requirements

1. The VFD shall be able to control motors using the following motor control types in accordance with the applications needs and energy savings: Volts per hertz VC Standard.
2. The VFD shall provide a Real Time Clock management with battery backup.
3. The VFD shall be capable of automatic tuning of motor parameters through measurement of the motor without rotation, and without the need to disconnect the load from the motor.
4. The VFD shall provide functionality adjustable within the drive parameters to reduce voltage surges on motor cables.
5. The Contractor shall provide AC chokes and filters to fit installation and motor requirements per the following guidelines:
 - a. Voltage reflection suppression for motors compliant to IEC60034-25 or NEMA MG1 Part 31
 - 1) Unshielded motor cable length up to 500 feet (150 meters) shall be managed with the VFD functionality
 - 2) Unshielded motor cable length up to 1000 feet (300 meters) an AC choke shall be required
 - 3) Unshielded motor cable length up to 1640 feet (500 meters) a dV/dt filter shall be required
 - 4) Unshielded motor cable length up to 3280 feet (1000 meters) a Sinus filter shall be required
 - b. Voltage reflection suppression with motors not compliant to IEC60034-25 or NEMA MG1 Part 31
 - 1) Unshielded motor cable length up to 50 meters a dV/dt filter shall be required
 - 2) Unshielded motor cable length up to 1000 meters a Sinus filter shall be required

D. Performance Requirements

1. The VFD shall be rated for the nominal input voltage specified or shown on the drawings. The VFD shall have an input voltage tolerance within the following range of the corresponding nominal input voltage:
 - a. Standard product, three phases power supply:
 - 1) 200V -15% 240V +10%, three-phase up to 100 HP / 75 KW
 - 2) 380V -15% 480V +10%, three-phase up to 250 HP / 160 KW
 - 3) 500 to 690V -15% / +10%, three-phase up to 250 HP / 160 KW
 - b. Enclosed Drive System, three phases power supply :
 - 1) 200V -15% 240V +10%, three-phase up to 60 HP / 45 KW
 - 2) 380V -15% 480V +10%, three-phase up to 1,100 HP / 800 KW
 - 3) 500 to 600V -15% / +10%, three-phase up to 1,500 HP / 1,500 KW
2. The VFD shall meet the following minimum operating requirements:
 - a. Rated Frequency: 50 Hz -5% to 60 Hz + 5%, [The VFD shall operate from 40 to 72 Hz when powered by standby or emergency generators]
 - b. Displacement Power Factor: ≥ 0.97
 - c. Efficiency:
 - 1) $>98\%$ at nominal load for VFD (IP 21 / UL Type 1)
 - 2) $>97.5\%$ at nominal load for enclosed VFD systems.
 - 3) $>96\%$ at nominal load for low harmonic VFD(IP 21 / UL Type 1)
 - 4) $>95.5\%$ at nominal load for low harmonic enclosed VFD systems.
 - d. Overload Capability: Normal duty at 110% nominal current for 1 min
 - e. Harmonics Mitigation: 5% at VFD input terminals at 80-100% load
 - f. Surge immunity according to IEC/EN 61000-4-5 Level 3
3. The VFD shall provide a speed range in the motor quadrant 1:100 in sensor less vector control and in the generator quadrant 1:50 in sensor less vector control.
4. The VFD shall provide an over torque capability better than 110% of the rated motor torque for normal duty applications during 60s, every 10 minutes.
5. The VFD shall provide a speed accuracy $\pm 10\%$ of the nominal slip of the motor in sensor less vector control
6. The VFD shall provide a torque control accuracy $\pm 15\%$ in sensor less vector control for AC motors

E. Protection

1. The VFD shall be UL 508 or UL61800-5-1 listed for use on distribution systems.
2. The VFD shall have coordinated short circuit rating designed to UL 508C or UL 61800-5-1 and NEMA ICS 7.1 Short Circuit Rating: 100 kAIC
3. Micro-short voltage sag immunity per SEMI F47.
4. Upon power-up the VFD shall automatically test for valid operation of memory, option module, loss of analogue reference input, loss of communication, DC to DC power supply, control power and the pre-charge circuit.
 5. The VFD shall be protected against short circuits, between output phases and ground and the logic and analogue outputs.
 6. The VFD shall have a selectable ride through function that will allow the logic to maintain control for a minimum of one second without tripping.
 7. The deceleration mode of the VFD shall be programmable for normal and trip conditions. The stop modes shall include freewheel stop, fast stop.
 8. Upon loss of the analog process follower reference signal, the VFD shall trip and/or operate at a user-defined speed set by a software programmed speed settings or last speed.
 9. The VFD shall integrate a protection against IGBT and heat sink over temperature.

10. The VFD shall have solid state thermal protection that is UL Listed and meets UL 508C as a Class 10 overload protection and meets IEC 947.
11. The VFD shall have a motor thermal memory retention function per UL requirements.
12. The VFD shall be able to protect the motor when temperature probes are connected.
13. The VFD shall be able to limit the motor surge ($I dv/dt$) at twice the DC bus voltage
14. The VFD shall provide IGBT protection
 - a. IGBT overcurrent protection
 - b. IGBT check up sequence
 - c. IGBT check up sequence before PWM enable sequence
 - d. IGBT over-heat protection
15. The VFD shall provide VFD Current protection
 - a. Phase short circuit protection
 - b. Ground protection
 - c. Over-current protection
16. The VFD shall provide VFD Voltage error protection
 - a. Mains over-voltage protection
 - b. Mains under-voltage protection
 - c. DC Bus over-voltage protection
 - d. DC Bus pre-charge protection
17. The VFD shall provide VFD Thermal protection
 - a. VFD over-temperature protection
 - b. FAN management
 - c. Switching Frequency management
18. The VFD shall provide internal error detection.
19. The VFD shall provide Motor protection functions
 - a. Motor output phase detection
 - b. Motor surge voltage
 - c. Motor over load detection
 - d. Motor stall protection
20. The VFD shall provide Application protection functions
 - a. Catch on fly function
 - b. Mains input phase lost protection
 - c. Motor over-speed input protection
 - d. Current limitation
 - e. Power limitation
 - f. Reverse inhibition
 - g. Under-load protection
 - h. Over-load protection
 - i. External error management
 - j. Loss of follower signal
 - k. Thermal Sensor management
 - l. PID Feedback
 - m. Customer defined input

F. Indicators

1. The VFD shall display a signal by LED near the connection point of the device when a hazardous voltage is present.
2. The VFD shall have 3 LEDs for local diagnostics.
3. The VFD shall have 3 dual color LEDs for embedded communication status.
4. The VFD shall have 4 dual color LEDs for optional communication status

G. User Interface

1. A detachable UL Type 12/IP65 rated bi-color backlit graphical user interface terminal with keypad and capacitive wheel shall be provided for monitoring, annunciation, and configuration. The graphical display shall change to a red backlit color when an alarm occurs. The door mounting for the user interface shall be done with a 22 mm hole.
- 2.
3. A "Simply Start" menu for fast and easy commissioning shall be provided and parameter setting shall be easily accessible and user friendly with plain text messaging and actual setting range.
4. The keypad shall be capable of providing password protection.
5. The user interface shall be capable of saving and downloading configurations of the VFDs, as well as porting them to other VFDs.
6. The user interface shall offer a Mini-USB port for mass storage or PC device connection.
7. The mechanical mounting for the user interface on the cabinet shall be done with a 22 mm hole.
8. The VFD shall have self-diagnostic capabilities to display alarms, errors, and warnings as they occur and be able to store at least 15 last messages into the memory. These shall be accessible by PC maintenance tools or web server with flash record for data logging expertise
9. The user interface shall be identical throughout the power range to avoid confusion amongst the users and need for training in several different units.
The displayed messages shall be in plain text English,

H. Control Interface:

1. VFD shall interface with automation systems to monitor, control, display, and record data for use in processing reports. VFD settings shall be retained within VFD's nonvolatile memory.
2. The speed command and reference may come from different control sources:
 - a. I/O terminals
 - b. Communication network
 - c. Web server
 - d. Remote graphic display terminal
3. A minimum of the following standard inputs / outputs shall be provided to interface with control systems and instrumentation:
 - a. Analog Inputs: [3] programmable 0(4)-20 mA or 0-10 vdc
 - 1) 2 analog inputs shall also be programmable for temperature sensors (PTC, PT100, PT1000, KTY84)
 - b. Analog Outputs: 2 programmable 0(4)-20 mA or 0-10 vdc
 - c. Discrete Inputs: [6] programmable isolated logic inputs as either sink or source
 - 1) 2 discrete inputs shall also be programmable as 0-30 kHz pulse inputs
 - 2) 2 discrete inputs shall be dedicated Safe Torque Off safety function in accordance with IEC/EN 61508-1 SIL3
 - d. Discrete Outputs: [3] programmable relay contacts
 - 1) 1 discrete output shall be dedicated to product watchdog logic
4. Programmable analog inputs shall be able to be assigned the following parameters:
 - a. Speed reference
 - b. Summing reference
 - c. Subtracting reference
 - d. Multiplying reference
 - e. Torque reference
 - f. Torque limitation
 - g. PID feedback
 - h. Manual PID reference
 - i. PID speed reference

- j. Forced local reference
- 5. Programmable analog outputs shall be able to be assigned the following parameters:
 - a. Motor current
 - b. Motor frequency
 - c. Motor torque (signed or unsigned)
 - d. Motor power
 - e. Motor voltage
 - f. Output frequency (signed or unsigned)
 - g. PID error
 - h. PID feedback
 - i. PID output
 - j. PID reference
 - k. Ramp output
 - l. Signed ramp
 - m. Drive thermal state
 - n. Motor thermal state
 - o. Pressure sensor
 - p. Flow sensor
- 6. Programmable discrete inputs shall be able to be assigned the following parameters:
 - a. Run
 - b. Forward
 - c. Reverse
 - d. Jog
 - e. Preset speeds
 - f. Reference switching
 - g. Ramp switching
 - h. Error reset
 - i. Error inhibition
 - j. Product reset
 - k. PID regulation mode (auto)
 - l. PID speed regulation mode (manual)
 - m. PID integral reset
 - n. Preset PID reference
 - o. Sleep/wake-up
 - p. Activate sleep mode by flow detection
 - q. Analogue torque limitation activation
 - r. Torque reference sign
 - s. Command switching
 - t. Parameter sets selection
 - u. Fast stop
 - v. DC injection
 - w. Freewheel stop
 - x. + speed
 - y. - speed
 - z. External error
 - aa. Pre Fluxing
 - bb. Forced local control
 - cc. Current limitation activation
 - dd. Output contactor feedback
 - ee. Reference memorization
 - ff. Auto-tuning
 - gg. Forced operation
 - hh. Under load detection
 - ii. Overload detection
 - jj. Limiting low speed operating time
 - kk. Switching frequency, noise reduction

- ll. Drive lock assignment
 - mm. Outlet pressure switch select
 - nn. Pipe fill
 - oo. External anti jam trigger
 - pp. Dry running no flow switch select
 - qq. Pump low flow no flow switch select
7. Programmable discrete outputs shall be able to be assigned the following parameters:
- a. Ready
 - b. Drive running
 - c. Frequency reference attained
 - d. Current attained
 - e. High speed attained
 - f. Drive error
 - g. Frequency threshold attained
 - h. Torque sign
 - i. Motor thermal state attained
 - j. Drive thermal state attained
 - k. Torque or current limitation attained
 - l. Output contactor command
 - m. Input contactor command
 - n. Current present
 - o. Power removed
 - p. Alarm Groups
 - q. Alarms: load slipping, 4-20mA loss, brake control, external error, PTC, PID error, PID feedback, IGBT temperature, under voltage, torque control, drive temperature, braking resistor, fan counter, fan feedback, customer warning, power threshold, electrical power drift
 - r. Active configuration
 - s. Active parameter set
 - t. Active channel
 - u. DC bus charged
 - v. DC bus charging
 - w. Water Command: jockey pump, priming pump
 - x. Water running: anti-jam, pipe fill, priming pump, jockey pump
 - y. Water warning: dry running, flow, inlet pressure, outlet pressure, pump cycling, anti-jam, outlet pressure switch,
8. Safety Inputs
- a. The VFD shall provide 2 inputs dedicated to Safe Torque Off (STO) safety function, which prohibits unintended equipment operation, in accordance with IEC/EN 61508-1 SIL3.
 - b. The VFD shall be compliant with EN13849 (PL e).
 - c. The VFD shall be compliant with safety of machinery EN 954-1
 - d. The VFD manufacturer shall provide the certified schematics and the list of devices in order to comply with IEC/EN 60204-1 stopping category 0 and 1.
 - e. The VFD shall integrate the safety contacts in compliance with EN-81 13.2.2.3
- I. Communications
1. The VFD shall provide at a minimum 1 Modbus and 1 Ethernet Modbus TCP communications ports. In addition the following communications options shall be provided as necessary for communications. Refer to communication requirements specified elsewhere within the Contract Documents.
- a. [Ethernet IP or Modbus TCP, RJ45 dual port for daisy chain]
2. VFD Ethernet ports shall be IPv6 compliant, allow for web server access and provide network management via SNMP and clock synchronization.
3. The VFD shall provide an embedded web server for enhanced diagnostic, configuration, parameter access, and energy management. There shall be the capability to create a user-

defined custom dashboard for viewing drive and process status through tables, charts, and graphical views. It shall be possible to export data in standard table format using the webserver, for information around energy consumption as well as error and warning history.

4. The VFD shall be compliant with the Cyber Security Management ISA Secure /Achilles.
5. VFD communications modules shall be capable of being remotely powered by a separate external 24 VDC to allow for continued communications when the drive power supply is off.
6. The VFD shall provide integration connectivity via
 - a. DHCP protocol for Fast Device Replacement
 - b. DTM library in compliance with standard FDT technology

J. Configuration

1. The VFD shall be capable of accepting independent command and speed reference signals from:
 - a. Terminals
 - b. Modbus port
 - c. Ethernet port
 - d. Communication option card
 - e. Keypad display.
2. The VFD shall provide a Speed set-point function capable of:
 - a. Maximum output frequency function
 - b. Low and High speed scaling and limitation function
 - c. Jump frequency
 - d. Speed summing references function
 - e. Preset-speed references function
 - f. Jog function
 - g. Up-Down speed references
3. The VFD shall provide a Stop function capable of:
 - a. Deceleration ramp on power loss
 - b. Freewheel stop
 - c. Stop by DC injection at motor stop detection
 - d. Stop by DC injection by Logic Input
 - e. Stop on deceleration ramp adaptation
4. The VFD shall have an acceleration/deceleration, time adjustable ramp function capable of:
 - a. Ramp type: linear ramp, S shape ramp, with U or customized profile.
 - b. Ramp Deceleration adaptation
 - c. Ramp switching
5. Application programming dedicated to pumps
 - 1) The VFD shall provide Pump Control & Monitoring Functions
 - a) Centrifugal pump characteristics and configurations.
 - b) Pump monitoring function in order to define data relevant for pump (acceleration, low speed, high speed, etc.)
 - c) Application Units function in order to define units used in applications
 - d) Pump Cyclic Start Protection in order to protect the pump against too many restarts in a dedicated time period.
 - e) Multi-pump functions.
 - 2) The VFD shall provide Pump Protection Functions
 - a) Anti-Jam function in order to remove automatically clogging substances from the pump impellers.
 - b) Pipe Cleaning function in order to start pump regularly to avoid sedimentation in pump impeller

- c) Cavitation Pump Protection
- d) Inlet protection in order to avoid system dry running.
- 3) The VFD shall provide Application control functions
 - a) Stop and Go function in order to reduce consumption of VFD in case of pump doesn't work
 - b) Pulse input in order to connect a flow meter.
 - c) Process control (PID) function in order to maintain a process at a given pressure or flow reference.
 - d) Flow limitation function in order to allow limiting the consumption of water.
 - e) Friction loss compensation function in order to compensate pressure losses in pipes due to friction.
 - f) Pipe Fill function in order to manage a smooth control during pipe filling and to lessen the affects of water hammer.
 - g) Sleep wake-up function in order to manage periods of the application when process demand is low and when it is not needed.
 - h) Low demand function in order to define periods of the application when process demand is low in order to save energy.
 - i) Jockey pump control function in order to start a jockey pump, during sleep period, to maintain emergency service pressure or demand such as low water.
 - j) Sensor management in order to define how will be used drive inputs to manage Pressure sensor or flow sensor
- 4) The VFD shall provide Application protection functions
 - a) High flow protection function in order to detect pipe burst or detect running outside normal working area
 - b) Outlet pressure protection function in order to fix minimum and maximum pressure.
- 5) The VFD shall provide Pump curve input to help optimize pump performance.
 - a) Input and storage of the pump characteristics including 5 points of the pump curve.
 - b) A best efficiency point (BEP) function in order to run in optimum conditions and detect deviation from this point.

K. Diagnostics and Configuration

1. The VFD Supplier shall have Windows based PC software for configuring and diagnosing the VFD. It shall be possible to set and modify parameters, control the drive, read actual values and make trend analysis using the software. The PC-tools may be connected to the VFD by wired or wireless connection.
2. The VFD shall display all faults in plain text and help screens shall be available to guide the user in the troubleshooting. Codes are not acceptable.
3. The VFD shall provide a Real Time Clock management for time stamping of detected errors.
4. The VFD shall display detected errors with QR codes to guide the user in the troubleshooting.
5. The VFDs must provide LED lights to indicate the status of the VFD.
6. The VFD must have the ability to dynamically display I/O status.

L. Energy Management

1. The VFD shall provide a data logging function in order to keep files ready for maintenance or user.
2. The VFD shall provide information related to Energy management through different ways such as: web server, keypad, facet for SCADA, communication networks.
3. The user interface shall be able to display a chart relative to energy efficiency and energy management.
 - a. Report in KW
 - b. Display energy history for instant, weekly, monthly, and yearly.
 - c. Trend base on variation /time
 - d. All power measurement precision must be less than 5 % of deviation.

4. The user interface shall be able to display the “efficient” set point for pump based on pump characteristics.
 5. The user interface shall be able to display the “efficiency board” including CO2 savings, Savings viewer, and Return of Investment.
- M. Enclosure: NEMA 4X
- N. Integral disconnect with lock-out tag-out capabilities.
- O. Voltage test station: Safeside model P-S11S21-M3RX

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine VFD exterior and interior prior to installation. Report any damage and do not install any VFDs that are structurally, moisture, or mildew damaged.
- B. Prior to locating the VFD at the planned installation site, ensure that the location is prepared for the installation and that the storage or operating condition requirements can be maintained. Verify installation space requirements are satisfied. Report any conditions that are detrimental to performance of the work. Proceed with installation only after detrimental conditions have been corrected.
- C. Before, during, and after installation ensure that the VFD is protected from area construction activities and site contaminants.

3.2 INSTALLATION

- A. Installation shall comply with manufacturer's instructions, drawings, and recommendations.

3.3 FIELD QUALITY CONTROL

- A. Configuration and Startup: Provide the services of a qualified factory-trained manufacturer's representative to assist the installing contractor with the installation, configuration and startup of each VFD. The manufacturer's representative shall inspect the installation of each VFD prior to energizing and configure each VFD for operation under the specified conditions. The manufacturer's representative shall conduct the initial startup and operation of each VFD. The manufacturer's representative shall revisit the project site as often as necessary to ensure that all issues are corrected and that the installation and operation of the VFD are satisfactory.
- B. Certification: The Contractor shall submit a written report certifying that each VFD has been installed, configured, and tested under load in accordance with the manufacturer's recommendations. This report shall be signed by a factory-trained manufacturer's representative and shall include a listing of all modifications and adjustments made onsite to include any settings / parameters not identified as factory defaults within the equipment's O&M documentation.
- C. Specified products shall be tested as a system for conformance to specification requirements prior to scheduling the acceptance tests. Contractor shall conduct performance verification tests in the presence of Government representative, observing and documenting complete compliance of the system to the specifications. Contractor shall submit a signed copy of the test results, certifying proper system operation before scheduling tests.

3.4 TRAINING

- A. The services of a factor-trained instructor shall be provided for the purpose of training the Owner's staff in the proper operation and maintenance of the VFDs. Training shall consist of not less than 2 repeated session(s) with 4 hours of onsite classroom and hands-on instruction for a minimum of 4 attendees per session. The instructor shall provide sufficient time and detail in each session to cover the following as a minimum:
1. Theory of operation
 2. Operation of VFDs furnished
 3. Maintenance and configuration
 4. Configurations of VFDs furnished
 5. Troubleshooting and repair
 6. Replacement of component level parts

3.5 TESTING AND COMMISSIONING

- A. General: VFDs and related equipment shall be tested and commissioned in accordance with Specification Division 26.

END OF SECTION 262923

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SECTION 263213 ENGINE GENERATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes packaged engine-generator sets for standby power supply with the following features:
 - 1. Diesel engine.
 - 2. Unit-mounted cooling system.
 - 3. Unit-mounted control and monitoring.
- B. Related Sections include the following:
 - 1. Division 26 Section "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine-generator sets.

1.3 DEFINITIONS

- A. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

1.4 SUBMITTALS

- A. Product Data: For each type of packaged engine generator indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. In addition, include the following:
 - 1. Thermal damage curve for generator.
 - 2. Time-current characteristic curves for generator protective device.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.
 - 2. Wiring Diagrams: Power, signal, and control wiring.
- C. Source quality-control test reports

1. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: Provide (3) hard copies in separate 3-ring binders and an electronic copy. Include the following:
1. Descriptions: Include the following:
 - a. Product name and model number.
 - b. Manufacturer's name.
 - c. Equipment identification with serial number of each component.
 - d. Equipment function.
 - e. Operating characteristics.
 - f. Limiting conditions.
 - g. Performance curves.
 - h. Engineering data and tests.
 - i. Complete nomenclature and number of replacement parts.
 2. Operating Procedures: Include start-up, break-in, and control procedures; stopping and normal shutdown instructions; routine, normal, seasonal, and weekend operating instructions; and required sequences for electric or electronic systems.
 3. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
 4. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
 5. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including maintenance instructions, drawings and diagrams for maintenance, nomenclature of parts and components, and recommended spare parts for each component part or piece of equipment:
 6. Maintenance Procedures: Include test and inspection instructions, troubleshooting guide, disassembly instructions, and adjusting instructions that detail essential maintenance procedures:
 7. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
 8. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
 9. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
- F. Fuel Delivery Receipt
1. Proof of fuel delivery with fuel type and quantity indicated
- G. Demonstration Training Sign-In Sheet
1. Sign in sheet with all attendee's signature from demonstration training for Owner

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
 - 1. Maintenance Proximity: Not more than three hours' normal travel time from Installer's place of business to Project site.
- B. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 150 miles of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.
- C. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- E. Comply with ASME B15.1.
- F. Comply with NFPA 37.
- G. Comply with NFPA 70.
- H. Comply with NFPA 110 requirements for Level 2 emergency power supply system.
- I. Comply with UL 2200.
- J. Engine Exhaust Emissions: Comply with applicable state and local government requirements.

1.6 PROJECT CONDITIONS

- A. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
 - 1. Ambient Temperature: -15 to 40 deg C.
 - 2. Relative Humidity: 0 to 95 percent.
 - 3. Altitude: Sea level to 1000 feet (300 m).

1.7 COORDINATION

- A. Coordinate size and location of concrete bases for package engine generators. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters: One set each of lubricating oil, fuel, and combustion-air filters.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufactures: Subject to compliance with requirements, provide products by one of the following:
 1. Caterpillar; Engine Div.
 2. Onan/Cummins Power Generation; Industrial Business Group.
 3. Taylor Power Systems

2.2 ENGINE-GENERATOR SET

- A. Factory-assembled and -tested, engine-generator set.
- B. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.
 1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and generator-set center of gravity.
- C. Capacities and Characteristics:
 1. Power Output Ratings: Nominal ratings as indicated.
 2. Output Connections: Three-phase, four wire.
 3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.
- D. Generator-Set Performance:
 1. Oversizing generator compared with the rated power output of the engine is permissible to meet specified performance.
 - a. Nameplate Data for Oversized Generator: Show ratings required by the Contract Documents rather than ratings that would normally be applied to generator size installed.
 2. Steady-State Voltage Operational Bandwidth: 1 percent of rated output voltage from no load to full load.
 3. Transient Voltage Performance: Not more than 10 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within 0.5 second.
 4. Steady-State Frequency Operational Bandwidth: Plus or minus 0.25 percent of rated frequency from no load to full load.
 5. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.

6. Transient Frequency Performance: Less than 2-Hz variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within three seconds.
7. Output Waveform: At no load, harmonic content measured line to neutral shall not exceed 2 percent total with no slot ripple. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
8. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to winding insulation or other generator system components.
9. Excitation System: Performance shall be unaffected by voltage distortion caused by nonlinear load.
 - a. Provide permanent magnet excitation for power source to voltage regulator.
10. Start Time: Comply with NFPA 110, Type 10, system requirements.

2.3 ENGINE

- A. Fuel: Fuel oil, Grade DF-2
- B. Rated Engine Speed: 1800 rpm.
- C. Maximum Piston Speed for Four-Cycle Engines: 2250 fpm (11.4 m/s).
- D. Lubrication System: The following items are mounted on engine or skid:
 1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
 2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
 3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.
- E. Engine Fuel System:
 1. Main Fuel Pump: Mounted on engine. Pump ensures adequate primary fuel flow under starting and load conditions.
 2. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.
- F. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity.
- G. Governor: Adjustable isochronous, with speed sensing.
- H. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump.
 1. Coolant: solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
 2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.

3. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
 4. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
 5. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.
 - a. Rating: 50-psig (343-kPa) maximum working pressure with coolant at 180 deg F (82 deg C), and noncollapsible under vacuum.
 - b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.
 6. Radiator air discharge duct adapter
- I. Muffler/Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.
1. Minimum sound attenuation of 25 dB at 500 Hz.
 2. Sound level measured at a distance of 10 feet (3 m) from exhaust discharge after installation is complete shall be 85 dBA or less.
- J. Exhaust Piping
1. Bellows style flexible exhaust connector
 - a. 321 stainless steel
 - b. End connections to be carbon steel
 - c. Provide with flow liner
 2. Steel Piping
 - a. ASTM A 53, black steel, Schedule 40, Type E or S, Grade B
 - b. Malleable Iron Threaded Fittings: ASME B16.3, Class 150 Standard pattern.
 - c. Wrought-Steel Welding Fittings: ASTM A 234 for butt welding and socket welding
 3. Wall/Roof Thimble
 - a. Carbon steel construction
 - b. Size to provide at least 9" of clearance on each side of wall or roof.
 - c. Provide with pest control screen
 - d. Provide with rain guard
 - e. Provide with high heat black paint
 4. Rain Cap
 - a. Heavy duty carbon steel construction
 - b. Sized to match exhaust pipe
 5. Thermal Wrap
 - a. Conforming to ASTM E84, ASTM E162, NFPA 701, UL 1709
 - b. Maximum Operating Temperature: 1000 deg F
 - c. Thickness: 1"

- d. Hook and loop fastening system
- K. Air-Intake Filter: Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.
- L. Starting System: 12 - V electric, with negative ground.
 - 1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 "Project Conditions" Article.
 - 2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
 - 3. Cranking Cycle: As required by NFPA 110 for system level specified.
 - 4. Battery: Adequate capacity within ambient temperature range specified in Part 1 "Project Conditions" Article to provide specified cranking cycle at least three times without recharging.
 - 5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
 - 6. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to maintain battery above 10 deg C regardless of external ambient temperature within range specified in Part 1 "Project Conditions" Article. Include accessories required to support and fasten batteries in place.
 - 7. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.
 - 8. Battery Charger: Current-limiting, automatic-equalizing and float-charging type. Unit shall comply with UL 1236 and include the following features:
 - a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
 - b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg C to plus 60 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.
 - c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
 - d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
 - e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
 - f. Enclosure and Mounting: NEMA 250, Type 1, mounted on generator. Mounting method shall isolate the battery charger from generator-set vibration.

2.4 FUEL OIL STORAGE

- A. Comply with NFPA 30.
- B. Base-Mounted Fuel Oil Tank: Factory installed and piped, complying with UL 142 fuel oil tank. Features include the following:
 - 1. Tank level indicator.
 - 2. Capacity: Fuel for 18 hours' continuous operation at 100 percent rated power output.
 - 3. Vandal-resistant fill cap.
 - 4. 24" maximum height of fuel tank
 - 5. Vent Piping
 - a. ASTM A 53, black steel, Schedule 40, Type E or S, Grade B
 - b. Wrought-Steel Welding Fittings: ASTM A 234 for butt welding and socket welding
 - c. Provide with appropriate caps to prevent rain intrusion
 - 6. Containment Provisions: Comply with requirements of authorities having jurisdiction.

2.5 EXTERNAL POWER SOURCE

- A. All control, monitoring, battery chargers, heaters, etc shall be factory wired and include a single point power connection. Power connection shall be 50 amps, 208V single-phase.
 - 1. If single point wiring is not available from the manufacturer, the Contractor shall be responsible for all field wiring required. All costs and coordination of this work shall be included within the Contractor's bid. No additional time or charges will be allowed to accommodate field wiring.

2.6 CONTROL AND MONITORING

- A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.
- B. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator-set vibration.
- C. Indicating and Protective Devices and Controls: As required by NFPA 110 for Level 2 system, and the following:
 - 1. AC voltmeter.
 - 2. AC ammeter.
 - 3. AC frequency meter.
 - 4. DC voltmeter (alternator battery charging).
 - 5. Engine-coolant temperature gage.
 - 6. Engine lubricating-oil pressure gage.

7. Running-time meter.
 8. Ammeter-voltmeter, phase-selector switch(es).
 9. Generator-voltage adjusting rheostat.

 10. Fuel tank derangement alarm.
 11. Fuel tank high-level shutdown of fuel supply alarm.
- D. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.

2.7 GENERATOR OVERCURRENT AND FAULT PROTECTION

- A. Provide (2) two identical generator output circuit breakers. One breaker shall be connected to the automatic transfer switch and one breaker shall be reserved for connection of an external load bank.
1. Breakers shall be interlocked to prevent simultaneous operation.
 2. Provide labels for each breaker.
 3. Protect all lug connections from incidental contact.
- B. Generator Circuit Breaker: Molded-case, thermal-magnetic type; 100 percent rated; complying with NEMA AB 1 and UL 489.
1. Tripping Characteristic: Designed specifically for generator protection.
 2. Trip Rating: Matched to generator rating.
 3. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.
 4. Mounting: Adjacent to or integrated with control and monitoring panel.

2.8 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

- A. Comply with NEMA MG 1.
- B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.
- C. Electrical Insulation: Class H or Class F.
- D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.
- E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.
- F. Enclosure: Outdoor enclosure.
- G. Instrument Transformers: Mounted within generator enclosure.
- H. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified.

1. Adjusting rheostat on control and monitoring panel shall provide plus or minus 5 percent adjustment of output-voltage operating band.
- I. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.
- J. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.
- K. Subtransient Reactance: 12 percent, maximum.

2.9 FINISHES

- A. Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

2.10 SOURCE QUALITY CONTROL

- A. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:
 1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
 2. Full load run.
 3. Maximum power.
 4. Voltage regulation.
 5. Transient and steady-state governing.
 6. Single-step load pickup.
 7. Safety shutdown.
8. Report factory test results within 10 days of completion of test.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.
- B. Examine roughing-in of piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.

- B. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.
- C. Install exhaust piping with welded joints and connect to engine muffler. Install thimble at wall or roof as shown on the drawings. Piping shall be same diameter as muffler outlet. Connect to generator using flexible connector. Provide rain cap on exhaust termination. Exhaust termination location and height to be in compliance with applicable codes.
 - 1. Install condensate drain piping to muffler drain outlet full size of drain connection with a shutoff valve, stainless-steel flexible connector, and Schedule 40, black steel pipe with threaded joints.
 - 2. All interior exhaust piping including the silencer shall be covered with thermal wrap.
- D. Install normal and emergency vent piping with welded joints. Allow for disconnection of vent piping from fuel tank via flange connection. Normal and emergency vents shall extend to 24" above roof.
- E. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.
- F. Grounding equipment according to Division 26 Section. Ground and Bonding for Electrical Systems.
- G. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- H. Fuel tank shall be filled full following all testing requirements and at the time of substantial completion. **NO** biodiesel shall be used.

3.3 CONNECTIONS

- A. Drawings indicate general arrangement of piping and specialties.
- B. Connect exhaust-system piping adjacent to packaged engine generator to allow service and maintenance.
- C. Connect engine exhaust pipe to engine with flexible connector.
- D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 IDENTIFICATION

- A. Identify system components according to Division 26 Section "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators.

END OF SECTION 262313

SECTION 263600 TRANSFER SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes transfer switches rated 600 V and less, including the following:
 - 1. Automatic transfer switches.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.
- C. Operation and Maintenance Data: Provide (3) hard copies in separate 3-ring binders and an electronic copy. Include the following:
 - 1. Description
 - a. Product name and model number.
 - b. Manufacturer's name.
 - c. Equipment identification with serial number of each component.
 - d. Equipment function
 - 2. Product Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
 - 3. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.
 - 4. Maintenance Procedures: Include test and inspection instructions, troubleshooting guide, disassembly instructions, and adjusting instructions that detail essential maintenance procedures:
- D. Field Quality Control Reports
- E. Demonstration Training Sign-In Sheet
 - 1. Sign in sheet with all attendee's signature from demonstration training for Owner

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Maintain a service center capable of providing training, parts, and emergency maintenance repairs within a response period of less than eight hours from time of notification.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NEMA ICS 1.
- D. Comply with NFPA 70.
- E. Comply with NFPA 110.
- F. Comply with UL 1008 unless requirements of these Specifications are stricter.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Contactor Transfer Switches:
 - a. Caterpillar; Engine Div.
 - b. Emerson; ASCO Power Technologies, LP.
 - c. Onan/Cummins Power Generation; Industrial Business Group.

2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

- A. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.
- B. Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.
- C. Solid-State Controls: Repetitive accuracy of all settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.
- D. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.
- E. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.

- F. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
 - 1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are not acceptable.
 - 2. Switch Action: Double throw; mechanically held in both directions.
 - 3. Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer-switch units, rated 225 A and higher, shall have separate arcing contacts.
- G. Neutral Terminal: Neutral Terminal: Solid and fully rated, unless otherwise indicated.
- H. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, either by color-code or by numbered or lettered wire and cable tape markers at terminations. Color-coding and wire and cable tape markers are specified in Division 26 Section "Identification for Electrical Systems."
 - 1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
 - 2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
 - 3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.

2.3 AUTOMATIC TRANSFER SWITCHES

- A. Comply with Level 1 equipment according to NFPA 110.
- B. Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.
- C. Manual Switch Operation: Unloaded. Control circuit automatically disconnects from electrical operator during manual operation.
- D. In-Phase Monitor: Factory-wired, internal relay controls transfer so it occurs only when the two sources are synchronized in phase. Relay compares phase relationship and frequency difference between normal and emergency sources and initiates transfer when both sources are within 15 electrical degrees, and only if transfer can be completed within 60 electrical degrees. Transfer is initiated only if both sources are within 2 Hz of nominal frequency and 70 percent or more of nominal voltage.
- E. Automatic Transfer-Switch Features:
 - 1. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage is adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
 - 2. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.
 - 3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.

4. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes to automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
5. Test Switch: Simulate normal-source failure.
6. Switch-Position Pilot Lights: Indicate source to which load is connected.
7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.
 - a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
 - b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."
8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
9. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
11. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
12. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings are for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:
 - a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
 - b. Push-button programming control with digital display of settings.
 - c. Integral battery operation of time switch when normal control power is not available.

2.4 SOURCE QUALITY CONTROL

- A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Identify components according to Division 26 Section "Identification for Electrical Systems."
- B. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

3.2 CONNECTIONS

- A. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installation, including connections, and to assist in testing.
 - 2. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
 - a. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
 - b. Verify that manual transfer warnings are properly placed.
 - c. Perform manual transfer operation.
 - 3. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.
 - a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
 - b. Simulate loss of phase-to-ground voltage for each phase of normal source.
 - c. Verify time-delay settings.
 - d. Verify pickup and dropout voltages by data readout or inspection of control settings.
 - e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
 - f. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for 1 pole deviating by more than 50 percent from other poles.
 - g. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.
- B. Coordinate tests with tests of generator and run them concurrently.
- C. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

- D. Remove and replace malfunctioning units and retest as specified above.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment.
- B. Coordinate this training with that for generator equipment.

END OF SECTION 263600

SECTION 265100 INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Interior Lighting Fixtures.
 - 2. Lighting Fixture Support Components.

1.3 SUBMITTALS

- A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
 - 1. Physical description of lighting fixture including dimensions.
 - 2. Energy-efficiency data.
 - 3. Life, output, and energy-efficiency data for lamps.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

1.5 COORDINATION

- A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. See lighting schedule on Drawings.

2.2 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

- A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
- B. Metal Parts: Free of burrs and sharp corners and edges.
- C. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.

2.3 LIGHTING FIXTURE SUPPORT COMPONENTS

- A. Comply with Division 26 Section "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.
- B. Support Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gauge.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.
- B. Suspended Lighting Fixture Support:
 - 1. Pendants and Rods: Where longer than 48 inches brace to limit swinging.
 - 2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
 - 3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
 - 4. Install so the minimum height above finished floor (AFF) is 8'-0" minimum, unless noted otherwise. Supplier shall select and provide suspension hardware as required to comply with this requirement.
- C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

END OF SECTION 265100

SECTION 265600 EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:

- 1. Exterior luminaires.

1.3 SUBMITTALS

- A. Product Data: For each luminaire, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:

- 1. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.
- 2. Details of installation and construction.
- 3. Luminaire materials.
- 4. Lamps, including life, output, and energy-efficiency data.
- 5. Materials, dimensions, and finishes of poles.
- 6. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.
- 7. Anchor bolts for poles.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store poles on decay-resistant-treated skids at least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.
- B. Retain factory-applied pole wrappings on metal poles until right before pole installation. For poles with nonmetallic finishes, handle with web fabric straps.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. See lighting schedule on Drawings.

2.2 LUMINAIRES, GENERAL REQUIREMENTS

- A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.
- B. Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.
- C. Metal Parts: Free of burrs and sharp corners and edges.
- D. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.
- E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.
- F. Exposed Hardware Material: Stainless steel.
- G. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
- H. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- I. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

PART 3 - EXECUTION

3.1 LUMINAIRE INSTALLATION

- A. Fasten luminaire to indicated structural supports.
- B. Adjust luminaires that require field adjustment or aiming.

3.2 GROUNDING

- A. Ground metal poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."
 - 1. Install grounding electrode for each pole, unless otherwise indicated.

2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

3.3 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.

END OF SECTION 265600

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Section 333123
Process Piping, Valves & Fittings

Part 1. General

1.1 Description

- A. This Section includes pipe, pipe fittings, valves and appurtenances to be installed as part of the sewage pumping system.

1.2 Submittals

- A. The following information shall be submitted to the Owner:
 - 1. Product data, including descriptive literature, brochures, catalogs, cut sheets and other detailed descriptive material of the equipment.
 - 2. Shop drawings, including dimensioned drawings and manufacturer's installation drawings.
 - 3. Installation manuals.
 - 4. Operation and maintenance manuals.

Part 2. Products

2.1 Pipe & Fittings

- A. Ductile Iron
 - 1. Pipe shall be designed, manufactured and installed in accordance with AWWA C115. All pipe spool pieces shall have factory-installed threaded flanges at both ends, except where specifically noted on the Plans.
 - 2. Fittings shall be designed, manufactured and installed in accordance with AWWA C110. Flanges shall match ANSI B16.1 Class 125 flanges.
 - 3. All pipe and fittings shall have a factory-applied cement interior lining per AWWA C104, and exterior high solids epoxy coating (3.0-8.0 mils dry film thickness).
 - 4. All exposed ductile iron pipe and fittings shall be field coated with a high solids epoxy (Tnemec Series 69 or equal, 4.0-6.0 mils dry film thickness). Field coat color shall be white.
 - 5. Ductile iron pipe and fittings shall be manufactured in the USA.
- B. Stainless Steel
 - 1. Pipe and fittings shall be designed and manufactured in accordance with ASTM A312. Wall thickness (Schedule) shall be as indicated on the Plans.
 - 2. Pipe joints shall be:
 - a. Nominal pipe size 2" or less – threaded.

- b. Nominal pipe size greater than 2" – butt welded

2.2 Valves

A. Knife Gate Valves

1. Valves shall have a cast 316 stainless steel body, triple o-ring stem seals, 316 stainless steel gate, PTFE packing, EPDM seat, 18-8 stainless steel body bolting, and cast iron handwheel.
2. Valves bodies shall be lug style, drilled for ASME Class 150 flange through-bolting.
3. Valves shall be DeZurik model KGN-RSB or approved equal.

B. Plug Valves

1. Valves shall have ductile iron body and cover, one-piece ductile iron plug that is fully encapsulated in EPDM rubber, 18-8 stainless steel body bolting, and epoxy coating on all internal and external surfaces of the valve body.
2. Valves shall be furnished with Class 150 flanged ends.
3. Valves 4" and smaller shall be provided with a lever (quarter turn) operator. Valves 6" and larger shall be provided with a gear reducer and handwheel operator.

C. Check Valves

1. Valves shall have ductile iron body, bonnet and disc, 304 SS body bolting, and epoxy coating on all internal and external surfaces of the valve body. Disc shall be fully encapsulated in EPDM rubber.
2. Valves shall meet all applicable requirements of AWWA C508.
3. Valves shall be Val-Matic series Swing-Flex® resilient seated check valve or approved equal.

D. Air Release Valves

1. Valve shall have ASTM A351 Grade CF8M stainless steel body and cover, type 316 lever, float, seat and trim.
2. Valve shall be Val-Matic series 49AS or approved equal.

Part 3. Not Used

End of Section 333123

Section 333211
Self-Priming Centrifugal Sewage Pumping System

Part 1. General

1.1 Description

- A. Work under this section includes, but is not limited to, furnishing and installing a duplex pump station as indicated on the project drawings, herein specified, as necessary for proper and complete performance.
- B. Contractor shall furnish and install two (2) 10" self-priming pumps and electric motors, factory assembled on stainless steel bases; and a pump motor control panel with thermal-magnetic circuit breakers, VFDs, and automatic liquid level control system. Factory built pump station design, including materials of construction, pump features, valves and piping, and motor controls shall be in accordance with requirements listed under PART 2 of this section.

1.2 Performance

- A. Pumps must be designed to handle raw, unscreened, domestic sanitary sewage. Pumps shall have 10" suction connection, and 10" discharge connection. Each pump shall be selected to perform under following operating conditions:
 - 1. Capacity 3,000 gpm at 80' TDH
 - 2. Total Dynamic Suction Lift 12.2 feet
 - 3. Maximum Repriming Lift 9.0 feet
 - 4. Maximum Static Suction Lift 11 feet
 - 5. Total Discharge Static Head 24.50 feet
 - 6. Liquid temperature 50-120°F
- B. Solids Handling Capability
 - 1. All internal passages, impeller vanes, and recirculation ports shall pass a 3" spherical solid. Smaller internal passages that create a maintenance nuisance or interfere with priming and pump performance shall not be permitted. Upon request from the engineer, Manufacturer's certified drawings showing size and location of the recirculation port(s) shall be submitted for approval.
- C. Reprime Performance
 - 1. Consideration shall be given to the sanitary sewage service anticipated, in which debris is expected to lodge between the suction check valve and its seat, resulting in the loss of the pump suction leg, and siphoning of liquid from the pump casing to the approximate center line of the impeller. Such occurrence shall be considered normal, and the pump must be capable of automatic, unattended operation with an air release line installed.

2. During unattended operation, the pump shall retain adequate liquid in the casing to insure automatic repriming while operating at its rated speed in a completely open system. The need for a suction check valve or external priming device shall not be required.
3. Pump must reprime 22 vertical feet at the specified speed and impeller diameter. Reprime lift is defined as the static height of the pump suction above the liquid, while operating with only one-half of the liquid remaining in the pump casing. The pump must reprime and deliver full capacity within five minutes after the pump is energized in the reprime condition.

1.3 Submittals

A. Product Data

1. Prior to fabrication, panel manufacturer shall submit three (3) copies of submittal data for review and approval.
2. Submittal shall include shop drawings, electrical ladder logic drawings, and support data as follows: Catalog cuts sheets reflecting characteristics for major items of equipment, materials of construction, major dimensions. Electrical components used in the motor branch and liquid level control shall be fully described.
3. Shop drawings shall include electrical ladder logic drawings illustrating motor branch and liquid level control circuits to extent necessary to validate function and integration of circuits to form a complete working system.

B. Operations Maintenance Manuals

1. Installation shall be in accordance with written instructions provided by the pump station control panel manufacturer. Comprehensive instructions supplied at time of shipment shall enable personnel to properly operate and maintain all equipment supplied. Content and instructions shall assume operating personnel are familiar with pumps, motors, piping and valves, but lack experience on exact equipment supplied.
2. Documentation shall be specific to the panel supplied and collated in functional sections. Each section shall combine to form a complete system manual covering all aspects of equipment supplied by the manufacturer. Support data for any equipment supplied by others, even if mounted or included in overall design, shall be provided by those supplying the equipment. Instructions shall include the following as a minimum:
 - a. Functional description of each major component, complete with operating instructions.
 - b. Instructions for operating pumps and pump controls in all modes of operation.

- c. Calibration and adjustment of equipment for initial start-up, replacement of level control components, or as required for routine maintenance.
 - d. Support data for commercially available components not produced by the station manufacturer, but supplied in accordance with the specifications, shall be supported by literature from the prime manufacturer and incorporated as appendices.
 - e. Electrical schematic diagram of the pump station circuits shall be in accordance with NMTBA and JIC standards. Schematics shall illustrate, to the extent of authorized repair, pump motor branch, control and alarm system circuits including interconnections. Wire numbers and legend symbols shall be shown. Schematic diagrams for individual components, not normally repairable by the station operator, need not be included. Details for such parts shall not be substituted for an overall system schematic. Partial schematics, block diagrams, and simplified schematics shall not be provided in lieu of an overall system diagram.
3. Operation and maintenance instructions which rely on vendor cut-sheets and literature which include general configurations, or require operating personnel to selectively read portions of the manual shall not be acceptable. Operation and maintenance instructions must be specific to equipment supplied in accordance with these specifications.

1.4 Quality Assurance

- A. Controls shall be factory tested at the Manufacturer's facility.
- B. The Manufacturer's technical representative shall inspect the completed installation, correct or supervise the correction of any defect or malfunction, and instruct operating personnel in the proper operation and maintenance of the equipment as described in Part 3 of this section.
- C. Manufacturer's Warranty
 1. The pump manufacturer shall warrant the pump equipment to be of quality construction, free of defects in material and workmanship. A written warranty shall include specific details described below.
 2. All equipment, apparatus, and parts furnished shall be warranted for sixty (60) months, excepting only those items that are normally consumed in service, such as oils, grease, packing, gaskets, O rings, etc. The pump manufacturer shall be solely responsible for warranty of the pump equipment and all components.
 3. Components failing to perform as specified by the engineer, or as represented by the manufacturer, or as proven defective in service during the warranty period, shall be replaced, repaired, or satisfactorily modified by the manufacturer.

1.5 Manufacturer

- A. The specifications and project drawings depict equipment and materials manufactured by The Gorman-Rupp Company which are deemed most suitable for the service anticipated. Pump components shall all be of USA source and manufacture
- B. In order to unify responsibility for proper operation, it is the intent of these Specifications that all system components be furnished by a single supplier (unitary source) and that source shall be the pump manufacturer. The pumps must be of standard catalog design, totally warranted by the manufacturer. Under no circumstances will a system consisting of parts compiled and assembled by a manufacturer's representative or distributor be accepted.
- C. The term "pump manufacturer" shall be defined as the entity which designs, machines, assembles, hydraulically tests and warranties the final product. Any entity that does not meet this definition will not be considered a "pump manufacturer and is not an acceptable supplier. For quality control reasons and future pump and parts availability, all major castings of the pump shall be sourced and machined in North America.

Part 2. Products

2.1 Pumps

- A. Pumps shall be horizontal, self-priming centrifugal type, designed specifically for handling raw, unscreened, domestic sanitary sewage. Pump solids handling capability and performance criteria shall be in accordance with requirements listed under PART 1 of this section.
- B. Materials and Construction Features
 - 1. Pump casing shall be stainless steel CD4MCu with integral volute scroll. Casing shall incorporate following features:
 - a. Mounting feet sized to prevent tipping or binding when pump is completely disassembled for maintenance.
 - b. Fill port cover plate, 3½" diameter, shall be opened after loosening a hand nut/clamp bar assembly. In consideration for safety, a clamp bar screw must provide slow release of pressure, and the clamp bar shall be retained by detente lugs. A Teflon gasket shall prevent adhesion of the fill port cover to the casing.
 - c. Casing drain plug shall be at least 1¼" NPT to insure complete and rapid draining.
 - 2. Liquid volume and recirculation port design shall be consistent with performance criteria listed under PART 1 of this section.
 - 3. Suction Head shall be stainless steel CD4MCu. Its design must incorporate following maintenance features:

- a. The suction head shall be secured to the pump casing by using hex head cap screws and lock washers. Access to the impeller and mechanical seal shall be accomplished by removing the suction head.
 - b. Removal of any blockages in the impeller shall be accomplished by removing the suction head, or through a cleanout cover on the suction head. In consideration of safety, two clamp bar screws must provide slow release of pressure on two clamp bars securing the cleanout cover. A Teflon gasket shall prevent adhesion of the cleanout cover to the suction head casing.
 - c. Removal of the suction check valve shall be accomplished through the removable cleanout cover on the suction head.
 - d. In consideration for safety, a pressure relief valve shall be supplied in the suction head. The relief valve shall open at 75-200 PSI.
 - e. A replaceable stainless steel CD4MCu wear plate shall be secured up against the pump casing by the suction head. Measurement of the clearance between this wearplate and impeller shall be accomplished through the cleanout cover plate.
4. Rotating assembly, which includes impeller, shaft, mechanical shaft seal, lip seals, bearings, sealplate and bearing housing, must be removable as a single unit without disturbing the pump casing or piping. Design shall incorporate following features:
- a. Seal plate and bearing housing shall be stainless steel CD4MCu. Separate oil filled cavities, vented to atmosphere, shall be provided for shaft seal and bearings. Cavities must be cooled by the liquid pumped. Three lip seals will prevent leakage of oil.
 - i. The bearing cavity shall have an oil level sight gauge and fill plug check valve. The clear sight gauge shall provide easy monitoring of the bearing cavity oil level and condition of oil without removal of the fill plug check valve. The check valve shall vent the cavity but prevent introduction of moist air to the bearings.
 - ii. The seal cavity shall have an oil level sight gauge and fill/vent plug. The clear sight gauge shall provide easy monitoring of the seal cavity oil level and condition of oil without removal of the fill/vent plug.
 - iii. Double lip seal shall provide an atmospheric path providing positive protection of bearings, with capability for external drainage monitoring.
 - b. Impeller shall be stainless steel CD4MCu, two-vane, semi-open, non-clog, with integral pump out vanes on the back shroud. Impeller shall

- thread onto the pump shaft and be secured with a lock screw and conical washer.
- c. Impeller shaft shall be AISI 17-4 pH stainless steel.
 - d. Bearings shall be anti-friction ball type of proper size and design to withstand all radial and thrust loads expected during normal operation. Bearings shall be oil lubricated from a dedicated reservoir. Pump designs which use the same oil to lubricate the bearings and shaft seal shall not be acceptable.
 - e. Shaft seal shall be cartridge oil lubricated mechanical type. The stationary and rotating seal faces shall be silicon carbide. Each mating surface shall be lapped to within three light bands flatness (35 millionths of an inch), as measured by an optical flat under monochromatic light. The stationary seal seat shall be double floating by virtue of a dual O-ring design; an external O-ring secures the stationary seat to the seal plate, and an internal O-ring holds the faces in alignment during periods of mechanical or hydraulic shock (loads which cause shaft deflection, vibration, and axial/radial movement). Elastomers shall be viton; cage and spring to be stainless steel. Seal shall be oil lubricated from a dedicated reservoir. The same oil shall not lubricate both shaft seal and shaft bearings. Seal shall be warranted in accordance with requirements listed under PART 1 - GENERAL of this section.
 - f. Pusher bolt capability to assist in removal of rotating assembly. Pusher bolt threaded holes shall be sized to accept same cap screws as used for retaining rotating assembly.
5. Adjustment of the impeller face clearance (distance between impeller and wear plate) shall be accomplished by external means.
- a. Clearances shall be maintained by using external shims between the casing ring of the rotation assembly and the pump casing itself. Shims will be of various sizes to allow precise adjustment of this clearance. The clearance can be measured by removing the cleanout cover on the suction head.
 - b. Clearance adjustment which requires movement of the shaft only, thereby adversely affecting seal working length or impeller back clearance, shall not be acceptable.
6. Suction check valve shall be molded Fluorocarbon with stainless steel reinforcement. A blow-out center shall protect pump casing from hydraulic shock or excessive pressure. Removal or installation of the check valve must be accomplished through the cleanout cover on the suction head without disturbing the suction piping. Sole function of check valve shall be to save

energy by eliminating need to reprime after each pumping cycle. Pumps requiring a suction check valve to assist reprime will not be acceptable.

7. Removal of the rotating assembly will be accomplished through the front or the back of the pump casing.

C. Serviceability

1. The pump manufacturer shall demonstrate to the engineer's satisfaction that consideration has been given to reducing maintenance costs.
2. No special tools shall be required for replacement of any components within the pump.

D. Spare Parts Kit

1. There shall be furnished with the pump station the following minimum spare parts:
 - a. One spare pump mechanical seal (complete), and with it all gaskets, seals, sleeves, O rings, and packing required to be replaced during replacement of the seal.
 - b. One set of adjustment shims.
 - c. One set cover plate O rings.
 - d. One set rotating assembly O rings.

2.2 Pumping System Accessories

A. Unit Bases

1. The unit bases shall be comprised of a base plate, perimeter flange, and reinforcements.
 - a. Base plate shall be fabricated from stainless steel plates and structural shapes.
 - b. Perimeter flange and reinforcements shall be designed to prevent flexing or warping under operating conditions.
 - c. Base plate and/or flange shall be drilled for hardware used to secure unit bases to concrete pad.
 - d. Unit bases shall contain provisions for lifting the complete pump unit during shipping and installation.

B. Air Release Valves

1. Each pump shall be equipped with an automatic air release valve designed to vent air to atmosphere during initial priming or unattended repriming cycles. Upon completion of the priming or repriming cycle, the valve shall automatically close operating solely on discharge pressure to prevent excess recirculation. A visible indication of valve closure shall be evident. Valves which connect to the suction line or rely on vacuum pumps shall not be acceptable.

2. The air release valve shall be constructed of UV-inhibiting, high impact composite polyester containing not less than 30% glass-filler. The valve body shall incorporate an internal passageway that allows all debris to pass through the valve chamber between operational cycles, thus making the valve self-cleaning upon sequential cycles. The valve diaphragms shall be Buna-N, Fluorocarbon or EPDM, and shall incorporate a polyester mesh sufficient to withstand 250 PSI of pressure. Diaphragm materials of lesser-rated durability will not be deemed equal.
3. The vertical valve plunger shall be constructed of Acetal and at least 20% PTFE fluorocarbon filler (DuPont Teflon or equivalent). The independent, dual diaphragms and single, vertical valve plunger shall incorporate a media fluid that passes through an orifice and separates the actions of each. This media fluid will impart sufficient energy for each diaphragm to act on the other to cause a metered stroke, allowing for predictable mechanical movement, thus opening and closing the valve smoothly, preventing chatter and harsh ramming forces. Valves with a single horizontal shaft or that do not incorporate straight-through passageways or media-limiting orifices will not be acceptable. The valve "seat" shall permit a prescribed bypass of the liquid being pumped to ensure that the valve does not become hydraulically locked in submerged discharge piping configurations.
4. The valve shall employ an externally-adjustable restrictor for applications below four feet of static discharge head. Valves having no means to accurately adjust their action, or which require spring selection and lubrication are unacceptable. Being mechanically maintenance-free, provisions for clearing debris in the internal passageway normally associated with valves of this type are incorporated in the valve design and are accessible with only normal hand tools.
5. The valve body shall incorporate passageways having minimal constrictions and no directional course changes integral to the body of the valve. The inlet shall be 1 inch NPT female and the discharge outlet shall be 1-1/4 inch NPT female, assuring that any debris that makes its way through the valve body will have unobstructed passage back to the source. Valves having smaller throughput, bends or turns that restrict or impede flow and create pockets or traps for debris shall not be acceptable. The valve shall be mounted horizontally, 90 degrees to the vertical plunger by means of an integral mounting bracket.
6. The valve shall be able to operate on applications ranging from 4 to 400 feet of water column without the need for adjustment or interchange of springs or other parts.
7. Connection of the air release valves to pump station piping shall include stainless steel fittings.

C. Gauge Kit

1. Each pump shall be equipped with a glycerin-filled compound gauge to monitor suction pressures, and a glycerin filled pressure gauge to monitor discharge pressures. Gauges shall be a minimum of 4 inches in diameter, and shall be graduated in feet water column. Rated accuracy shall be 1 percent of full scale reading. Compound gauges shall be graduated -34 feet to +34 feet water column minimum. Pressure gauges shall be graduated 0 to 230 feet water column minimum.
2. Gauges shall be mounted onto stainless steel isolation rings, Red Valve Series 40 or equal. Fill fluid shall be ethylene glycol & water.

2.3 Drive Units

A. Motors

1. Pump motors shall be 100 HP, 3 phase, 60 hertz, 480 VAC, horizontally mounted, hazardous location rated (NFPA Class I, Group D), 1800 RPM, NEMA design B with cast iron frame with copper windings, induction type, with class F insulation and 1.15 SF for normal starting torque and low starting current characteristics, suitable for continuous service. The motors shall not overload at the design condition or at any head in the operating range as specified.
2. Motors shall be tested in accordance with provisions of ANSI/IEEE Standard 112.
3. Each pump shall be directly coupled to the motor. After installation the pump and motor shall be aligned by a certified millwright to ensure proper alignment as well as check for soft foot.

2.4 Electrical Control Components

- A. Site power furnished to pump station shall be 3 phase, 60 hertz, 460 volts, 4 wire, maintained within industry standards. The available fault current provided at the pump station control panel is _____ kA rms symmetrical. Voltage tolerance shall be plus or minus 10 percent. Phase-to-phase unbalance shall not exceed 1% average voltage as set forth in NEMA Standard MG-1. Control voltage shall not exceed 132 volts.
- B. Panel Enclosure
 1. Electrical control equipment shall be mounted within a NEMA 4X stainless steel, free standing or floor mounted enclosure with two-doors, continuous hinges and 3-point latches.
 2. Control components shall be mounted on a removable steel back panel secured to enclosure with collar studs.
 - a. All control devices and instruments shall be secured to the sub-plate with machine screws and lock-washers. Mounting holes shall be drilled and tapped; self-tapping screws shall not be used to mount and

component. All control devices shall be clearly labeled to indicate function.

3. Pilot devices and instrument displays shall be mounted through an aluminum swing-out panel near the front of the enclosure.

C. Branch Components

1. All motor branch and power circuit components shall be of highest industrial quality. The short circuit current rating of all power circuit devices shall be a tested combination or evaluated per the National Electrical Code Article 409. The lowest rated power circuit component shall be the overall control panel short circuit rating and shall not be less than the fault current available. The minimum control panel rating shall not be less than 10 kA, rms symmetrical. Control assemblies operating at 120 volts nominal or less may be provided with transformers which limit the fault current and may be rated less than the minimum required short circuit rating.
2. Circuit Breakers and Operating Mechanisms
 - a. A properly sized heavy duty circuit breaker shall be furnished for each pump motor. The circuit breakers must be sealed by the manufacturer after calibration to prevent tampering.
 - b. An operating mechanism installed on each motor circuit breaker shall penetrate the control panel door. A padlockable operator handle shall be secured on the exterior surface. Interlocks must prevent opening the door until circuit breakers are in "OFF" position. An additional mechanism(s) shall be provided on the circuit breaker permitting the breaker to be operated and/or locked with the control panel door in the open position.
3. Motor Controls
 - a. Variable frequency drives shall be capable of operation under any combination of the following conditions without mechanical or electrical damage.
 - i. Ambient Temperature: 0 to + 40°C
 - ii. Relative Humidity: Less than 95% non-condensing
 - iii. Altitude: Less than 1,000M (3300 ft) above sea level
 - iv. Vibration: .006 inches displacement, 1G peak
 - v. Shock: 15G peak for 11mS (+/- 1.0mS)
 - b. Control Specification
 - i. Control System: Sinusoidal pulse width modulated voltage waveform
 - ii. Frequency Accuracy: +/- 0.4% of max. frequency

- iii. Volts/Hertz Ratio: V/Hz user programmable
 - iv. Operation Frequency: 0 to 400 Hz
 - v. Overload Capacity: 110% Overload capability for up to 1 minute, 150% Overload capability for up to 3 seconds
- c. Digital Readout and Monitor
- i. Interface to each drive shall be provided via a module with integral LCD display, 7 line by 21 character backlit display with graphics capability. It shall display drive operating conditions, fault/alarm indications and programming information with full text support in English
 - ii. The unit shall display standby status (power on, not running), output frequency (drive run), set-up parameters and fault.
 - iii. With keypad, user shall be able to monitor current, voltage, frequency, acceleration and deceleration time, minimum frequency and maximum frequency. Readout shall also provide inverter status and protective circuit status.
 - iv. Drive interfaces shall be mounted through the aluminum swing-out panel.
- d. Protection
- i. The variable speed drive system shall include a diode or fully gated bridge rectifier, capacitor filter, and transistorized inverter section. Base driver signals to control firing of the power transistors will be designed with optically coupled isolators for maximum protection of the control circuits from high voltage and noise. The output will be a sinusoidal, pulse width modulated, voltage waveform for reduced harmonic heating in the motor.
 - ii. The system protection will provide the following:
 - a) Intermittent overload - 50 to 150%
 - b) Current limit - 50 to 115%
 - c) Overcurrent - 220-300% of rated output current
 - d) Inverse time overload - 50 to 100%
 - e) Short circuit - Phase to phase or phase to ground
 - f) Overvoltage - 10% above input line or DC bus voltage
 - g) Undervoltage - 10% below line voltage
 - h) Power loss ride-through - 500mS
 - iii. When the inverter trips out on a fault, the fault relay shall activate and the display shall indicate the reason for the trip as follows:
 - a) Overcurrent

- b) Short circuit
 - c) Overload
 - d) Overvoltage
 - e) Undervoltage
 - f) Overheat
 - g) Ground fault
 - h) Motor stalled
 - i) Power supply fault
- iv. Auto restart shall occur when the inverter faults. Auto restart shall be adjustable up to 9 attempts with a 0.5 to 30 second interval. Auto restart will not be attempted for ground fault, output shorted, transistor shorted or internal microprocessor fault but will trip out immediately, activate the fault relay and make the appropriate indication on the display.
 - v. In the event of a fault trip, the microprocessor shall save the status of the inverter at the time of the fault and make that information available on the digital display. Information regarding the last 4 faults is maintained in event of a power loss.
- e. Operational Functions:
 - i. Acceleration and deceleration time independently adjustable from 0.1 to 3600.0 seconds (selectable ranges).
 - ii. Volts/Hertz patterns user selectable.
 - iii. Maximum and minimum frequency limit adjustments.
4. Phase Monitor:
- a. The control panel shall be equipped to monitor the incoming power and shut down the pump motors when required to protect the motors from damage caused by phase reversal, phase loss, high voltage, low voltage, and voltage unbalance. An adjustable time delay shall be provided to minimize nuisance trips. The motors shall automatically restart, following an adjustable time delay, when power conditions return to normal.
5. Transient Voltage Surge Suppressor
- a. The control panel shall be equipped with a UL Type 2 surge arrester to minimize damage to the pump motors and control from transient voltage surges. The suppressor shall utilize thermally protected zinc oxide varistors encapsulated in a non conductive housing. Visual status indication shall be provided to show the operating state of each phase.

The suppressor shall have a max discharge current of 80,000 Amps phase to phase and a 125kA SCCR.

6. Pump Start Delay
 - a. Control circuits shall be equipped with a time delay to prevent simultaneous motor starts.
7. Branch Circuits
 - a. A normal duty thermal magnetic circuit breaker shall protect all branch circuits by interrupting power. The following branch circuits shall be provided:
 - i. Control power (120V/1P/15A)
8. Selector Switches & Front Panel Mounted Components
 - a. Pump mode selector switches shall permit manual start or stop of each pump individually, or permit automatic operation under control of the liquid level control system. Manual operation shall override all shutdown systems, except the motor overload relays.
 - b. Six-digit elapsed time meter (non-reset type) shall be connected to each motor starter to indicate total running time of each pump in “hours” and “tenths of hours”. An integral pilot light shall be wired in parallel to indicate that the motor is energized and should be running.
 - c. Selector switches, pushbuttons and indicator lights shall be water-tight/oil-tight (NEMA 4/13) 30 mm Allen Bradley 800T Series, or approved equal, with metal operator bushing and mounting ring.
 - d. Switches, indicators, and instruments mounted through the control panel door shall be labeled to indicate function, position, etc. Labels shall be mounted adjacent to, or above the device.
9. Auxiliary Power Transformer:
 - a. The panel shall be equipped with a 500VA step-down transformer to supply 115 volt, AC, single phase for the control and auxiliary equipment. The primary and secondary side of the transformer to be protected by a thermal magnetic circuit breaker, sized to meet the power requirements of the transformer. An operating mechanism shall penetrate the control panel door and a pad-lockable operator handle shall be secured on the exterior surface. Interlocks must prevent opening the door until circuit breakers are in “OFF” position.
10. Wiring
 - a. All wiring, workmanship, and schematic wiring diagrams shall comply with applicable standards and specifications of the National Electrical Code (NEC).

- b. All user serviceable wiring shall be type MTW or THW, 600 volts, color coded as follows:

Line and Load Circuits, AC or DC power	Black
AC Control Circuit Less Than Line Voltage	Red
DC Control Circuit	Blue
Interlock Control Circuit from external source	Yellow
Equipment Grounding Conductor	Green
Current Carrying Ground	White
Hot With Circuit Breaker Open	Orange
- c. Control circuit wiring inside the panel, with exception of internal wiring of individual components, shall be 16 gauge minimum, type MTW or THW, 600 volts. Power wiring to be 14 gauge minimum. Motor branch wiring shall be 10 gauge minimum.
- d. Motor branch and other power conductors shall not be loaded above the temperature rating of the connected termination. Wires must be clearly numbered at each end in conformance with applicable standards. All wire connectors in the control panel shall be ring tongue type with nylon insulated shanks. All wires on the sub-plate shall be bundled and tied. All wires extending from components mounted on door shall terminate at a terminal block mounted on the back panel. All wiring outside the panel shall be routed through conduit.
- e. Control wires connected to door mounted components must be tied and bundled in accordance with good commercial practice. Bundles shall be made flexible at the hinged side of the enclosure. Adequate length and flex shall allow the door to swing full open without undue stress or abrasion. Bundles shall be held on each side of hinge by mechanical fastening devices.

11. Grounding

- a. Station manufacturer shall ground all electrical equipment inside the pump station to the control panel back plate. All paint must be removed from the grounding mounting surface before making final connection.
- b. The Contractor shall provide an earth driven ground connection to the pump station at the main grounding lug in accordance with the National Electrical Code (NEC).

12. Equipment Marking

- a. Permanent corrosion resistant name plate(s) shall be attached to the control and include following information:
 - i. Equipment serial number
 - ii. Control panel short circuit rating

- iii. Supply voltage, phase and frequency
 - iv. Current rating of the minimum main conductor
 - v. Electrical wiring diagram number
 - vi. Motor horsepower and full load current
 - vii. Motor overload heater element
 - viii. Motor circuit breaker trip current rating
 - ix. Name and location of equipment manufacturer
- b. Control components shall be permanently marked using the same identification keys shown on the electrical diagram. Labels shall be mounted adjacent to device being identified.
- D. Level Controller
1. The level control system shall start and stop the pump motors and modulate speed in response to changes in wet well level, as set forth herein.
 2. Pump alternation shall be integral to the liquid level controller. Provisions for automatic alternation or manual selection shall also be integral to the liquid level controller.
 3. The level control system shall utilize alternation to select first one pump, then the second pump, to run as lead pump for a pumping cycle. Alternation shall occur at the end of a pumping cycle, or in the event of excessive run time.
 4. The level control system shall utilize an electronic pressure switch which shall continuously monitor the wet well level, permitting the operator to read wet well level at any time.
 5. The User shall be able to program the following level control points, arranged highest to lowest:
 - a. High Level Alarm
 - b. Start Lag Pump
 - c. Target Operating Level
 - d. Start Lead Pump
 - e. Stop All Pumps
 - f. Low Level Alarm
 6. The User shall be able to program the following motor speed control points:
 - a. Maximum operating frequency
 - b. Minimum operating frequency
 7. When in pump selector switches are in the AUTO position:
 - a. When the liquid level rises to the "Start Lead Pump" level, the control system shall start the lead pump and operate the lead pump at the maximum operating frequency.

- i. If the liquid level drops below the Target Operating Level, the control system shall decrease the operating frequency and operate in proportional-integral (PI) loop to maintain the liquid level at the Target Operating Level (plus or minus deadband).
 - ii. At no point shall the operating frequency drop below the minimum programmed value or rise above the maximum programmed value.
 - b. The control system shall stop the lead pump when the liquid level falls to the "Stop All Pumps" level.
 - c. If the liquid level rises to the "Start Lag Pump" level, the control system shall cancel the lead pump call and call the lag pump to start and operate as described in the preceding paragraphs.
 - i. Calls to start the lag pump shall be recorded as a system warning.
8. The level control system shall be the air bubbler type, containing air bubbler piping which extends into the wet well. A pressure sensor contained within the electronic pressure switch shall sense the air pressure in this piping to provide wet well level signals for the remainder of the level control system.
 - a. Two vibrating reed, industrial rated, air pumps shall be furnished to deliver free air at a rate of approximately 5 cubic feet per hour and a pressure not to exceed 7 psi. A selector switch shall be furnished to provide manual alternation of the air pumps. The switch shall be connected in such a manner that either pump may be selected to operate continuously.
 - b. An air flow indicator gauge shall be provided and connected to the air bubbler piping to provide a visual indication of rate of flow in standard cubic feet per hour.
9. The internal pressure sensor shall be a strain gauge transducer and shall receive an input pressure from the air bubbler system. The transducer shall convert the input to a proportional electrical signal for distribution to the display and electronic comparators. The transducer output shall be filtered to prevent control response to level pulsations or surges. The transducer range shall be 0 to 14.5 PSI, temperature compensated from -40°C through 85°C, with a repeat accuracy of (plus/minus) 2.5% full scale about a fixed temperature. Transducer overpressure rating shall be 3 times full scale.
10. The level monitoring system shall incorporate a digital back lighted LCD panel display which, upon operator selection, shall indicate liquid level in the wet well, and pump status indication for up to 3 pumps. The display shall include a 128 x 64 bit resolution LCD to read out directly in feet of water, accurate to within one tenth foot (0.1 foot), with a full scale indication of not less than 12 feet.

11. Level adjustments shall be electronic comparator set points to control the levels at which the lead and lag pumps start and stop. Each of the level settings shall be easily adjustable with the use of membrane type switches and accessible to the operator without opening the control panel door.
12. The level indicating controller shall:
 - a. Be equipped with pump start/stop and alarm input delay(s) that have an adjustable delay set points.
 - b. Be capable of jumping to next available pump if current pump is out of service due to pump failure or manual selection. Circuit design in which application of power to the lag pump motor starter is contingent upon completion of the lead pump circuit shall not be acceptable.
 - c. Be equipped with a simulator system capable of performing system cycle testing functions.
 - d. Be capable of calculating and displaying pump elapsed run time. The elapsed run time shall be resettable and adjustable.
 - e. Have internal capability of providing automatic simplex, duplex, and triplex alternation, manual selection of pump sequence operation, and alternation in the event of 1-24 hours of excessive run time.
 - f. Be equipped with alarm banners with time and date history for displaying alarm input notification. Alarm history will retain a 16 of the most recent alarm events.
 - g. Be equipped with a security access code to prevent accidental set up changes and provide liquid level set point lock out. The supervisor access code is adjustable.
 - h. Be equipped with the following I/O
 - i. Two (2) scalable analog inputs, 0-5 VDC or 4-20 mA.
 - ii. Eleven (11) optically isolated, user-defined digital inputs for pump and alarm status, rated at 10 mA at 24VDC.
 - iii. Eight (8) digital output relays (mechanical contacts), configurable for pump start/stop or alarms; three (3) relays rated at 12 amp @ 28VDC and 120VAC, and five (5) relays rated at 3 Amp @ 30Vdc and 120Vac.
 - iv. One (1) scalable analog output of either 0-5VDC, 0-10VDC or 4-20 mA. Output shall be powered by 10-24VDC supply. Load resistance for 4-20mA output shall be 100-1000 ohms.
 - i. Include a DC power supply to convert 120VAC control power to 12 or 24VDC power. The power supply shall be 500 mA (6W) minimum and be UL listed Class II power limited power supply.
 - j. Be equipped with an electronic comparator and mechanical output relay to alert maintenance personnel to a high liquid level in the wet well. An alarm banner, visible on the front of the controller, shall

indicate that a high wet well level exists. The alarm signal shall be maintained until the wet well level has been lowered and the circuit has been manually reset. High water alarm shall be furnished with a dry contact wired to terminal blocks.

- k. Be equipped with an electronic comparator and mechanical output relay to alert maintenance personnel to a low liquid level in the wet well. An alarm banner, visible on the front of the controller, shall indicate that a low wet well level exists. The alarm signal shall be maintained until the cause for the low wet well level has been corrected and the circuit has been manually reset. A low liquid level condition shall disable all pump motors. When the wet well rises above the low level point, all pump motors shall be automatically enabled. Low water alarm shall be furnished with a dry contact wired to terminal blocks.
 - l. The electronic level monitoring system shall include integral components to perform all pressure sensing, signal conditioning, EMI and RFI suppression, DC power supply and 120 volt outputs. Comparators shall be solid state, and shall be integrated with other components to perform as described below.
 - m. The electronic pressure switch shall be capable of operating on a supply voltage of 12-24VDC in an ambient temperature range of -10°C through 55°C.
 - n. Control range shall be 0 to 33.3 feet of water with an overall repeat accuracy of (plus/minus) 0.1 feet of water.
 - o. Include non-volatile memory and a battery backed up real time clock.
 - p. Include an alarm silence pushbutton and relay to permit maintenance personnel to de-energize the audible alarm device while corrective actions are under way. After silencing the alarm device, manual reset of the alarm condition shall clear the alarm silence relay automatically.
- E. Pump Station Discharge Flow Meter
- 1. Station discharge flow meter shall be an electromagnetic flow tube with remote mounted signal converter.
 - a. Flow tube shall be Krohne Optiflux 2000 with remote signal converter, or approved equal.
 - i. Flow tube shall be suitable for mounting in a Class I, Division 1 hazardous location.
 - ii. Flow tube shall be shipped loose for field installation by the Contractor as shown on the Plans.
 - b. Flow signal converter shall be Krohne IFC300.
 - i. Signal converter shall be rack mounted housing style (28 TE).

- ii. Signal converter shall be mounted through the aluminum swing-out panel.
 - c. Analog output (4-20 mA) from the signal converter shall be wired to terminal blocks for field connection to the wireless telemetry unit.
 - F. North Sewer Incoming Flow Meter
 - 1. Incoming sewer flow meter shall be an ultrasonic level sensor with remote mounted flow converter.
 - a. Ultrasonic level sensor shall be Endress+Hauser FMU90 or approved equal. Level sensor shall be furnished with flooding protection tube.
 - i. Ultrasonic level sensor shall be suitable for mounting in a Class I, Division 1 hazardous location.
 - ii. Ultrasonic level sensor shall be shipped loose for field installation by the Contractor as shown on the Plans.
 - b. Flow converter shall Endress+Hauser Prosonic S FMU90 or approved equal.
 - i. Flow converter shall be DIN rail mounted style with a separate display and operating module.
 - a) Flow converter shall be mounted on the control panel sub-plate.
 - b) Display & operating module shall be mounted through the aluminum swing-out panel.
 - c) Analog output (4-20 mA) from the flow converter shall be wired to terminal blocks for field connection to wireless telemetry unit.

Part 3. Execution

3.1 Examination

- A. Contractor shall off-load equipment at installation site using equipment of sufficient size and design to prevent injury or damage. Immediately after off-loading, Contractor shall inspect complete pump and appurtenances for shipping damage or missing parts. Any damage or discrepancy shall be noted in written claim with shipper prior to accepting delivery. Validate all pump serial numbers and parts lists with shipping documentation. Notify the manufacturer's representative of any unacceptable conditions noted with shipper.

3.2 Installation

- A. Install, level, align, and lubricate pumps as indicated on project drawings. Installation must be in accordance with written instructions supplied by the manufacturer at time of delivery.
- B. Suction pipe connections shall be vacuum-tight. Fasteners at all pipe connections must be tight. Install pipe with supports and thrust blocks to prevent strain and vibration on pump piping. Install and secure all service lines (level control, air release valve or pump drain lines) as required in wet well.
- C. Check motor and control data plates for compatibility to site voltage. Install and test the station ground prior to connecting line voltage to control panel.
- D. Prior to applying electrical power to any motors or control equipment, check all wiring for tight connection. Verify that protective devices (fuses and circuit breakers) conform to project design documents. Manually operate circuit breakers and switches to ensure operation without binding. Open all circuit breakers and disconnects before connecting utility power. Verify line voltage, phase sequence and ground before actual start-up.
- E. After all anchor bolts, piping and control connections are installed, completely fill the grout dam in the pump station base with non-shrink grout.

3.3 Field Quality Control

- A. Operational Test
 - 1. Prior to acceptance by Owner, an operational test of all pumps, drives, and control systems shall be conducted to determine if the installed equipment meets the purpose and intent of the specifications. Tests shall demonstrate that all equipment is electrically, mechanically, structurally, and otherwise acceptable, it is safe and in optimum working condition, and conforms to the specified operating characteristics.
 - 2. After construction of the replacement pumping system is complete, Contractor shall install temporary piping to return discharge from the new pumping system back to the wetwell. The pump station shall be placed into automatic mode and the system operated for an eight (8) hour period to demonstrate proper system operation.
 - a. Observe and record operation of pumps, suction and discharge gage readings, ampere draw, pump controls, and liquid level controls.
 - b. Check calibration of all instrumentation equipment, test manual control devices, and automatic control systems.
 - c. Be alert to any undue noise, vibration or other operational problems.
 - 3. When the Owner is satisfied with the replacement pumping system performance, the Contractor shall remove temporary discharge piping and

connect the pump station discharge to the forcemain. Demolition of the existing pumping equipment shall then commence.

3.4 Startup & Training

- A. The Manufacturer shall provide a service representative properly trained in inspection and operation of the equipment to inspect the installation, assist in start up, and instruct plant personnel in the proper operation and maintenance of system.
 - 1. This service shall be in the form of a minimum of one (1) trip to the site and two (2) eight (8) hour days of service per trip.
 - 2. The Manufacturer shall furnish Operating and Maintenance manuals for the equipment to the Owner prior to performing field service.

End of Section 333211

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