District IFB 38732
Exhibit 1

TECHNICAL
SPECIFICATIONS
ISSUED FOR BID

Black Creek Water Resource Development Project
Aquifer Recharge Area
(Contract III)

St. Johns River Water
Management District

May 2023

CDM Smith

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SECTION 01001
GENERAL REQUIREMENTS

PART 1 GENERAL

1.01 SCOPE AND INTENT

A. Description

1. The work to be done consists of the furnishing of all labor, materials and equipment, and the performance of all work included in this Contract. The summary of the work is presented in Section 01010.

B. Work Included

1. The Contractor shall furnish all labor, superintendence, materials, power, light, heat, fuel, tools, appliances, equipment, supplies, and other means of construction necessary or proper for performing and completing the work. The Contractor shall obtain and pay for all required permits. The Contractor shall perform and complete the work in the manner best calculated to promote rapid construction consistent with safety of life and property and to the satisfaction of the Engineer and District, and in strict accordance with the Contract Documents. The Contractor shall clean up the work and maintain it during and after construction, until accepted, and shall do all work and pay all costs incidental thereto. The Contractor shall repair or restore all structures and property that may be damaged or disturbed during performance of the work.

2. The cost of incidental work described in these General Requirements, for which there are no specific Contract Items, shall be considered as part of the general cost of doing the work and shall be included in the prices for the various Contract Items. No additional payment will be made therefore.

3. The Contractor shall provide and maintain such modern plant, tools, and equipment as may be necessary, in the opinion of the Engineer and District, to perform in a satisfactory and acceptable manner all the work required by this Contract. Only equipment of established reputation and proven efficiency shall be used. The Contractor shall be solely responsible for the adequacy of their workmanship, materials and equipment, prior approval of the Engineer and District notwithstanding.

4. The Contractor shall remove, demolish and dispose of all equipment, piping, asphalt, rock and appurtenances as shown on the Drawings and required to complete the work. No additional payment will be made for additional demolition or disposal work, not specifically specified on the plans as required, to complete the work.

5. The Contractor shall perform all work in accordance with applicable local, state, and federal codes and regulations.

C. Public Utility Installations and Structures

1. Public utility installations and structures shall be understood to include all poles, tracks, pipes, wires, conduits, house service connections, vaults, manholes and all other appurtenances and facilities pertaining thereto whether owned or controlled by the District,

other governmental bodies or privately owned by individuals, firms or corporations, used to serve the public with transportation, traffic control, gas, electricity, telephone, sewerage, drainage, water or other public or private property which may be affected by the work shall be deemed included hereunder.

2. The Contract Documents contain data relative to existing public utility installations and structures above and below the ground surface. These data are not guaranteed as to their completeness or accuracy and it is the responsibility of the Contractor to make his own investigations to inform himself fully of the character, condition and extent of all such installations and structures as may be encountered and as may affect the construction operations.

3. The Contractor shall protect all public utility installations and structures from damage during the work. Access across any buried public utility installation or structure shall be made only in such locations and by means approved by the Engineer. The Contractor shall so arrange his operations as to avoid any damage to these facilities. All required protective devices and construction shall be provided by the Contractor at his expense. All existing public utilities damaged by the Contractor which are shown on the Plans or have been located in the field by the utility shall be repaired by the Contractor, at his expense, as directed by the Engineer. No separate payment shall be made for such protection or repairs to public utility installations or structures.

4. Public utility installations or structures owned or controlled by the District or other governmental body which are shown on the Drawings to be removed, relocated, replaced or rebuilt by the Contractor shall be considered as a part of the general cost of doing the work and shall be included in the prices bid for the various contract items. No separate payment shall be made therefore.

5. Where public utility installations or structures owned or controlled by the District or other governmental body are encountered during the course of the work, and are not indicated on the Drawings or in the Specifications, and when, in the opinion of the Engineer, removal, relocation, replacement or rebuilding is necessary to complete the work under this Contract, such work shall be accomplished by the utility having jurisdiction, or such work may be ordered, in writing by the Engineer, for the Contractor to accomplish. If such work is accomplished by the utility having jurisdiction it will be carried out expeditiously and the Contractor shall give full cooperation to permit the utility to complete the removal, relocation, replacement or rebuilding as required. If such work is accomplished by the Contractor, it will be in accordance with the Contract Documents.

6. All District and other governmental utility departments and other owners of public utilities which may be affected by the work have been informed in writing by Engineer. Such notice will set out, in general, and direct attention to the responsibilities of the District and other governmental utility departments and other owners of public utilities for such installations and structures as may be affected by the work and will be accompanied by one set of Drawings and Specifications covering the work under such Contract or Contracts.

7. In addition to the general notice given by the Engineer, the Contractor shall give written notice to District and other governmental utility departments and other owners of public utilities of the location of his proposed construction operations, at least one (1) week in advance of breaking ground in any area or on any unit of the work. This can be

accomplished by making the appropriate contact with the "Underground Facilities Location Service (1-800-432-4770)."

8. The maintenance, repair, removal, relocation or rebuilding of public utility installations and structures, when accomplished by the Contractor as herein provided, shall be done by methods approved by the Engineer.

1.02 DRAWINGS AND SPECIFICATIONS

A. Drawings

1. The Drawings referred to in the Contract Documents bear the general project name and number as shown in the Invitation to Bid (Advertisement).

2. When obtaining data and information from the Drawings, figures shall be used in preference to scaled dimensions, and large-scale drawings in preference to small scale drawings.

B. Copies Furnished to Contractor

1. After the Contract has been executed, the Contractor will be furnished with two hard copy sets of paper prints, the same size as the original drawings, of each sheet of the Drawings and two hard copies of the Specifications. Electronic copies, in PDF format, of the Drawings and Specifications are also available upon request.

2. The Contractor shall furnish each of the subcontractors, manufacturers, and material suppliers such copies of the Contract Documents as may be required for their work.

C. Supplementary Drawings

1. When, in the opinion of the Engineer, it becomes necessary to explain more fully the work to be done or to illustrate the work further or to show any changes which may be required, drawings known as Supplementary Drawings, with specifications pertaining thereto, will be prepared by the Engineer and two paper prints thereof will be given to the Contractor.

D. Contractor to Check Drawings and Data

1. Contractor shall verify all dimensions, quantities and details shown on the Drawings, Supplementary Drawings, Schedules, Specifications or other data received from the Engineer, and shall notify him of all errors, omissions, conflicts, and discrepancies found therein. Failure to discover or correct errors, conflicts or discrepancies shall not relieve the Contractor of full responsibility for unsatisfactory work, faulty construction or improper operation resulting therefrom nor from rectifying such conditions at his own expense. The Contractor will not be allowed to take advantage of any errors or omissions, as full instructions will be furnished by the Engineer, should such errors or omissions be discovered. All schedules are given for the convenience of the Engineer, District and the Contractor and are not guaranteed to be complete. The Contractor shall assume all responsibility for the making of estimates of the size, kind, and quality of materials and equipment included in work to be done under the Contract.

E. Specifications

1. The Technical Specifications consist of three parts: General, Products and Execution. The General Section contains General Requirements which govern the work. Products and Execution modify and supplement these by detailed requirements for the work and shall always govern whenever there appears to be a conflict.

F. Intent

1. All work called for in the Specifications applicable to this Contract, but not shown on the Drawings in their present form, or vice versa, shall be of like effect as if shown or mentioned in both. Work not specified in either the Drawings or in the Specifications but involved in carrying out their intent or in the complete and proper execution of the work, is required and shall be performed by the Contractor as though it were specifically delineated or described.

2. The apparent silence of the Specifications as to any detail, or the apparent omission from them of a detailed description concerning any work to be done and materials to be furnished, shall be regarded as meaning that only the best general practice is to prevail and that only material and workmanship of the best quality is to be used, and interpretation of these Specifications shall be made upon that basis.

3. The inclusion of the Related Requirements (or work specified elsewhere) in the General part of the specifications is only for the convenience of the Contractor and shall not be interpreted as a complete list of related Specification Sections.

1.03 MATERIALS

A. Manufacturer

1. The names of proposed manufacturers, material, suppliers and dealers who are to furnish materials shall be submitted to the Engineer for approval. Such approval must be obtained before shop drawings will be checked. No manufacturer will be approved for any materials to be furnished under this Contract unless they shall be of good reputation and have a plant of ample capacity. The Contractor shall, upon the request of the Engineer, be required to submit evidence that he has manufactured a similar product to the one specified and that it has been previously used for a like purpose for a sufficient length of time to demonstrate its satisfactory performance.

2. All transactions with the manufacturers or subcontractors shall be through the Contractor, unless the Contractor shall request, in writing to the Engineer, that the manufacturer or subcontractor deal directly with the Engineer. Any such transactions shall not in any way release the Contractor from his full responsibility under this Contract.

3. Any two or more pieces of material or equipment of the same kind, type or classification, and being used for identical types of service, shall be made by the same manufacturer.

B. Delivery

1. The Contractor shall deliver materials in ample quantities to insure the most speedy and uninterrupted progress of the work so as to complete the work within the allotted time.

The Contractor shall also coordinate deliveries in order to avoid delay in, or impediment of, the progress of the work of any related Contractor.

2. The Contractor shall deliver materials and equipment in Manufacturer's original unopened and undamaged containers with legible labeling. Materials and equipment shall be stored in such manner as to prevent damage from environment and construction operations. Handling shall be in accordance with Manufacturer's requirements.

1.04 INSPECTION AND TESTING

A. General

1. Inspection and testing of materials will be performed by the Contractor unless otherwise specified.

2. For tests specified to be made by the Contractor, the testing personnel shall make the necessary inspections and tests and the reports thereof shall be in such form as will facilitate checking to determine compliance with the Contract Documents. Two copies of the reports shall be submitted and authoritative certification thereof must be furnished to the Engineer as a prerequisite for the acceptance of any material or equipment.

3. If, in the making of any test of any materials, it is ascertained by the Engineer that the material or equipment does not comply with the Contract, the Contractor will be notified thereof and he will be directed to refrain from delivering said materials or to remove it promptly from the site or from the work and replace it with acceptable material, without cost to the District.

B. Costs

1. All inspection and testing of materials furnished under this Contract will be performed by the Contractor or duly authorized inspection engineer or inspection bureaus in accordance with appropriate bid items.

2. Materials submitted by the Contractor as the equivalent to those specifically named in the Contract may be tested by the District for compliance. The Contractor shall reimburse the District for the expenditures incurred in making such tests on materials which are rejected for non-compliance.

C. Inspection of Materials

1. The Contractor shall give notice in writing to the Engineer, sufficiently in advance of his intention to commence the manufacture or preparation of materials especially manufactured or prepared for use in or as part of the permanent construction. Such notice shall contain a request for inspection, the date of commencement and the expected date of completion of the manufacture or preparation of materials. Upon receipt of such notice, the Engineer will arrange to have a representative present at such times during the manufacture as may be necessary to inspect the materials or he will notify the Contractor that the inspection will be made at a point other than the point of manufacture, or he will notify the Contractor that inspection will be waived. The Contractor must comply with these provisions before shipping any material. Such inspection shall not release the

Contractor from the responsibility for furnishing materials meeting the requirements of the Contract Documents.

D. Certificate of Manufacture

1. When inspection is waived or when the Engineer so requires, the Contractor shall furnish to him authoritative evidence in the form of Certificates of Manufacture that the materials to be used in the work have been manufactured and tested in conformity with the Contract Documents. These certificates shall be notarized and shall include copies of the results of physical tests and chemical analyses, where necessary, that have been made directly on the product or on similar products of the manufacturer.

E. Final Field Tests

1. Upon completion of the work and prior to final payment, all materials installed under this Contract shall be subjected to acceptance tests as specified or required to prove compliance with the Contract Documents.

2. The Contractor shall furnish labor, fuel, energy, and all other materials, equipment and instruments necessary for all acceptance tests, at no additional cost to the District. The Furnishing Supplier shall assist in the final field tests as applicable.

F. Failure of Tests

1. Any defects in the materials or their failure to meet the tests, guarantees or requirements of the Contract Documents shall be promptly corrected by the Contractor by replacements or otherwise. The decision of the Engineer and District as to whether or not the Contractor has fulfilled his obligations under the Contract shall be final and conclusive. If the Contractor fails to make these corrections or if the improved materials, when tested, shall again fail to meet the guarantees or specified requirements, the District, notwithstanding its partial payment for work, and materials, may reject the materials and may order the Contractor to remove them from the site at his own expense.

2. In case the District rejects any materials, then the Contractor shall replace the rejected materials within a reasonable time. If he fails to do so, the District may, after the expiration of a period of 30 calendar days after giving him notice in writing, proceed to replace such rejected materials, and the cost thereof shall be deducted from any compensation due or which may become due the Contractor under his Contract.

G. Final Inspection

1. During such final inspections, the work shall be clean and free from water. In no case will the final estimate be prepared until the Contractor has complied with all requirements set forth and the Engineer and District have made their final inspection of the entire work and is satisfied that the entire work is properly and satisfactorily constructed in accordance with the requirements of the Contract Documents.

1.05 TEMPORARY STRUCTURES

A. Responsibility for Temporary Structures

1. In accepting the Contract, the Contractor assumes full responsibility for the sufficiency and safety of all temporary structures or work and for any damage which may result from their failure or their improper construction, maintenance or operation and will indemnify and save harmless the District from all claims, suits or actions and damages or costs of every description arising by reason of failure to comply with the above provisions.

1.06 SAFETY

A. Accident Prevention

1. Precautions shall be exercised at all times for the protection of person and property. The safety provisions of applicable laws, building and construction codes shall be observed. The Contractor shall comply with the U.S. Department of Labor Safety and Health Regulations for construction promulgated under the Occupational Safety and Health Act of 1970 (PL 91-596), and under Section 107 of the contract Work Hours and Safety Standards Act (PL-54), except where state and local safety standards exceed the federal requirements and except where state safety standards have been approved by the Secretary of Labor in accordance with provisions of the Occupational Safety and Health Act, shall be complied with.

B. First Aid

1. The Contractor shall keep upon the site, at each location where work is in progress, a completely equipped first aid kit and shall provide ready access thereto at all times when people are employed on the work.

1.07 LINES AND GRADES

A. Grade

1. All work under this Contract shall be constructed in accordance with the lines and grades shown on the Drawings, or as approved by the Engineer. The full responsibility for keeping alignment and grade shall rest upon the Contractor.

2. The Engineer has established benchmarks as shown on the drawings. Reference marks for lines and grades as the work progresses will be located in such a manner by the Contractor as to cause as little inconvenience to the prosecution of the work as possible. The Contractor shall so place excavation and other materials as to cause no inconvenience in the use of the reference marks provided. The Contractor shall remove any obstructions placed by him contrary to this provision.

B. Surveys

1. The Contractor shall furnish and maintain, at his own expense, stakes and other such materials, and give such assistance, including qualified helpers, as may be required by the Engineer for setting reference marks. The Contractor shall check such reference marks by such means as he may deem necessary and, before using them, shall call the Engineer's

attention to any inaccuracies. The Contractor shall, at his own expense, establish all working or construction lines and grades as required from the reference marks set by the Engineer, and shall be solely responsible for the accuracy thereof.

C. Safeguarding Marks

1. Contractor shall safeguard all points, stakes, grade marks, monuments and bench marks made or established on the work, bear the cost of reestablishing them if disturbed, and bear the entire expense of rectifying work improperly installed due to not maintaining or protecting or to removing without authorization such established points, stakes and marks.

2. The Contractor shall safeguard all existing and known property corners, monuments and marks adjacent to but not related to the work and, if required, shall bear the cost of reestablishing them if disturbed or destroyed.

D. Datum Plane

1. All elevations indicated or specified refer to the North American Vertical Datum of 1988 (NAVD88).

1.08 ADJACENT STRUCTURES AND LANDSCAPING

A. Responsibility

1. The Contractor shall also be entirely responsible and liable for all damage or injury as a result of his operations to all other adjacent public and private property, structures of any kind and appurtenances thereto met with during the progress of the work. The cost of protection, replacement in their original locations and conditions or payment of damages for injuries to such adjacent public and private property and structures affected by the work, whether or not shown on the Drawings, and the removal, relocation and reconstruction of such items called for on the Drawings or specified shall be included in the various Contract Items and no separate payments will be made therefore. Where such public and private property, structures of any kind and appurtenances thereto are not shown on the Drawings and when, in the opinion to avoid interference with the work, payment therefore will be made as provided for in the General Conditions.

2. Contractor is expressly advised that the protection of buildings, structures, tunnels, tanks, pipelines, etc. and related work adjacent and in the vicinity of his operations, wherever they may be, is solely his responsibility. Conditional inspection of buildings or structures in the immediate vicinity of the project which may reasonably be expected to be affected by the Work shall be performed by and be the responsibility of the Contractor.

3. Contractor shall, before starting operations, make an examination of the interior and exterior of the adjacent structures, buildings, facilities, pools, etc., and record by notes, measurements, photographs, etc., conditions which might be aggravated by open excavation and construction. Repairs or replacement of all conditions disturbed by the construction shall be made to the satisfaction of the District and to the satisfaction of the Engineer. This does not preclude conforming to the requirements of the insurance underwriters. Copies of surveys, photographs, reports, etc., shall be given to the Engineer and District.

4. Prior to the beginning of any excavations the Contractor shall advise the Engineer of all buildings or structures on which he intends to perform work or which performance of the project work will affect.

B. Lawn Areas

1. Lawn areas shall be left in as good condition as before the starting of the work. Where sod is to be removed, it shall be carefully removed, and later replaced, restored with new sod, or left as bare soil in the manner described in these specifications or on the drawings.

1.09 PROTECTION OF WORK AND PUBLIC

A. Barriers and Lights

1. During the prosecution of the work, the Contractor shall put up and maintain at all times such barriers and lights as will effectually prevent accidents. The Contractor shall provide suitable barricades, red lights, "danger" or "caution" or "street closed" signs and watchmen at all places where the work causes obstructions to the normal traffic or constitutes in any way a hazard to the public, in accordance with state and local requirements.

B. Smoke Prevention

1. The Contractor shall use hard coal, coke, oil or gas as fuel for equipment generating steam. A strict compliance with ordinances regulating the production and emission of smoke will be required. No open fires will be permitted.

C. Noise

1. The Contractor shall eliminate noise to as great as extent as practicable at all times. Electric or quiet pumps shall be used as the primary to limit noise. Backup fuel powered pumps are acceptable. Air compressing plants shall be equipped with silencers and the exhaust of all gasoline motors or other power equipment shall be provided with mufflers. The Contractor shall strictly observe all local regulations and ordinances covering noise control.

2. Sound levels shall not exceed 65dba during working hours. This sound level to be measured at the property line of the nearest residence and/or commercial structure. Sound levels in excess of these values are sufficient cause to have the work halted until equipment can be quieted to these levels. Work stoppage by the District for excessive noise shall not relieve the Contractor of the other potions of this specification including, but not limited to contract time and contract price.

3. If mufflers cannot achieve the necessary noise reduction, noise abatement shall be accomplished by the Contractor’s installation of baffles (or other acceptable means) positioned to break line-of-site from the noise source to affected residences and/or commercial structures. Minimum noise abatement measures shall consist of equipping all engines with hospital grade mufflers or silencers.

D. Access to Public Services

1. Neither the materials excavated nor the materials or plant used in the construction of the work shall be so placed as to prevent free access to all fire hydrants, valves or manholes.

E. Dust Prevention

1. The Contractor shall prevent dust nuisance from his operations or from traffic by keeping the roads and/or construction areas sprinkled with water at all times.

1.10 CUTTING AND PATCHING

A. The Contractor shall do all cutting, fitting or patching of his portion of the work that may be required to make the several parts thereof join and coordinate in a manner satisfactory to the Engineer and in accordance with the Drawings and Specifications. The work must be done by competent workmen skilled in the trade required by the restoration.

1.11 CLEANING

A. During Construction

1. During construction of the work, the Contractor shall, at all times, keep the site of the work and adjacent premises as free from material, debris and rubbish as is practicable and shall remove the same from any portion of the site if, in the opinion of the Engineer, such material, debris, or rubbish constitutes a nuisance or is objectionable.

2. The Contractor shall remove from the site all of his surplus materials and temporary structures when no further need therefore develops.

3. The Contractor shall be responsible and liable for all spillage and incur all associated costs including, but not limited to, costs related to repair and maintenance resulting from damages thereof.

B. Final Cleaning

1. At the conclusion of the work, all erection plant, tools, temporary structures and materials belonging to the Contractor shall be promptly taken away, and he shall remove and promptly dispose of all water, dirt, rubbish or any other foreign substances.

2. The Contractor shall thoroughly clean all materials installed by him and shall deliver such materials undamaged and in a clean condition.

1.12 MISCELLANEOUS

A. Protection Against Siltation and Bank Erosion

1. The Contractor shall arrange his operations to minimize siltation and bank erosion on construction sites and on existing or proposed water courses and drainage ditches.

2. The Contractor, at his own expense, shall remove any siltation deposits and correct any erosion problems as directed by the Engineer or other agencies which results from his construction operations.

B. Existing Facilities

1. The work shall be so conducted to maintain existing facilities in operation insofar as is possible. Requirements and schedules of operations for maintaining existing facilities in service during construction shall be as described in these Specifications.

C. Use of Chemicals

1. All chemicals used during project construction or furnished for project operation, whether herbicide, pesticide, disinfectant, polymer, reactant, or of other classification, must show approval of either EPA or USDA. Use of all such chemicals and disposal of residues shall be in strict conformance with instructions.

PART 2 PART 2 - PRODUCTS (NOT USED)

PART 3 PART 3 - EXECUTION (NOT USED)

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SECTION 01010
SUMMARY OF WORK

PART 1 GENERAL

1.01 OWNER/DISTRICT

A. Throughout these Contract Documents, the terms "Owner" and "District" shall have the same meaning and shall refer to the St. Johns River Water Management District.

1.02 LOCATION OF WORK

A. The Work of this Contract is located within the Camp Blanding (a 73,000-acre training center for Florida National Guard Units) located in southwestern Clay County, Florida. The project site is within an easement that has been granted to the District. The project site is located on the southwest side of Treat Road approximately 1 mile west of the intersection of Treat Road and State Road 21 (SR 21) and 2.5 miles north of Keystone Heights, Florida.

1.03 SCOPE OF WORK

A. The Work consists of construction of a water resources development project that will provide passive treatment of diverted surface water in lined earthen basins (containing a granular media) prior to discharge to Alligator Creek. The project includes six treatment basins each covering approximately 2 acres. The granular media will be furnished and delivered to the site, by a Media Supplier under separate contract to the District.

B. Contractor shall furnish all labor, materials, equipment, tools, services, and incidentals required and complete all work required by these Specifications and as shown on the Drawings, including placement/speading of the granular media furnished by the Media Supplier.

C. The scope of work for this contract includes the following:

1. Construction of six treatment basins and associated piping including, but not limited to:

    a. Preconstruction topographic survey
    b. Double-row silt fence installation within two weeks after the District completes gopher tortoise relocation
    c. Erosion and sedimentation control
    d. Clearing and grubbing
    e. Site grading
    f. Yard piping and motor-operated valves
    g. Polyethylene liner
    h. Gravel underdrain
    i. Distribution lateral piping and appurtenances
    j. Drain lateral piping and appurtenances
    k. Spreading of granular media (furnished by the Media Supplier) to the grades indicated on the Drawings

2. All excess clean soils to be loaded, transported to, and unloaded at a stockpile area on Camp Blanding property within 5 road-miles of the project site (debris and other materials from clearing and grubbing operations shall be disposed of outside of Camp Blanding

property at the Contractor's expense). The engineer has estimated the quantity of clean soils at 3,000 cubic yards. However, Contractor is responsible to make its own estimate of excess clean soils.

3. Construction of a water storage tank and flow control system including, but not limited to:

    a. Wire-wrapped prestressed tank
    b. Underslab piping
    c. Interior piping
    d. Above-ground flow control assembly consisting of a flow meter and motor-operated valve
    e. Above-ground influent flow metering facility

4. Raw water transmission main including:

    a. 30-inch raw water piping
    b. Jack and bore (48-inch casing, 30-inch carrier piper)

5. Outfall piping and outfall structure

6. Miscellaneous sitework including, but not limited to:

    a. Asphalt driveway
    b. Fencing and gates
    c. Seeding and sodding
    d. Miscellaneous work and cleanup

7. All instrumentation and electrical components including but not limited to power distribution equipment, conduit, wire, electric valve actuators, control panels, field instruments, and programming.

8. Operational and maintenance manuals for all equipment.

9. Equipment and services for acceptance testing.

10. Warranties and warranty bonds.

11. All testing required during construction and startup.

12. All other work in these contract documents not covered by the items listed above.

D. Contractor shall store all construction equipment and materials outside of gas line easements. Equipment and material storage is the responsibility of Contractor and shall be within limits of disturbance shown on the Drawings, or at additional dedicated staging area(s) obtained by Contractor at no additional cost to the District.

E. Substantial Completion: Refer to the District's Agreement for details and requirements on substantial completion and punch list.

F. Final Completion: The last stage of construction shall be final construction and shall include the final remaining items subject to Engineer's and District's approval as well as items listed in Section 01700 – Contract Closeout.

1.04 WORK SEQUENCE

A. Perform Work in a sequence that will allow completion of the Work in the Contract Time. Completion dates of the various stages shall be in accordance with the approved construction schedule submitted by the Contractor.

1. There will be a 6-month operational testing phase (operation by District) for Cells 1-3 before deliveries of granular media to Cells 4-6 are made.

B. The Contractor shall submit a written construction schedule including ancillary functions including shop drawing preparation and submittal, off-site and on-site testing, commissioning activities, and performance testing to the Engineer for approval prior to commencing work. Completion dates of the various stages shall be in accordance with the approved construction schedule submitted by the Contractor. For additional information related to the construction schedule, refer to the District's Agreement for details and requirements on Scheduling and Work Planning; Progress Reporting.

1.05 CONTRACTOR'S USE OF PREMISES

A. Contractor shall have use of the premises for the performance of the Work.

B. Contractor shall coordinate with the Media Supplier to facilitate deliveries of the granular media.

C. Contractor shall limit the use of the premises for their Work and for storage to allow for:

1. Work by other Contractors.

2. District's occupancy

D. Contractor shall assume full responsibility for security of all subcontractors' materials and equipment stored on the site.

E. If directed by the District or Engineer, Contractor must move any stored items which interfere with operations of the District or other District contractors at no cost to the District.

1.06 CONTRACTOR'S STAGING, STORAGE AND STOCKPILE AREA

A. The Contractor's will not be allowed to stage or store materials and equipment beyond the limits of clearings shown on the Drawings, except that the Contractor may obtain (from others) and pay for use of additional storage and staging areas if needed to perform the work.

1.07 DISTRICT OCCUPANCY

A. Coordinate all construction operations with District or Engineer to minimize conflict and to facilitate District usage.

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SECTION 01014
CONSTRUCTION SEQUENCE AND CONSTRAINTS

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. The construction progress schedule required under Section 01310 shall reflect the conditions presented in this section.

B. See Sections 01465 and 01730 for additional requirements and Divisions 11 through 16, inclusive, on specific equipment startup and testing requirements.

C. During Start-Up Testing, make available the manpower, equipment and manufacturer's representatives required to make any necessary adjustments and training.

1.02 NOTIFICATION REQUIREMENTS

A. The Contractor shall give a minimum of 14 days advance written notice to the Engineer and District of each component proposed for shutdown, tie-in, or disruption, all of which shall be subject to District's approval and limitations. Shutdowns, tie-ins or disruptions specifically mentioned in this Section must conform to this requirement and any others requested by the Engineer or District.

1.03 SUBMITTAL REQUIREMENTS

A. Contractor shall submit the proposed construction sequence to be approved by Engineer and District prior to beginning work.

B. Contractor shall submit shop drawings and working drawings in accordance with Section 01300 to show details of all temporary services and connections to existing systems.

1.04 SITE CONDITIONS

A. Contractor is required to coordinate all areas of construction with the District in order to accomplish the Work in a logical order that allows construction to be completed within the time specified in the Contract Documents. Contractor is responsible to coordinate all of its activities with its and other contractors (if any) to allow orderly and timely completion of all work. Time is of the essence for each and every aspect of this project.

B. Coordinate the activities in the interface or common areas with these other contractors and the District personnel. Submit to the Engineer a description and schedule as to how the common areas will be utilized, recognizing the required coordination with other contractors.

C. When the work requires an existing facility to be taken out of operation, temporarily or permanently, notify the Engineer and District 7 days in advance.

1.05 CONSTRUCTION CONSTRAINTS

A. The following is a list of constraints to consider in developing the overall plan of construction. This list is not intended to release the Contractor from the responsibility to coordinate the work

in any manner which will ensure project completion within the time allowed. The following areas are not necessarily listed in their required sequence of construction. A suggested sequence within each area, where necessary, is included.

B. The Contractor must have at least one Unexploded Ordinance (UXO) trained individual on site, during all activity that occurs on Camp Blanding property (includes Treat Road). UXO training will be provided by Camp Blanding staff at no cost to the Contractor. The training shall be scheduled with Camp Blanding conservation manager, Matt Corby at (904) 626-8572. The training is only required once per individual. The District strongly encourages the Contractor to obtain the training for multiple members of its staff. If any of the staff changes during the contract term, training for the new individuals shall be required. The Contractor will coordinate the additional training with Camp Blanding's conservation manager.

C. Contractor to man gate on Treat Road.

D. Sitework

1. Double-row silt fence shall be installed to completely encompass the limits of construction within two weeks after the District completes gopher tortoise survey and relocation activities. The silt fences shall remain in place throughout the duration of construction.

2. All underground pipes, conduits, cables, duct banks, and structures shall be located by electronic locator equipment and test pits in each area of excavation and flagged and mapped before any excavation is performed for structures, pipes, cables, conduits, duct banks, or removals. Working drawings of existing and proposed new work shall be prepared to scale and submitted to the Engineer in advance of excavation. The Contractor shall be fully responsible for any process outages caused by disruption of underground facilities including responsibility for regulatory fines.

3. The Contractor's field office shall be set up and fully equipped and all utilities connected prior to initiation of onsite construction (excluding silt fence installation). The office shall be removed not earlier than the date of substantial completion and not later than the date of final payment.

4. The Contractor shall provide a fully operational office for the Engineer's Resident Project Representative (RPR) within 30 days after insurance of the Effective Date of the Agreement.

5. Existing utilities include Florida Gas Transmission (FGT) gas mains within a dedicated FGT easement. Contractor shall comply with appliable FGT requirements for all Work within the Florida Gas easement included at the end of this section.

6. All underground pipes, conduits, cables, duct banks, and structures installation work shall be organized and scheduled to accomplish the following:

    a. District access to operating facilities shall be maintained at all times.
    b. All underground work in each area shall be performed concurrently to avoid subsequent trenching through the same areas.
    c. Yard electrical work and piping work shall be shown on the same working drawings and fully coordinated horizontally and vertically.

7. After the Contractor has completed construction of the cells except for the media, the Media Supplier (under separate contract to the District) will transport the treatment media to the cells and unload the media along the berm on one side of each cell. The Contractor is responsible for spreading the media to the grades indicated on the Drawings.

8. Cells 1, 2, and 3 are to be completed first, including placement of media. Upon completion of Cells 1 through 3, there will be a 6-month operational testing phase (operation by District) before the media for Cells 4, 5, and 6 is delivered, to be placed by the Contractor.

9. New asphalt pavement shall not be installed until all piping, cables, conduits, and duct banks under the paved area have been installed. Roads shall be stabilized with crushed stone until that time. The surface pavement course and cap on existing roads shall not be installed until all other construction work is finished. Any weak areas in base course or existing pavement shall be removed and replaced prior to the final surface course installation.

10. Locations and numbers of sedimentation control facilities shall be adjusted as the work progresses so that all site runoff flows through sedimentation control facilities at all times. Facilities shown are minimums only. At no time shall undesilted water be allowed to leave the site. Maintenance and upgrading of facilities shall be scheduled weekly and after all rain events.

11. Discharges from the Contractor's dewatering operations (if applicable) shall be in accordance with the requirements of the NPDES permit for construction activities obtained by the Contractor from the Florida Department of Environmental Protection (FDEP) or in accordance with a "Generic Permit for Discharge of Groundwater from Dewatering Operations" obtained by the Contractor from the FDEP.

12. All connections to existing facilities shall be scheduled through the Engineer and the District to minimize the impact on existing pump stations and construction progress.

13. All existing trees and vegetation located outside of the limits of clearing shown on the Drawings shall be protected and remain undamaged at all times.

E. Testing

1. All facilities and systems shall be tested as a condition precedent to substantial completion. See Section 01465 and equipment specifications for additional requirements. Start-up plans for each facility and equipment shall be submitted, reviewed and approved by the Engineer and the District.

1.06 PERMITS

A. The Contractor shall arrange for all required inspections and shall close out all Contractor-obtained permits at the end of the Contract.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

ENGINEERING AND CONSTRUCTION SPECIFICATIONS

1. No work can be done in FGT's easement property unless FGT has reviewed and approved the plans and an agreement in writing has been entered into between FGT and Owner. Any encroachment consented to by FGT shall not interfere with the operation, maintenance, and access of FGT's pipeline facilities, including but not limited to, close interval surveys; leak detection surveys; pipeline patrol, pipeline marking and similar activities.

2. Owner shall provide a minimum of forty-eight (48) hours' notice to FGT prior to any installation, construction, excavation, or demolition work on the easement area. To ensure further safety, Owner must call appropriate ONE CALL for a locate by calling 811. An FGT representative must be present when any work is done on the easement area. The onsite FGT representative will have the authority to shutdown work by the Owner if the Owner's activities are judged to be unsafe by the FGT representative. The FGT representative will be invited to participate in Owner's safety meetings. This provision applies each time FGT's pipeline facilities are crossed.

3. Existing ground elevation is to be maintained.

4. For vehicles and/or construction equipment requesting approval to cross FGT's facilities, each crossing location will be reviewed on a case-by-case, site-specific basis and will require the surveyed elevation of the pipeline and/or facility verified by an FGT field representative to be performed by the party requesting the crossing encroachment and submitted to FGT. The execution of a wheel load calculation must be completed and approved by FGT prior to crossing FGT's facilities for every vehicle and/or construction equipment requesting to cross. FGT may require matting or other suitable material be installed to achieve the necessary support for such crossing. This too will be site specific and case-by-case only.

5. Where consent for roadway crossings has been granted, a minimum of forty-eight inches (48") of cover, including thirty-six (36") of undisturbed or compacted soil, shall be maintained within the easement area. All roads must cross the easement at a ninety degree (90°) angle.

6. Upon completion of paragraph 1, sidewalks, trails and bike paths may cross FGT's pipelines at a ninety degree (90°) angle provided the width does not exceed forty-eight inches (48").

7. When crossing an FGT pipeline (via drill or open lay) Owner must visually verify the elevation of the pipeline both vertically and horizontally, by an FGT approved method such as vacuum excavation with an FGT field representative on-site at all times during this operation. When using directional drill method, a minimum vertical clearance of ten feet (10') from the pipeline is required across the entire easement.

8. Where the encroachment includes utilities, all such utilities crossing the easement area must have a minimum separation of twenty-four inches (24") between the utility and the FGT pipeline(s) at the point of crossing and must cross at a ninety degree (90°) angle. No utilities shall be constructed between the surface of the easement area and the top of the subsurface pipeline facilities unless agreed to in writing by FGT. No parallel utilities, structures, and/or appurtenances are permitted within the easement area. All proposed aerial crossings will be reviewed on a case-by-case basis.

9. Where consent for fiber optic, telephone and/or cable television lines has been granted, lines must be placed in a rigid non-metallic conduit across the entire easement width with bags of concrete-mix placed directly above and below the conduit across the confines of the easement. Orange warning burial tape must be placed a minimum of 18" directly above the cable across the width of the easement. Crossings must be clearly and permanently marked on each side of the easement with permanent identification.

10. Where consent for utility lines has been granted, electric lines must be encased in pvc or steel throughout the entire easement area. Cables energized to 600 volts or more must cross a minimum of three feet (3') below the subsurface pipeline facilities, and also be encased in concrete, color coded red, across the entire easement width, and have external, spiral wound, neutrals grounded on each side of the easement. The cable crossing should be clearly and permanently marked on each side of the easement where permissible.

11. Where consent for fencing has been granted, the Owner must install and maintain a vehicle access gate at least twelve feet (12') in width at each point in the fence line(s) crossing the easement area. Posthole excavations for fencing placed on the easement area shall not be greater than eighteen inches (18") below the ground surface elevation. No fence posts shall be placed over the pipeline facilities or closer than six feet (6') on either side of the pipeline facilities. Any exceptions will be determined by FGT management. Any such fence shall be constructed and maintained by Owner in such a manner that does not prevent FGT personnel from viewing the easement area from the ground level through the fence(s) (i.e. no solid fences allowed). No fencing parallel to the FGT pipeline facilities will be allowed within the easement area. FGT's access to its pipeline facilities shall be maintained by Owner. If the gate is locked with Owner's lock, Owner shall provide FGT with keys or allow a FGT lock to enable access.

12. No retention ponds, ditches or swales shall be allowed within the easement area.

13. No roto-mixing or vibrating machinery is allowed within the easement area.

14. When conducting pile driving operations, Owner shall adhere to a minimum separation of twenty-five feet (25') from the outside edge of the FGT pipeline.

15. Excavations that expose the FGT pipeline must follow OSHA standards. Time will be allowed for a FGT representative to inspect and make coating repairs as the subsurface pipeline facilities are exposed.

16. Twelve inches (12") of backfill around the subsurface pipeline facilities shall be sand or clean fill; free of rocks and debris.

17. With prior approval, no more than twenty feet (20') of pipe shall be exposed at any given time; if more than twenty feet (20') of pipe is to be exposed, all Standard Operating Procedures (SOP) must be adhered to, pressure reductions must be scheduled at least one (1) year in advance and engineering stress calculations must be performed by FGT Engineering and approved by FGT management prior to allowing any more than the twenty feet (20') of exposed pipe.

18. With prior approval and an FGT representative on site at all times, excavation equipment equipped with toothless buckets may be allowed to dig or excavate within three (3) feet of the pipeline facilities. All other construction/excavation equipment will not be allowed to perform any excavation within three feet (3') of the pipeline facilities. All mechanical excavation performed within three feet (3') of the pipeline will be performed parallel to the pipeline (i.e. track-hoe may not reach over the pipeline to dig on the opposite side of the pipeline).

19. All excavation within twenty-four (24") from the top or thirty-six inches (36") from the side or bottom of the pipeline shall be by manual means. After top exposure, excavation up to twenty four inches (24") from the side or bottom of the exposed pipeline may proceed by mechanical means if the FGT representative is satisfied it may be done safely with the equipment and operator available.

20. Barriers adequate to prevent vehicular damage to any exposed pipeline facilities shall be installed and maintained at all times.

21. All FGT pipeline facilities, cathodic protection equipment, and test lead wires shall be protected from damage by construction activity at all times.

22. No installation, construction, excavation, or demolition work shall be performed within the easement area on weekends or holidays.

23. The Owner shall provide and install temporary construction fence along the easement boundaries for the entire length of the proposed work area to preserve and protect the pipeline(s). The fence must be maintained for the duration of the development or construction activity. Access across FGT's easement will be granted at specific locations for vehicle and equipment traffic once a wheel load calculation has been completed. Additional cover or matting may be required. Any changes to this requirement must be approved in writing by FGT prior to start of work.

24. Where consent for landscaping has been granted, Owner shall not plant shrubs on the easement area which are classified as "deep rooted" or are projected to exceed an eventual growth height of four (4) feet. Shrubs shall be planted so that no part, at its ultimate growth, shall be closer than ten feet (10') to the pipeline facilities. No trees shall be planted on the easement.

25. These Engineering and Construction Specifications may address activities on the easement area for which FGT has not granted consent to Owner to include as part of the encroachment. Notwithstanding anything to the contrary contained in these Engineering and Construction Specifications, FGT's consent is and shall be limited to the encroachment as described and limited by the Encroachment Agreement to which this Exhibit is attached.

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SECTION 01025
MEASUREMENT AND PAYMENT

PART 1 GENERAL

1.01 SCOPE

A. This Section includes specification for the measurement and payment of the various elements of the Work; with provisions applicable to lump sum prices, unit prices, and allowances, if applicable.

B. In the case of conflict between this Section and the measurement methods specified in the individual technical Sections, the measurement methods in the technical specifications shall govern.

C. The Contractor shall receive no payment for any portion of the work until it is installed. The only exception to this is payment for stored materials on site if the Contract provides for the payment of stored materials. Partial payment may be requested for items partially installed.

1.02 RELATED WORK

A. Schedule of Values is included in Section 01370

B. Applications for Payment are included in Section 01026.

C. General Conditions

1.03 LUMP SUM ITEMS

A. Lump Sum measurement will be for the entire item, unit of work, structure, or combination thereof, as specified and as indicated in the Cost Schedule. Measurement and payment for all bid items indicated as Lump Sums shall include the cost of all labor, materials and equipment necessary to furnish, install, clean, test, and place each bid item into operation; including permitting, general conditions, overhead and profit.

B. Progress payments will be based on the Schedule of Values prepared by the Contractor as approved by the Engineer and District (in writing) before acceptance of the first Application for Payment.

C. In order for the Contractor to request progress payments against Lump Sum items, Contractor shall provide a disaggregation or breakdown in sufficient measurable detail that is acceptable to the Engineer and the District.

D. Measurement

1. Measurement shall be based on the estimated percent complete of each item of the Schedule of Values, as determined by the Engineer and approved by the District.

E. Payment

1. Payment will be made at the lump sum price proportional to the completion percentages approved by the Engineer and the District.

1.04 UNIT PRICE ITEMS

A. Quantity and measurement estimates stated in the Cost Schedule are estimates for bidding purposes only. Actual payments shall be based on actual quantities installed, in-place, as measured and/or verified by the Engineer and approved by the District.

B. Unless otherwise provided in the General Conditions, the bid unit prices shall be in effect throughout the contract duration, regardless of variances between the estimated quantities and the actual installed quantities.

C. The Contractor shall make no claim, nor receive any compensation, for anticipated profits, loss of profit, damages, or any extra payment due to any difference between the amounts of work actually completed, or materials or equipment furnished, and the estimated quantities

D. Unless otherwise approved by the District, any unit quantities exceeded may not be invoiced until the estimated quantity is increased by contract change order.

E. Contractor shall assist Engineer by providing necessary equipment, workers, and survey personnel as required to measure quantities.

F. Measured quantities shall be rounded to the nearest whole integer, unless the value of the unit price exceeds $100, in which case measured quantities shall be rounded to the nearest half unit.

G. Measurement

1. Measurement for progress payment shall be made by, or approved by, the Engineer based on the estimated effective quantity installed. The effective quantity installed represents the actual units or quantities installed, adjusted for incomplete elements or components.

2. Unless otherwise provided for in the Cost Schedule unit price items are all-inclusive of all related work, direct and indirect, to provide a complete and functional item. For example, underground pipe installation would include trenching, shoring, dewatering, bedding, installation, backfill, testing, flushing, disinfection, and commissioning; including all labor, materials and equipment necessary to furnish, install, clean, test, and place into operation; including permitting, general conditions, overhead and profit.

3. The final measurement shall be based on actual quantities, jointly measured by Contractor and Engineer, complete, fully, tested and placed into service.

H. Payment

1. Progress payments shall be in accordance with the contract documents based on estimated effective quantities installed, paid at the bid unit price.

2. The final payment shall be based on actual quantities, fully installed, tested and placed into service, paid at the bid unit price.

1.05 ALLOWANCES

A. Allowances, if any, specified in the Contract Documents and indicated in the Cost Schedule are considered provisional amounts to be used only if needed. Allowances are exclusive of work indicated in the Contract Documents for which payment is included under other items in the Cost Schedule. No work may be performed under an allowance without prior written approval of the District.

B. Any unused balance of the allowances shall revert to the District upon completion of the project. Prior to final payment, the original amount provided for allowances shall be adjusted to actual costs by deductive Change Order, adjusting the contract price, accordingly.

C. The Contractor shall make no claim, nor receive any compensation, for anticipated profits, loss of profit, damages, or any extra payment due to any unexpended portion of the allowances.

D. The Contractor is to include time for allowance work in the construction schedule. No adjustment of Contract Time shall be allowed for any work performed under allowance items unless approved by District in a written change order.

E. Allowance items shall be included in the Schedule of Values.

F. The measurable and allowable costs for work performed under an Allowance item shall be limited to the actual, demonstrable, and direct costs associated with that Allowance item plus associated overhead and profit. Shipping and sales taxes are allowable costs.

1. Work authorized by the District under an allowance may be performed as a lump sum (negotiated before the fact), unit prices (when applicable), or time and material. For work performed under time and material, Contractor shall submit detailed verification (break-down) of all costs, subject to the approval of the Engineer or District.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.01 LUMP SUM BID ITEMS

A. Construction of the Black Creek Water Resource Development Project - Aquifer Recharge Area Complete

1. Payment shall be full compensation for all Work shown on the Contract Drawings and as specified herein including clearing and grubbing, earthwork, grading, drainage, ground storage tank, 30-inch raw water transmission main (including jack and bore of gas line easement), distribution and drainage system yard piping and valves, miscellaneous site work, off-site transport of up to 3,000 cubic yards of excess clean soil, and all ancillary items necessary to provide a fully-functioning system. The Contractor shall furnish and install all material and equipment and shall furnish all supervision, equipment, labor, overhead and profit required to complete the Work in-place, fully tested, ready for continuous uninterrupted service and Final Acceptance by the District.

2. Measurement shall be in accordance with the accepted Schedule of Values (Section 01370).

3. Progress payments shall be based on the actual percentage of Work satisfactorily completed during the progress payment period in accordance with the approved Schedule of Values. Final Payment shall be the balance of the stated Lump Sum as adjusted by approved Change Orders.

END OF SECTION

SECTION 01026
APPLICATION FOR PAYMENT

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. Submit Applications for Payment to the District in accordance with the schedule established by Conditions of the Contract and Agreement between District and Contractor.

B. The accepted Schedule of Values, Section 01370, shall be used as the basis for the Contractor's Application for Payment.

1.02 RELATED WORK

A. Agreement between District and Contractor is included in the Front-End Documents provided by the District.

B. Schedule of Values are included in Section 01370.

C. Audio Video Taping and Construction Photographs are included in Section 01380.

D. Contract Closeout is included in Section 01700.

1.03 SUBMITTALS

A. Submit, in accordance with Section 01300, applications typed on forms provided by the District, Application for Payment, with itemized data typed on 8-1/2-in by 11-in or 8-1/2-in by 14-in white paper continuation sheets.

B. Provide itemized data on continuation sheet.

1. Format, schedules, line items and values: Those of the Schedule of Values accepted by the Engineer.

C. Provide construction photographs in accordance with Section 01380.

D. As a prerequisite for payment, Contractor shall submit the following:

1. Updated schedule

2. Man hours

3. Updated record drawings (red-lines)

1.04 PREPARATION OF APPLICATION FOR EACH PROGRESS PAYMENT

A. Application Form

1. Fill in required information, including that for Change Orders executed prior to date of submittal of application.

2. Fill in summary of dollar values to agree with respective totals indicated on continuation sheets.

3. Include signature of a responsible officer of Contract firm.

4. The Contractor shall provide an example Application for Payment for District's approval at least 30 days prior to submission of first payment request.

B. Continuation Sheets

1. Fill in total list of all scheduled component items of Work, with item number and scheduled dollar value for each item.

2. Fill in dollar value in each column for each scheduled line item when work has been performed or products stored.

   a. Round off values to nearest dollar, or as specified for Schedule of Values.

3. List each Change Order executed prior to date of submission, at the end of the continuation sheets.

   a. List by Change Order Number and description, as for an original component item of work.

4. To receive approval for payment on component material stored on site, submit copies of the original paid invoices with the application for payment.

1.05 SUBSTANTIATING DATA FOR PROGRESS PAYMENTS

A. When the District requires substantiating data, submit suitable information, with a cover letter identifying.

1. Project.

2. Application number and date.

3. Detailed list of enclosures.

4. For stored products:

   a. Item number and identification as shown on application.
   b. Description of specific material.

B. Submit one copy of data and cover letter for each copy of application.

C. Maintain an updated set of red-line drawings to be used as as-build drawings in accordance with Section 01720. As a prerequisite for monthly progress payments, exhibit the updated record drawings (updated to within seven days of pay application date) for review by the District and the Engineer.

1.06 PREPARATION OF APPLICATION FOR FINAL PAYMENT

A. Fill in Application form as specified for progress payments.

B. Use continuation sheet for presenting the final statement of accounting as specified in Section 01700.

C. Submit all Project Record Documents in accordance with Section 01050 and 01700.

1.07 SUBMITTAL PROCEDURE

A. Submit Draft Application for Payment with required documentation to the District at the time stipulated in the Agreement via e-mail.

B. After approval of the District or after making revisions requested by the District, resubmit approved Application for Payment via email.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 01030
SPECIAL PROJECT PROCEDURES

PART 1 GENERAL

1.01 GENERAL

A. Carefully coordinate and conduct all work in strict accordance with District's requirements and standards.

B. All other permits and approvals will be the responsibility of the Contractor.

1.02 EQUIPMENT DELIVERY AND STORAGE

A. Unload and store equipment within the location(s) shown on the Drawings or as approved by Engineer.

B. Block equipment up, off the ground, protect in accordance with manufacturer recommendations, and store away from drainage ways.

1.03 LINES AND GRADES

A. The Contractor shall be responsible for establishing all lines and measurements necessary to the proper execution and control of the work.

1.04 ACCESS AND DRAINAGE

A. The Contractor shall provide and maintain adequate access to and through the site and shall keep all natural and constructed drainage unobstructed or provide equal courses effectively placed.

1.05 LOCATION, PROTECTION AND MAINTENANCE OF EXISTING UTILITIES, STRUCTURES AND PROPERTY

A. Existing utilities are located and are operating in the construction area. Contractor shall contact the Engineer and ascertain the extent of specific service areas prior to performing any excavation.

B. The location of existing utilities across or along the line of the proposed work is not necessarily shown on the Drawings and, where shown, is only approximately correct. The Contractor shall locate all underground lines and structures prior to excavation.

C. The Contractor shall assume full responsibility for the protection and restoration of all structures, and utilities, public or private, including poles, signs, services to buildings, utilities in the street, gas pipes, water pipes, hydrants, sewers, drains, and electric and telephone cables, whether or not they are shown on the Drawings. Contractor shall carefully support and protect all such structures and utilities from injury. Damages resulting from the construction operations shall be repaired by Contractor.

D. The Contractor shall fully cooperate at all times with the utility owners to maintain the operation of existing utilities with the least amount of interference and interruption possible. Continuous service, public health and safety considerations shall exceed all others and the

Contractor's schedule, plans and work shall at all times be subject to alteration and revision if necessary for these considerations.

E. Temporary support, adequate protection and maintenance of all underground and surface utility installations and structures, drains, sewers, and other obstructions encountered shall be provided as required by the Contractor. Arrange and pay all costs for required support of utility poles and other structures as required by the utility owners prior to excavation.

1.06 NOISE LIMITATIONS

A. All equipment to be furnished under this Contract, unless specified otherwise in the technical specifications, shall be designed to ensure that the sound pressure level does not exceed 85 decibels over a frequency range of 37.8 to 9600 cycles per second at a distance of three ft from any portion of the equipment, under any load condition, when tested using standard equipment and methods. Noise levels shall include the noise from the motor. Mufflers or external baffles shall not be acceptable for the purpose of reducing noise. Data on noise levels shall be included with the shop drawing submittal.

1.07 SPARE PARTS

A. Where spare parts are specified in the technical Sections, furnish all spare parts recommended by the manufacturer or system supplier for one year of service. In addition, furnish all spare parts itemized in each Section.

B. Collect and store all spare parts in an area to be designated by the Engineer. Furnish the Engineer with an inventory listing all spare parts, the equipment they are associated with, the name and address of the supplier and the delivered cost of each item. Copies of actual invoices for each item shall be furnished with the inventory to substantiate the delivery cost.

C. Spare parts shall be packed in cartons, properly labeled with indelible markings with complete descriptive information including manufacturer, part number, part name and equipment for which the part is to be used and shall be properly treated for one year of storage.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01045
CUTTING, CORING, AND PATCHING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section covers the cutting, coring, rough and finished patching of holes and openings Holes and opening maybe in existing construction, or in parts of new construction. Procedures for cutting and patching will be the same for either condition.

B. All cutting, coring, and rough patching shall be performed by the Contractor. Finish patching shall be the responsibility of the Contractor and shall be performed by the trade associated with the application of the particular finish.

C. Provide all cutting, fitting and patching, including attendant excavation and backfill, required to complete the work or to:

1. Make its several parts fit together properly.

2. Uncover portions of the work to provide for installation of ill-timed or improperly scheduled work.

3. Remove and replace defective work.

4. Remove and replace work not conforming to requirements of Contract Documents.

5. Remove samples of installed work as specified for testing.

6. Provide penetrations of structural surfaces and materials for installation of piping, ductwork, equipment and electrical conduit.

7. Provide penetrations of non-structural surfaces and materials for installation of piping, ductwork, equipment and electrical conduit. The determination of what is a nonstructural surface or material shall be made by the Engineer.

8. Remove, install, or relocate materials or equipment.

1.02 RELATED WORK

A. Summary of Work is included in Section 01010.

B. Site work is included in Division 02.

C. Concrete is included in Division 03.

D. Masonry is included in Division 04.

E. Conduit sealing methods is included in Division 16.

F. Duct penetration assemblies are included in Division 15.

1.03 SUBMITTALS

A. Submit, in accordance with Section 01300, a written request prior to executing any cutting or alteration which is not shown or detailed on the contract documents which affects or requires:

1. Cutting structural members.

2. Holes drilled in beams or other structural members.

3. Work of the District or any separate contractor.

4. Structural value or integrity of any element of the project.

5. Integrity or effectiveness of weather-exposed or moisture-resistant elements or systems.

6. Efficiency, operational life, maintenance or safety of operational elements.

7. Visual qualities of sight-exposed elements.

B. Request shall include:

1. Identification of the project.

2. Description of affected work.

3. The reason for cutting, alteration or excavation.

4. Effect on work of District or any separate contractor, or on structural or weatherproof integrity of project.

5. Description of proposed work:

a. Method and extent of cutting, patching, alteration, or excavation.
b. Trades who will execute the work.
c. Products proposed to be used.
d. Extent of refinishing to be done.

6. Alternatives to cutting and patching.

7. If the work is considered out of scope, provide a cost proposal.

8. Confirmation of coordination with any separate contractor whose work will be affected.

9. Related shutdown requests if required to do the work.

10. Request for hot work permit if required to do the work.

C. Submit written notice to the Engineer designating the date and the time the work will be uncovered.

D. When a written request is required, do not proceed with the work until a written Effective Date of the Agreement is received from the Engineer.

PART 2 PRODUCTS

2.01 MATERIALS

A. Comply with specifications and standards for each specific product involved. Where there is no equivalent specification, the Contractor shall notify the Engineer who will provide a specification for the materials to be used.

B. Concrete and grout for rough patching shall be as specified in Divisions 3.

C. Materials for finish patching shall be equal to those of adjacent construction. Where existing materials are no longer available, use materials with equivalent properties and that will provide the same appearance. The materials are to be approved by the Engineer prior to their use.

PART 3 EXECUTION

3.01 INSPECTION

A. Inspect existing conditions of project, including elements subject to damage or to movement during cutting and patching.

B. After uncovering work, inspect conditions affecting installation of products, or performance of work.

C. Report unsatisfactory or questionable conditions to the Engineer in writing; do not proceed with work until the Engineer has provided further instructions.

3.02 PREPARATION

A. Provide adequate temporary support as necessary to assure structural value or integrity of affected portion of work.

B. Protect surrounding materials and equipment prior to starting work.

C. Contain and control cooling liquids and slurry produced by the cutting and coring operations.

D. When the cutting or coring will result in the structure or equipment being exposed to provide adequate weather protection.

E. Provide dewatering for excavation work in accordance with Division 2.

3.03 PERFORMANCE

A. Execute cutting and demolition by methods which will prevent damage to other work and will provide proper surfaces to receive installation of repairs.

B. Execute excavating and backfilling by methods which will prevent settlement or damage to other work. When excavating in close proximity to piping, duct banks or other items subject to damage, use hand excavation.

C. All equipment and workplace safety shall conform to OSHA standards and specifications pertaining to plugs, noise and fume pollution, wiring and maintenance.

D. Where possible, employ original installer or fabricator to perform cutting and patching for:

1. Weather-exposed or moisture-resistant elements.

2. Sight-exposed finished surfaces.

E. Execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances and finishes.

F. Restore work which has been cut or removed; install new products to provide completed work in accordance with requirements of Contract Documents.

G. Refinish entire surfaces as necessary to provide an even finish to match adjacent finishes:

1. For continuous surfaces, refinish to nearest intersection.

2. For an assembly, refinish entire unit.

H. Remove rubble and excess patching materials from the premises.

3.04 CORING

A. All coring shall be performed in such a manner as to limit the extent of patching. Locate the rebar before coring to minimize cut throughs.

B. Coring shall be performed with an approved non-impact rotary tool with diamond core drills.

C. Size of holes shall be suitable for pipe, conduit, sleeves, equipment or mechanical seals to be installed.

D. Fit work to minimize space to pipes, sleeves, ducts, conduit and other penetrations through surfaces.

E. Fit to pipes and other penetrations in tanks to be water tight using seals or other methods defined in the specifications.

F. All holes cut through concrete and masonry walls, slabs or arches shall be core drilled unless otherwise approved. All work shall be performed by mechanics skilled in this type of work.

G. If holes are cored through floor slabs they shall be drilled from below where possible. If holes are drilled from above, provide protection and containment below the area being drilled to catch the plug and contain liquid and slurry.

3.05 CUTTING

A. All cutting shall be performed in such a manner as to limit the extent of patching.

B. Fit work to minimize space to pipes, sleeves, ducts, conduit and other penetrations through surfaces.

C. Cutting shall be performed with a concrete saw and diamond saw blades of proper size.

D. Provide for control of slurry generated by sawing operation on both sides of wall and from below if cutting a floor.

E. When cutting a reinforced concrete wall or floor, the cutting shall be done so as not to damage the bond between the concrete and reinforcing steel left in structure. Cut shall be made so that steel neither protrudes nor is recessed from face of the cut.

F. Adequate bracing of area to be cut shall be installed prior to start of cutting. Check area during sawing operations for partial cracking and provide additional bracing as required to prevent a partial release of cut area during sawing operations.

G. Provide equipment of adequate size to remove cut panel.

H. Saw cut concrete and masonry prior to breaking out sections.

I. Install work at such time as to require the minimum amount of cutting and patching.

J. All cutting of structural members shall be done in a manner directed by the Engineer.

K. Cut opening only large enough to allow easy installation of the equipment, ducting, piping or conduit.

L. When existing conduits or pipe sleeves are cut off at the floor line or wall line, they shall be filled with grout or suitable patching material.

3.06 PROTECTION

A. Provide devices and methods to protect other portions of project from damage.

B. Provide protection from elements for that portion of the project which may be exposed by cutting and patching work.

C. Maintain excavations free from water.

3.07 PATCHING

A. Rough patching shall be such as to bring the cut or cored area flush with existing construction unless otherwise shown.

B. Finish patching shall match existing surfaces as approved.

C. Patching shall be of the same kind and quality of material as was removed.

D. The completed patching work shall restore the surface to its original appearance or better.

E. Patching of waterproofed surfaces shall render the area of the patching completely waterproofed to include the joint between the existing material and the patch.

F. Equipment damaged during cutting and patching shall be replaced or repaired by the equipment manufacturer, at the Engineer's sole discretion and at the expense of the Contractor doing the work.

G. Repaint any damage to factory applied paint finishes using touch-up paint furnished by the equipment manufacturer. The entire damaged panel or section shall be repainted in accordance with the field painting requirements specified in Section 09902 at the expense of the Contractor doing the work.

H. Slurry or tailings resulting from coring or cutting operations shall be contained and vacuumed or otherwise removed from the area following drilling or cut.

I. Equipment shall be protected against mechanical and water damage during cutting and patching. Provide protective covers or use other means such as temporary relocation to protect equipment that is at risk of damage from the cutting and patching

J. Provide protection for existing equipment, utilities and critical areas against water or other damage caused by drilling operation.

END OF SECTION

SECTION 01046
CONTROL OF WORK

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Contractor must meet all general requirements of the following general construction requirements outlined in this Section hereinafter.

1.02 PRIVATE LAND

A. The Contractor shall stay within limits of disturbance and limits of right of way shown on the drawings, except by permission of the Owner of the private property.

1.03 PIPE LOCATIONS

A. The Contractor shall locate pipelines substantially as indicated on the Drawings. The Engineer reserves the right to make such modifications in locations as may be found desirable to avoid interference with existing structures or for other reasons. Where fittings are noted on the Drawings, such notation is for the Contractor 's convenience and does not relieve him from laying and jointing different or additional items where required.

1.04 OPEN EXCAVATIONS

A. The Contractor shall adequately safeguard all open excavations by providing temporary barricades, caution signs, lights and other means to prevent accidents to persons and damage to property. The Contractor shall provide suitable and safe bridges and other crossings for accommodating travel by pedestrians and workmen. The Contractor shall remove bridges provided for access during construction when no longer required. The length or size of excavation will be controlled by the particular surrounding conditions, but shall always be confined to the limits prescribed by the Engineer. If the excavation becomes a hazard, or if it excessively restricts traffic at any point, the Engineer may require special construction procedures such as limiting the length of the open trench, prohibiting stacking excavated material in the street and requiring that the trench shall not remain open overnight.

B. The Contractor shall take precautions to prevent injury to the public due to open trenches. The Contractor shall provide adequate light at all trenches, excavated material, equipment, or other obstacles which could be dangerous to the public at night.

1.05 TEST PITS

A. The Contractor shall be responsible for locating underground pipelines or structures in advance of the construction. Gas lines shall be located via vacuum excavation methods in coordination with the utility owner. The Contractor shall backfill test pits or vacuum holes immediately after their purpose has been satisfied and restore and maintain the surface in a manner satisfactory to the Engineer.

1.06 CARE AND PROTECTION OF PROPERTY

A. The Contractor shall be responsible for the preservation of all public and private property and use every precaution necessary to prevent damage thereto. If any direct or indirect damage is done to public or private property by or on account of any act, omission, neglect, or misconduct in the execution of the work on the part of the Contractor, the Contractor shall restore such property to a condition similar or equal to that existing before the damage was done, or make good the damage in other manner acceptable to the Engineer.

1.07 PROTECTION AND RELOCATION OF EXISTING STRUCTURES AND UTILITIES

A. The Contractor shall assume full responsibility for the protection of all buildings, structures, and utilities, public or private, including poles, signs, services to buildings, utilities in the street, gas pipes, water pipes, hydrants, sewers, drains and electric and telephone cables, whether or not they are shown on the Drawings. The Contractor shall carefully support and protect all such structures and utilities from injury of any kind. Immediately repair any damage resulting from the construction operations.

B. Assistance will be given the Contractor in determining the location of existing services. The Contractor, however, shall bear full responsibility for obtaining all locations of underground structures and utilities (including existing water services, drain lines and sewers). Maintain services to buildings and pay costs or charges resulting from damage thereto.

C. The Contractor shall notify all utility companies in writing at least 72 hours (excluding Saturdays, Sundays and Legal holidays) before excavating in any public way.

D. If, in the opinion of the Engineer, permanent relocation of a utility owned by the District is required, the Engineer may direct the Contractor, in writing, to perform the work. Work so ordered will be paid for at the Contract unit prices. No claim for delay will be allowed due to such relocation.

E. Along the proposed pipe lines as indicated on the plans, the Contractor shall remove the surface materials only to such widths as will permit a trench to be excavated which will afford sufficient room for proper efficiency and proper construction. All applicable regulations shall be followed. Where sidewalks, driveways, pavements, and curb and gutter are encountered, care shall be taken to protect against fracture or disturbance beyond reasonable working limits. All fractured, broken, or disturbed surfaces shall be restored to their original condition prior to completion of the work.

F. Restoration of all surfaces including road subbase, soil cement, limerock base, asphaltic concrete surface, portland cement concrete pavement and driveways, sidewalks, and concrete curbs shall be in strict accordance with Drawings. All grassing and mulching shall be done. Sites shall be restored to existing conditions. Any modifications from existing conditions shall require prior approval from District of existing structure, property, or utility.

   Lawn areas shall be left in as good or better condition as before starting the work. Where sod is to be removed, it shall be carefully restored with new sod of the same type. Solid sodding shall be placed on all slopes greater than 4:1, within 10 feet of all proposed structures and where existing sod is removed or disturbed by the work. In addition, Contractor shall restore all storm drains, culverts, inlets, and storm manholes to equal or better condition.

Any fence, or part thereof, that is damaged or removed during the course of the work shall be replaced or repaired by the Contractor and shall be left in as good a condition as before the starting of the work. The manner in which the fence is repaired and replaced and the materials used shall be subject to the approval of the Engineer.

All trees and shrubs not shown to be removed on the plans shall be protected by the Contractor at his expense. No excavated materials shall be placed so as to injure such trees and shrubs. Trees or shrubs destroyed by negligence of the Contractor or his employees shall be replaced by him with new stock of similar size and age at the sole expense of the Contractor.

1.08 PROTECTION OF CONSTRUCTION AND EQUIPMENT

A. All newly constructed work shall be carefully protected from injury in any way. No wheeling or walking or placing of heavy loads on it shall be allowed and all portions damaged shall be reconstructed by the Contractor at his own expense.

B. All structures shall be protected in a suitable manner. Proposed methods of protection shall be submitted to the Engineer. Should any of the floors or other parts of any structures become heaved, cracked or otherwise damaged, all such damaged portions of the work shall be completely repaired and made good by the Contractor at his own expense and to the satisfaction of the District. If, in the final inspection of the work, any defects, faults or omissions are found, the Contractor shall cause the same to be repaired or removed and replaced by proper materials and workmanship without extra compensation for the materials and labor required. Further, the Contractor shall be fully responsible for the satisfactory maintenance and repair of the construction and other work undertaken herein, for at least the guarantee period described in the Contract.

1.09 COOPERATION WITHIN THIS CONTRACT

A. All firms or persons authorized to perform any work under this Contract shall cooperate with Contractor and Subcontractors or trades and assist in incorporating the work of other trades where necessary or required.

B. Cutting and patching, drilling and fitting shall be carried out where required by the trade or subcontractor having jurisdiction, unless otherwise indicated herein or directed by the Engineer.

1.10 CLEANUP AND DISPOSAL OF EXCESS MATERIAL

A. During the course of the work, the Contractor shall keep the site of operations as clean and neat as possible. The Contractor shall dispose of all residue resulting from the construction work and, at the conclusion of the work, remove and haul away any surplus excavation, broken pavement, lumber, equipment, temporary structures and any other refuse remaining from the construction operations and leave the entire site of the work in a neat and orderly condition.

B. In order to prevent environmental pollution arising from the construction activities related to the performance of this Contract, the Contractor shall comply with all applicable Federal, State and local laws and regulations concerning waste material disposal, as well as the specific requirements stated in this Section and in other related sections.

C. Disposal of excess excavated material in wetlands, stream corridors and plains is strictly prohibited even if the permission of the property District is obtained. Any violation of this

restriction by the Contractor or any person employed by him will be brought to the immediate attention of the responsible regulatory agencies, with a request that appropriate action be taken against the offending parties. The Contractor will be required to remove the fill and restore the area impacted at no increase in the Contract Price.

1.11 GRADES, SURVEY LINES, AND PROTECTION OF MONUMENTS

A. All work shall be constructed in accordance with the lines and grades shown on the drawings. The full responsibility for keeping alignment and grade shall rest upon the Contractor.

B. Bench marks and base line controlling points shall be established prior to beginning work. Reference marks for lines and grades as the work progresses will be located to cause as little inconvenience to the prosecution of the work as possible. The Contractor shall so place excavation and other materials as to cause no inconvenience in the use of the reference marks provided. Contractor shall remove any obstructions placed contrary to this provision.

C. The Contractor shall furnish and maintain, at his own expense, stakes and other such materials and give such assistance, including qualified helpers, for setting reference marks to the satisfaction of the Engineer. The Contractor shall check reference marks by such means, as he may deem necessary. The Contractor shall, at his own expense, establish all working or construction lines and grades as required from the reference marks and shall be solely responsible for the accuracy thereof.

D. Property corners and survey monuments shall be preserved using care not to disturb or destroy them. If a property corner or survey monument is disturbed or destroyed during construction, whether by accident, careless work, or required to be disturbed or destroyed by construction work, said property corner or survey monument shall be restored by a land surveyor registered in the state of Florida. All costs for this work shall be paid for by the Contractor.

END OF SECTION

SECTION 01050
PROJECT CONTROLS (SURVEYING)

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall retain the services of a registered land surveyor currently licensed in the State of Florida to:

1. Perform a preconstruction topographic survey including but not limited to spot elevations at the following locations:
   a. Northing/Easting coordinates of the corners of each Cell 1 through 6.
   b. Midpoints of cell berms.
   c. Tank site.
   d. Alligator Creek outfall.

2. Perform survey work required for project controls and layout.

3. Provide certified as-built surveys specified herein.

4. Identify existing control points and property line corners indicated on the Drawings.

5. Verify and record all existing structure locations in the vicinity of, or adjacent to, the proposed Work; and the locations of all pro-posed structures and facilities.

6. Maintain an accurate record of locations of all new buried piping and existing buried piping and other buried existing facilities (piping, conduits, and structures) encountered and/or relocated during construction of the new Work.

7. Maintain accurate locations of all new structures and equipment within the project site.

1.02 RELATED WORK

A. Summary of Work is included in Section 01010.

B. Contract Closeout is included in Section 01700.

C. Record Drawings are included in Section 01720.

1.03 SUBMITTALS

A. The Contractor shall submit, to the Engineer, in accordance with Section 01300, the name, address and state registration and license number of proposed registered land surveyor.

B. On request of the Engineer, the Contractor shall submit documentation to verify accuracy of field engineering work.

C. At the end of the project, as a prerequisite for the final Application for Payment, the Contractor shall submit certified drawing(s) (with the Surveyor's title block) of the items listed below. All surveys shall be tied to the applicable Grid System and shall indicate all pre-existing and new

project benchmarks. Vertical Control shall conform to the project elevation datum designated on the plans.

1. Building corners, sidewalks, paved areas and location of all above ground structures within the project site or limits of construction.

2. Locations, lines and grades in plan a of all below-grade lines (piping and concrete-encased electrical ducts) exterior to buildings and other buried facilities. This requirement includes all utilities installed as a part of the scope of this project, as well as existing lines encountered during the installation of the new Work.

3. Topographical information including spot elevations, finished floor elevations of new buildings, and top of slab elevations for other new structures, retaining walls, and slabs on grade.

1.04 QUALIFICATIONS OF SURVEYOR

A. Registered land surveyor, licensed in the state of Florida.

1.05 SURVEY REFERENCE POINTS

A. Existing basic horizontal and vertical control points for the project are those designated on Drawings.

B. The Contractor shall locate and protect control points prior to starting site work and preserve all permanent reference points during construction.

1. The Contractor shall make no changes or relocations without prior written notice to and approval by the Engineer.

2. The Contractor shall report to the Engineer when any reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations.

3. The Contractor shall require the surveyor to correctly replace project control points which may be lost or destroyed. Establish replacements based on original survey control.

1.06 PROJECT SURVEY REQUIREMENTS

A. The Contractor shall establish a minimum of two permanent bench marks on site, referenced to data established by survey control points.

1. Record locations, with horizontal and vertical data, on the as-built Survey.

2. Permanent benchmarks shall be installed and spaced for convenient reference and use at locations along the pipeline route and/or on the project site.

3. Benchmarks shall be installed to National Geodetic Survey standards and shall include horizontal and vertical data, as well as the installation date.

B. The Contractor shall establish lines and levels; locate and lay out:

1. Site improvements.

a. Stakes for grading, fill and topsoil placement.
b. Utility slopes and invert elevations.
c. Sidewalks, pavement, fencing, storm drainage facilities, and other finish surface work.
d. Locations, sizes and depths of manholes, valves and fittings.

2. Batter boards for structures.

3. Building foundation, column locations and floor levels.

4. Controlling lines and levels required for mechanical and electrical trades.

C. If lines, levels or layouts are lost or destroyed, or if required by the District or Engineer, the Contractor shall verify layouts by same methods.

D. The Surveyor shall provide all elevation in North American Vertical Datum of 1988 (NAVD 88).

E. The Contractor shall establish all lines and grades prior to construction of line work for all force mains, transmission mains, storm drainage piping, gravity sewers and other new utility lines at 100-ft increments, at defined breaks in grade, and at manholes.

F. The following dimensional references must be depicted on the As-Built drawings.

1. Depths of various elements of foundation in relation to finish first floor datum.

2. All underground piping with elevations and dimensions. Changes to piping location. Horizontal and vertical locations of all underground utilities and appurtenances, referenced to permanent surface improvements. Actual installed pipe material, class, etc. All pipes and valves shall be labeled using the method as per the contract drawings.

3. Location of internal utilities and appurtenances concealed in the construction, referenced to visible and accessible features of the structure.

4. Field changes of dimension and detail.

5. Changes made by a District Supplemental Instruction Form or by Change Order.

6. Details not on original contract drawings.

7. Equipment and piping relocations.

8. All underground duct banks with elevations and dimensions, horizontal and vertical locations of underground duct banks, and manholes along duct banks.

9. All underground cable elevations and horizontal locations of underground cables.

10. All existing and new structures clearly indicated.

11. All elevations of new structures clearly indicated.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 RECORDS

A. The Contractor shall maintain a complete, accurate log of all control and survey work as it progresses.

B. The Contractor shall update the project as-built survey on a monthly basis, based on the work performed during the month. The Contractor shall submit one copy of up to date as-built documentation with Contractor's monthly applications for payment.

C. The Contractor shall maintain an accurate record of new and existing piping, conduit and structure changes, revisions, relocations, and modifications.

D. At the end of the project, the Contractor shall submit the following:

1. Four signed and sealed prints of all required as-built survey information.

2. Copy of all AutoCAD files of documents specified in Article 1.03.C, above on a CD or DVD.

END OF SECTION

SECTION 01065
PERMITS AND FEES

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. The Contractor shall: Obtain and pay for any and all permits and licenses as provided for in the General Conditions, except as otherwise provided herein, and in effect at the time of bidding.

B. Schedule all inspections and obtain all written approvals of the agencies required by the permits and licenses.

C. Comply with all construction related conditions specified in each of the permits and licenses.

D. A copy of the permits obtained by the District will be furnished to the Contractor.

1.02 PERMITS BY DISTRICT

A. The District has acquired (or will acquire) the following permits::

1. USACOE – Standard Permit Authorization under Section 10 of the Rivers and Harbors Act (33 USC 403) and Section 404 of the Clean Water Act (33 USC 1344).

2. FDEP – Consumptive Use Permit.

3. FDEP – Environmental Resource Permit.

4. FDOT – Utility Permit.

5. Clay County – Site Development Plan Approval.

1.03 PERMITS BY CONTRACTOR

A. The Contractor shall be responsible for acquiring building permits (Clay County), NPDES General Permit for Stormwater Discharge from Construction Activities (FDEP) and, if applicable, Generic Permit for Discharge of Groundwater from Dewatering Activities (FDEP)..

B. The dewatering plan shall include sequence of excavation, discharge locations, sediment sump, turbidity control, erosion control, and turbidity monitoring.

C. A gopher tortoise survey of the project area is required and shall be performed by the District. Contractor will be responsible for installation of double-row silt fence within two weeks after the District completes gopher tortoise relocation.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 01110
ENVIRONMENTAL PROTECTION PROCEDURES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall furnish all labor, materials and equipment and perform all work required for the prevention of environmental pollution in conformance with applicable laws and regulations, during and as the result of construction operations under this Contract. For the purpose of this Section, environmental pollution is defined as the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances of importance to human life; affect other species of importance to man; or degrade the utility of the environment for aesthetic and/or recreational purposes.

B. The control of environmental pollution requires consideration of air, water and land, and involves management of noise and solid waste, as well as other pollutants.

C. The Contractor shall schedule and conduct all work in a manner that will minimize the erosion of soils in the area of the work. The Contractor shall provide erosion control measures such as diversion channels, sedimentation or filtration systems, berms, staked hay bales, seeding, mulching or other special surface treatments as are required to prevent silting and muddying of streams, rivers, impoundments, lakes, etc. All erosion control measures shall be in place in an area prior to construction activity in that area. Specific requirements for erosion and sedimentation controls are specified in Division 2.

D. This Section is intended to provide that construction is achieved with a minimum of disturbance to the existing ecological balance between a water resource and its surroundings. These are general guidelines. It is the Contractor's responsibility to determine the specific construction techniques to meet these guidelines.

E. All phases of sedimentation and erosion control shall comply with and be subject to the approval of the District. The Contractor shall prepare a sedimentation and erosion control plan meeting the requirements all applicable Federal, State, and Local regulatory agencies. Upon approval of the aforementioned plan by the Engineer and District, the Contractor will implement the plan. It shall be the responsibility of the Contractor to modify the plan as needed to address changing site conditions to comply with applicable regulations. No additional compensation shall be provided or contract time added to for the Contractor’s environmental protection procedures.

1.02 APPLICABLE REGULATIONS

A. The Contractor shall comply with all applicable Federal, State and local laws and regulations concerning environmental pollution control and abatement.

1.03 NOTIFICATIONS

A. The Engineer or the District will notify the Contractor in writing of any non-compliance with the foregoing provisions or of any environmentally objectionable acts and corrective action to be taken. State or local agencies responsible for verification of certain aspects of the

environmental protection requirements shall notify the Contractor in writing, through the Engineer, of any non-compliance with State or local requirements. After receipt of such notice from the Engineer or from the regulatory agency through the Engineer, immediately take corrective action. Such notice, when delivered to the Contractor or his authorized representative at the site of the work, shall be deemed sufficient for the purpose. If the Contractor fails or refuses to comply promptly, the District may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to any such stop orders shall be made the subject of a claim for extension of time or for excess costs or damages by the Contractor unless it is later determined that the Contractor was in compliance.

1.04 IMPLEMENTATION

A. Prior to commencement of the work, the Contractor shall meet with the Engineer and the District to develop mutual understandings relative to compliance with these provisions and administration of the environmental pollution control program.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 EROSION CONTROL

A. The Contractor shall provide positive means of erosion control such as shallow ditches around construction to carry off surface water. Erosion control measures, such as siltation basins, check dams, mulching, jute netting and other equivalent techniques, shall be used as appropriate. Offsite surface water shall be diverted around the site, to a downstream channel ahead of siltation barriers. Flow of surface water into excavated areas shall be prevented. Ditches around construction area shall also be used to carry away water resulting from dewatering of excavated areas. At the completion of the work, ditches shall be backfilled and the ground surface restored to original condition.

3.02 PROTECTION OF STREAMS AND SURFACE WATERS

A. The Contractor shall take all precautions to prevent, or reduce to a minimum, any damage to any stream or surface water from pollution by debris, sediment or other material, or from the manipulation of equipment and/or materials in or near such streams. Water that has been used for washing or processing, that contains oils or sediments that will reduce the quality of the water in the stream, shall not be directly returned to the stream. Divert such waters through a settling basin or filter before being directed into streams or surface waters.

B. The Contractor shall not discharge water from dewatering operations directly into any live or intermittent stream, channel, wetlands, surface water or any storm sewer. Water from dewatering operations shall be treated by filtration, settling basins, or other District-/Engineer-approved method to reduce the amount of sediment contained in the water to allowable levels.

C. The Contractor shall take all preventative measures to avoid spillage of petroleum products and other pollutants. In the event of any spillage, the Contractor must promptly take remedial action. All remedial costs shall be borne by the Contractor.

D. Water being flushed from structures or pipelines after disinfection, with a Cl_2 residue of 2 mg/l or greater shall be treated with a dechlorination solution, in a method approved by the Engineer, prior to discharge.

3.03 PROTECTION OF LAND RESOURCES

A. The Contractor shall restore land resources within the project boundaries and outside the limits of permanent work to a condition, after completion of construction that will appear to be natural and not detract from the appearance of the project. The Contractor shall confine all construction activities to areas shown on the Drawings.

B. The locations of the Contractor's storage and other construction buildings required temporarily in the performance of the work, shall be cleared portions of the job site or areas to be cleared as shown on the Drawings and approved by the Engineer and shall not be within wetlands or floodplains. The preservation of the landscape shall be an imperative consideration in the selection of all sites and in the construction of buildings. Drawings showing storage facilities shall be submitted for approval of the Engineer.

C. If the Contractor proposes to construct temporary roads or embankments and excavations for plant and/or work areas, he shall submit the following for approval at least 10 days prior to scheduled start of such temporary work.

1. A layout of all temporary roads, excavations, embankments and drainage to be constructed within the work area.

2. Details of temporary road construction.

3. Drawings and cross sections of proposed embankments and their foundations, including a description of proposed materials.

4. A landscaping drawing showing the proposed restoration of the area. Indicate the proposed removal of any trees and shrubs outside the limits of existing clearing area. Indicate locations of guard posts or barriers required to control vehicular traffic and protect trees and shrubs to be maintained undamaged. The Drawing shall provide for the obliteration of construction scars as such and shall provide for a natural appearing final condition of the area. Modification of the Contractor's approved drawings shall be made only with the written approval of the Engineer. No unauthorized road construction, excavation or embankment construction including disposal areas will be permitted.

D. The Contractor shall remove all signs of temporary construction facilities such as haul roads, work areas, structures, foundations of temporary structures, stockpiles of excess of waste materials, or any other vestiges of construction as directed by the Engineer. It is anticipated that excavation, filling and plowing of roadways will be required to restore the area to near natural conditions which will permit the growth of vegetation thereon. The disturbed areas shall be prepared and sodded as described in Section 02900, or as approved by the Engineer.

3.04 PROTECTION OF AIR QUALITY

A. Burning - The use of burning at the project site for the disposal of refuse and debris will not be permitted.

B. Dust Control - Maintain all excavations, embankment, stockpiles, access roads, plant sites, waste areas, borrow areas and all other work areas within or without the project boundaries free from dust which could cause the standards for air pollution to be exceeded and which would cause a hazard or nuisance to others.

C. An approved method of stabilization consisting of sprinkling or other similar methods will be permitted to control dust. The use of petroleum products is prohibited. The use of chlorides may be permitted with approval from the Engineer.

D. Sprinkling, to be approved, must be repeated at such intervals as to keep all parts of the disturbed area at least damp at all times, and the Contractor shall have sufficient competent equipment on the job to accomplish this. Dust control shall be performed as the work proceeds and whenever a dust nuisance or hazard occurs, as determined by the Engineer.

3.05 NOISE CONTROL

A. The Contractor shall make every effort to minimize noises caused by the construction operations. Equipment shall be equipped with silencers or mufflers designed to operate with the least possible noise in compliance with Federal and State regulations.

3.06 MAINTENANCE OF POLLUTION CONTROL FACILITIES DURING CONSTRUCTION

A. The Contractor shall maintain all facilities constructed for pollution control as long as the operations creating the particular pollutant are being carried out or until the material concerned has become stabilized to the extent that pollution is no longer being created and approval for removal is provided by the Engineer.

END OF SECTION

SECTION 01172
PIPE PENETRATIONS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and install pipe penetration assemblies as shown. This Section covers materials for the various pipe penetration configurations. Refer to Drawings for details of assembly and location.

1.02 SUBMITTALS

A. Submit manufacturers' literature, installation instructions, and where applicable, fire rating and certified test results of the various components on all items to be furnished in accordance with Section 01300.

PART 2 PRODUCTS

2.01 PIPE SLEEVES

A. Unless otherwise shown all pipe sleeves shall be Schedule 40 galvanized steel pipe conforming to ASTM A53. The inside diameter of the sleeve shall be larger than the outside diameter of the flanges of process water piping that will pass through the wall. Ends of sleeves shall be cut and ground smooth and shall be flush with the wall or ceiling and extend two in. above finished floors. Sleeves to be sealed with mechanical seals shall be sized in accordance with the seal manufacturer's recommendations. Sleeves to be sealed by caulking and sleeves for insulated piping shall be sized as required.

2.02 WALL CASTINGS

A. Unless otherwise shown, wall castings shall be ductile iron conforming to ANSI/AWWA A21.51/C151, thickness Class 53, diameter as required. Flanges and/or mechanical joint bells shall be drilled and tapped for studs where flush with the wall. Castings shall be provided with an intermediate two-in. minimum circumferential thrust collar type waterstop integrally cast with or welded to the casting, located as follows: for castings set flush with walls located at the center of the overall length of the casting; for castings which extend through wall located such that it falls within the middle third of the wall.

2.03 SEALING MATERIALS

A. Mechanical seals shall be modular, adjustable, bolted, mechanical type consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and sleeve. The seal shall be rated by the manufacturer for 40-ft of head or 20 psig. Mechanical seals shall be Link-Seal Model S-316 and sized appropriately, depending on pipe size, manufactured by PSI Thunderline/Link-Seal, Houston, TX or equal.

B. Caulking for iron, steel and copper piping shall consist of braided oakum packing or fire retardant pliable material, Fig. 310 by Sealite Co.; White Oakum W.S. - 600 by American Manufacturing Co., or equal, followed by poured molten soft virgin lead. Minimum length of lead segment shall

be one half of pipe diameter, or six inches, whichever is less. Lead shall be flush with end of sleeve. Cooled lead shall be expanded with a caulking iron to form a water seal.

C. Caulking for PVC pipe shall meet all the requirements in Paragraph B above except that lead wool, compacted to form a watertight seal, shall be used in place of molten lead.

D. Sealant shall be a two part foamed silicone elastomer as manufactured by Dow Corning Co., Product No. 3-6548 silicone R.T.V.; 3M brand fire barrier products caulk C.P. 25 and 3M brand putty 303; or Flame-Safe fire stop systems Fig. No. FS-500 by Thomas & Betts Corp. Sealant bead configuration, depth and width shall be in accordance with manufacturer's recommendations.

2.04 MISCELLANEOUS MATERIALS

A. Bonding compound shall be Sikadur Hi-Mod epoxy by Sika Corp.; equal by Euclid Chemical Corp.; Master Builders Company or equal.

B. Non-shrink grout shall be Masterflow 713 by Master Builders Co.; Euco N-S by Euclid Chemical Co.; Five Star Grout by U.S. Grout Corp. or equal.

PART 3 EXECUTION

3.01 INSTALLATION

A. Assemble and install components of pipe penetration assemblies as detailed on the Drawings.

END OF SECTION

SECTION 01200
PROJECT MEETINGS

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. The District shall schedule and administer pre-construction meeting, periodic progress meetings and specially called meetings throughout progress of the work.

1. Make physical arrangements for meetings.

B. The Engineer shall

1. Preside at meetings.

2. Record the minutes; include significant proceedings and decisions.

3. Reproduce and distribute copies of minutes within 10 working days after each meeting.

a. To participants in the meeting.
b. To parties affected by decisions made at the meeting.

C. Representatives of the Contractor, subcontractors and suppliers attending meetings shall be qualified and authorized to act on behalf of the entity each represents.

D. Attend meetings to ascertain that work is expedited consistent with Contract Documents and construction schedules.

E. Contractor to prepare agenda for meetings.

1.02 RELATED REQUIREMENTS

A. Construction Schedules are included in Section 01310.

B. Shop Drawings, Working Drawings and Samples are included in Section 01300.

C. Project Record Documents are included in Section 01720.

D. Operating and Maintenance Data is included in Section 01730.

1.03 PRE-CONSTRUCTION MEETING

A. Schedule a preconstruction meeting no later than 10 days after date of Effective Date of the Agreement.

B. Location: A central site, convenient for all parties, designated by the District.

C. Attendance

1. District's Representative.
2. Engineer and their professional consultants.
3. Resident Project Representative.
4. Contractor's Superintendent.
5. Major Subcontractors.
6. Major suppliers.
7. Utilities
8. Others as appropriate.

D. Suggested Agenda

1. Distribution and discussion of:
    a. List of major subcontractors and suppliers.
    b. Projected Construction Schedules.
2. Critical work sequencing.
3. Major equipment deliveries and priorities.
4. Project Coordination.
    a. Designation of responsible personnel.
5. Procedures and processing of:
    a. Field decisions – District Supplemental Instructions.
    b. Proposal requests.
    c. Submittals.
    d. Change Orders.
    e. Applications for Payment.
6. Adequacy of distribution of Contract Documents.
7. Procedures for maintaining Record Documents.
8. Use of premises:
    a. Office, work and storage areas.
    b. District's requirements.
9. Construction facilities, controls and construction aids.

10. Temporary utilities.

11. Housekeeping procedures.

1.04 PROGRESS MEETINGS

A. Schedule regular periodic meetings. The progress meetings will be held every 30 days with the first meeting 30 days after the pre-construction meeting or 30 days after the date of Effective Date of the Agreement.

B. Hold called meetings as required by progress of the work.

C. Location of the meetings: Project field office of Contractor or District, or virtual meetings.

D. Attendance

1. Engineer and their professional consultants as needed.

2. Contractor's superintendent and key staff as appropriate to the agenda.

3. Subcontractors as appropriate to the agenda.

4. Suppliers as appropriate to the agenda.

5. Others as appropriate.

E. Suggested Agenda

1. Review, approval of minutes of previous meeting.

2. Review of work progress since previous meeting.

3. Field observations, problems and conflicts.

4. Problems which impede Construction Schedule.

5. Review of off-site fabrication, delivery schedules.

6. Corrective measures and procedures to regain projected schedule.

7. Revisions to Construction Schedule.

8. Progress, schedule, during succeeding work period.

9. Coordination of schedules.

10. Review submittal schedules; expedite as required.

11. Maintenance of quality standards.

12. Pending changes and substitutions.

13. Review proposed changes for:

    a. Effect on Construction Schedule and on completion date.
    b. Effect on other contracts of the project.

14. Other business.

    a. Asset management update

15. Construction schedule.

16. Critical/long lead items.

F. Attend progress meetings and study previous meeting minutes and current agenda items, in order to be prepared to discuss pertinent topics such as deliveries of materials and equipment, progress of the work, etc.

G. Provide a current submittal log at each progress meeting in accordance with Section 01300.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01300
SUBMITTALS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section includes the requirements for compiling, processing and transmitting submittals required for execution of the project.

B. Submittals are categorized into two types: Action Submittals and Informational Submittals, as follows:

1. Action Submittal: Written and graphic information submitted by the Contractor that requires the Engineer's and District’s written approval. The following are examples of action submittals:

    a. Shop drawings (including working drawings, valve schedule in accordance with Section 01170, and product data)
    b. Samples
    c. Operation & maintenance manuals
    d. Site Usage Plan (Contractor's staging - including trailer siting and material laydown area)
    e. Schedule of values
    f. Payment application format

2. Informational Submittal: Information submitted by the Contractor that does not require the Engineer's or District’s written approval. The following are examples of informational submittals:

    a. Shop Drawing Schedule
    b. Construction Schedule
    c. Statements of Qualifications
    d. Health and Safety Plans
    e. Construction Photography and Videography
    f. Asset Management
    g. Work Plans
    h. Maintenance of Traffic Plans
    i. Outage Requests
    j. Proposed Testing Procedures
    k. Test Records and Reports
    l. Vendor Training Outlines/Plans
    m. Test and Start-Up Reports
    n. Certifications
    o. Record Drawings
    p. Record Shop Drawings
    q. Submittals required by laws, regulations and governing agencies
    r. Submittals required by funding agencies
    s. Other requirements found within the technical specifications

t. Warranties and Warranty Bonds
u. As-Built Surveys
v. Contract Close-out Documents

1.02 RELATED WORK

A. Additional requirements may be specified in the District's Agreement and attachments thereto.

B. Additional submittal requirements may be specified in the respective technical Specification Sections.

C. Operation and Maintenance manuals are included in Section 01730.

D. Contract closeout submittals are included in Section 01700.

E. Warranties and Warranty Bonds are included in Section 01740.

F. Construction Photos are included in Section 01380.

G. Applications for Payment are included in Section 01026.

H. Construction Schedules are included in Section 01310.

I. Project Controls (Surveying) 01050.

J. Project Record Documents are included in Section 01720.

1.03 CONTRACTOR'S RESPONSIBILITIES

A. All submittals shall be clearly identified as follows:

1. Date of Submission.

2. Project Number.

3. Project Name.

4. Contractor Identification.

a. Contractor.
b. Supplier.
c. Manufacturer.
d. Manufacturer or supplier representative.

5. Identification of the Product.

6. Reference to Contract Drawing.

7. Reference to specification section number, page and paragraph(s).

8. Reference to applicable standards, such as ASTM or Federal Standards numbers.

9. Indication of Contractor's approval.

10. Contractor's Certification statement.

11. Identification of deviations from the Contract Documents, if any.

12. Reference to previous submittal (for resubmittals).

13. Made in America (when required by the Contract).

B. Submittals shall be clear and legible, and of sufficient size for legibility and clarity of the presented data.

C. Maintain a log of all submittals. The submittal log shall be kept accurate and up to date. This log should include the following items (as applicable):

1. Description.

2. Submittal Number.

3. Submittal Type (Approval Required or Informational Only – No Approval Required)

4. Date transmitted to the Engineer.

5. Date returned to Contractor (from Engineer).

6. Status of Submittal (Approved/Not Approved/etc.).

7. Date of Resubmittal to Engineer and Return from Engineer (if applicable and repeat as necessary).

8. Date material released for fabrication.

9. Projected (or actual) delivery date.

D. Numbering System. Utilize the following submittal identification numbering system:

1. The first character shall be a D, S, M or I which represents Shop Drawing (including working drawings and product data), Sample, Manual (Operating & Maintenance) or Informational, respectively.

2. The next five digits shall be the applicable Section Number.

3. The next three digits shall be the sequential number of each separate item or drawing submitted under each Specification Section, in the chronological order submitted, starting at 001.

4. The last character shall be a letter, A to Z, indicating the submission (or resubmission) of the same submittal, i.e., "A" = 1st submission, "B" = 2nd submission, "C" = 3rd submission, etc. A typical submittal number would be as follows:

a. D-03300-008-B.
b. D = Shop Drawing03300 = Section for Concrete.
c. 008 = the eighth different submittal under this Section.
d. B = the second submission (first resubmission) of that particular shop drawing.

E. Variances

1. Notify the Engineer in writing, at the time of submittal, of any deviations in the submittals from the requirements of the Contract Documents.

2. Notify the Engineer in writing, at the time of re-submittal (resubmission), of all deviations from previous submissions of that particular shop drawing, except those deviations which are the specific result of prior comments from the Engineer.

F. Action Submittals

1. Shop Drawings, Working Drawings, Product Data and Samples.

a. Shop Drawings.

1) Shop drawings as defined in the General Conditions, and as specified in individual Sections may include, but are not necessarily limited to, custom prepared data such as fabrication and erection/installation (working) drawings, scheduled information, setting diagrams, actual shop work manufacturing instructions, custom templates, valve schedules, wiring diagrams, coordination drawings, equipment inspection and test reports, and performance curves and certifications, as applicable to the work.
2) Contractor shall verify all field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data, and coordinate each item with other related shop drawings and the Contract requirements.
3) All details on shop drawings shall clearly show the relation of the various parts to the main members and lines of the structure and where correct fabrication of the work depends upon field measurements, such measurements shall be made and noted on the drawings before being submitted.
4) All shop drawings submitted by subcontractors and vendors shall be reviewed by the Contractor. Contractor shall confirm, materials, dimensions, catalog numbers, technical data and performance criteria; and shall coordinate with other related shop drawings and the Contract requirements. In addition, Contractor shall confirm existing field conditions and dimensions and assure that the submittal is coordinated and compatible with existing conditions. Submittals directly from subcontractors or vendors will not be accepted by the Engineer.
5) The Contractor shall be responsible for the accuracy of the subcontractor’s or vendor’s submittal; and, for their submission in a timely manner to support the requirements of the Contractor’s construction schedule. Shop drawings found to be inaccurate or otherwise in error shall be returned to the subcontractor or vendor to correct, before submission to the Engineer. All shop drawings shall be approved by the Contractor before submission to the Engineer.
6) Delays to construction due to the untimely submission of submittals will constitute inexcusable delays, for which Contactor shall not be eligible for additional cost nor additional contract time. Inexcusable delays consist of any delay within the Contactor’s control.

b. Working Drawings

1) Detailed installation drawings (piping, electrical conduits and controls, etc.) shall be prepared and submitted for review and approval by the Engineer prior to installing such work. Installation drawings shall be to-scale and shall be fully dimensioned.
2) Piping working drawings shall show the laying dimensions of all pipes, fittings, valves, as well as the equipment to which it is being connected. In addition, all pipe supports shall be shown.
3) Equipment working drawings shall show all equipment dimensions, anchor bolts, support pads, piping connections and electrical connections. In addition, show clearances required around such equipment for maintenance of the equipment.
4) Electrical working drawings shall show conduits, junction boxes, disconnects, control devices, lighting fixtures, support details, control panels, lighting and power panels, and motor control centers. Coordinate all locations with the Contract Documents and the Contractor's other working drawings.

c. Product Data

1) Product data, as specified in individual Specification Sections, include, but are not limited to, the manufacturer's standard prepared data for manufactured products (catalog data), such as the product specifications, installation instructions, availability of colors and patterns, rough-in diagrams and templates, product photographs (or diagrams), wiring diagrams, performance curves, quality control inspection and reports, certifications of compliance (as specified or otherwise required), mill reports, product operating and maintenance instructions, recommended spare parts and product warranties, as applicable.

d. Samples

1) Furnish, samples required by the Contract Documents for the Engineer's approval. Samples shall be delivered to the Engineer as specified or directed. Unless specified otherwise, provide at least two samples of each required item. Materials or equipment for which samples are required shall not be used in the work unless and until approved by the Engineer.
2) Samples specified in individual Specification Sections, include, but are not limited to: physical examples of the work (such as sections of manufactured or fabricated work), small cuts or containers of materials, complete units of repetitively-used products, color/texture/pattern swatches and range sets, specimens for coordination of visual effect, graphic symbols, and other specified units of work.
3) Approval of a sample shall be only for the characteristics or use named in such approval and shall not be construed to change or modify and Contract Requirements.
4) Approved samples not destroyed in testing shall be sent to the Engineer or stored at the site of the work. Approved samples of the hardware in good condition will be marked for identification and may be used in the work. Materials and equipment incorporated in work shall match the approved samples. Samples which fail testing or are not approved will be returned to the Contractor at his expense, if so requested at time of submission.

e. Professional Engineer (P.E.) Certification Form

1) If specifically required in any of the technical Specification Sections, submit a Professional Engineer (P.E.) Certification for each item required, using the form appended to this Section.

2. Contractor's Certification

a. Each shop drawing, working drawings, product data, and sample shall have affixed to it the following Certification Statement:

1) "Certification Statement: by this submittal, I hereby represent that I have determined and verified all field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data and I have checked and coordinated each item with other applicable approved shop drawings and all Contract requirements."

b. Shop drawings, working drawings, and product data sheets 11-in x 17-in and smaller shall be bound together in an orderly fashion and bear the above Certification Statement on the cover sheet. The transmittal cover sheet for each identified shop drawing shall fully describe the packaged data and include a listing of all items within the package.

3. The review and approval of shop drawings, working drawings, product data, or samples by the Engineer shall not relieve the Contractor from the responsibility for the fulfillment of the terms of the Contract. All risks of error and omission are assumed by the Contractor and the Engineer will have no responsibility therefor.

4. Project work, materials, fabrication, and installation shall conform to approved shop drawings (including working drawings and product data) and applicable samples.

5. No portion of the work requiring a shop drawing (including working drawings and product data) or sample shall be started, nor shall any materials be fabricated or installed before approval of such item. Procurement, fabrication, delivery or installation or products or materials that do not conform to approved shop drawings shall be at the Contractor's risk. Furthermore, such products or materials delivered or installed without approved shop drawings, or in non-conformance with the approved shop drawings will not be eligible for progress payment until such time as the product or material is approved or brought into compliance with approved shop drawings. Neither the District nor Engineer will be liable for any expense or delay due to corrections or remedies required to accomplish conformity.

6. Operation and Maintenance Data

a. Operation and maintenance data shall be submitted in assembled manuals as specified. Such manuals shall include detailed instructions for District personnel on safe operation procedures, controls, start-up, shut-down, emergency procedures, storage, protection, lubrication, testing, trouble-shooting, adjustments, repair procedures, and other maintenance requirements.

7. Schedule of Values

    a. On projects consisting of lump sums (in whole or in part) submit a proposed schedule of values providing a breakdown of lump sum items in to reasonably small components – generally disaggregated by building, area, and/or discipline. The purpose of the schedule of values is for processing partial payment applications. If requested by the Engineer, provide sufficient substantiation for all or some items as necessary to determine the proposed schedule of values is a reasonable representation of the true cost breakdown of the Work. The schedule of values shall not be unbalanced to achieve early payment or over-payment in excess of the value of work or any other mis-distribution of the costs. If, in the opinion of the Engineer, the schedule of values is unbalanced, Contractor shall reallocate components to achieve a balanced schedule acceptable to Engineer.

8. Payment Application Format

    a. If an application form is included in the Contract Documents, use that form unless otherwise approved by the Engineer and District. If an application form is not included in the Contract Documents, Contractor may propose a form for approval.

9. Site Usage

    a. Submit a proposed site staging plan, including but not limited to the location of office trailers, storage trailers and material laydown. Such plan shall be a graphic presentation (drawing) of the proposed locations; and, shall include on-site traffic modifications, and temporary utilities, as may be applicable.

G. Informational Submittals

1. Shop Drawing Schedule

    a. Prepare and submit a schedule indicating when shop drawings are required to be submitted to support the as-planned construction schedule. The submittal schedule shall allow sufficient time for preparation and submittal, review and approval, and fabrication and delivery to support the construction schedule.

2. Construction Schedule

    a. Prepare and submit construction schedules and monthly status reports as specified.

3. Statements of Qualifications

    a. Provide evidence of qualification, certification, or registration, as required in the Contract Documents, to verify qualifications of licensed land surveyor, professional engineer, materials testing laboratory, specialty subcontractor, technical specialist, consultant, specialty installer, and other professionals.
    b. Health and Safety Plans

        1) When specified, prepare and submit a general company Health and Safety Plan (HSP), modified or supplemented to include job-specific considerations.

4. Construction Photography and Videography

    a. Provide periodic construction photographs and videography as specified – including but not limited to preconstruction photographs and/or video, monthly progress photos and/or video and post-construction photographs and/or video.

5. Work Plans

    a. Prepare and submit copies of all work plans needed to demonstrate to the District that Contractor has adequately thought-out the means and methods of construction and their interface with existing facilities.

6. Maintenance of Traffic Plans

    a. Prepare maintenance of traffic plans where and when required by the Contract Documents and by local ordinances or regulations. If Contractor is not already knowledgeable about local ordinances and regulations regarding maintenance of traffic requirements, become familiar with such requirements and include all costs for preparation and submittal of traffic management plans and all associated costs for permits and fees to implement the traffic management plan, in the bid amount. In addition, unless a supplemental payment provision is provided in the bid form, include the cost of police attendance, when required.

7. Outage Requests

    a. Provide sufficient notification of any outages required (electrical, flow processes, etc.) as may be required to tie-in new work into existing facilities. Unless specified otherwise elsewhere, a minimum of seven calendar days' notice shall be provided.

8. Proposed Testing Procedures

    a. Prepare and submit testing procedures it proposes to use to perform testing required by the various technical specifications.

9. Test Records and Reports

    a. Provide copies of all test records and reports as specified in the various technical specifications.

10. Vendor Training Outlines/Plans

    a. At least two weeks before scheduled training of District's personnel, provide lesson plans for vendor training in accordance with the specification for O&M manuals.

11. Test and Start-up Reports

    a. Manufacture shall perform all pre-start-up installation inspection, calibrations, alignments, and performance testing as specified in the respective Specification Section. Provide copies of all such test and start-up reports.

12. Certifications

    a. Provide various certifications as required by the technical specifications. Such certifications shall be signed by an officer (of the firm) or other individual authorized to sign documents on behalf of that entity.
    b. Certifications may include, but are not limited to:

        1) Welding certifications and welders' qualifications
        2) Certifications of Installation, Testing and Training for all equipment
        3) Material Testing reports furnished by an independent testing firm
        4) Certifications from manufacturer(s) for specified factory testing
        5) Certifications required to indicate compliance with any sustainability or LEEDS accreditation requirements indicated in the Contract Documents

13. Record Drawings

    a. No later than Substantial Completion, submit a record of all changes during construction not already incorporated into drawings – in accordance with specification on Project Record Documents.

14. Record Shop Drawings

    a. Before final payment is made, furnish one set of record shop drawings to the Engineer. These record shop drawings shall be in conformance with the approved documents and should show any field conditions which may affect their accuracy.
    b. Submittals required by laws, regulations and governing agencies

        1) Prepare and submit all documentation required by state or local law, regulation or government agency directly to the applicable agency. This includes, but is not limited to, notifications, reports, certifications, certified payroll (for projects subject to wage requirements) and other documentation required to satisfy all requirements. Provide to Engineer one copy of each submittal made in accordance with this paragraph.

    c. Submittals required by funding agencies

        1) Prepare and submit all documentation required by funding agencies. This includes, but is not limited to segregated pay applications and change orders when required to properly allocate funds to different funding sources; and certified payrolls for projects subject to wage requirements. Provide one copy of each submittal made in accordance with this paragraph to the Engineer.

15. Other requirements of the technical Specification Sections

    a. Comply with all other requirements of the technical specifications.

16. Warranties and Warranty Bonds

    a. Assemble a booklet or binder of all warranties and bonds as specified in the various technical specifications and in accordance with the specification on Warranties and Warranty Bonds; and provide two originals to the Engineer.

17. As-Built Surveys

    a. Engage the services of an active Florida licensed land surveyor in accordance with the Project Controls (Surveying) specification. Prior to Final Completion, provide an as-built survey of the constructed facility, as specified.

18. Contract Close-Out Documents

    a. Submit Contract documentation as indicated in the specification for Contract Close-out.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 SUBMITTAL SCHEDULE

A. Provide an initial submittal schedule at the pre-construction meeting for review by District and Engineer. Incorporate comments from District or Engineer into a revised submittal schedule.

B. Maintain the submittal schedule and provide sufficient copies for review by District and Engineer. An up-to-date submittal schedule shall be provided at each project progress meeting.

3.02 TRANSMITTALS

A. Prepare separate transmittal sheets for each submittal. Each transmittal sheet shall include at least the following: the Contractor's name and address, District's name, project name, project number, submittal number, description of submittal and number of copies submitted.

B. Submittals shall be transmitted or delivered directly to the office of the Engineer, as indicated in the Contact Documents or as otherwise directed by the Engineer.

C. Provide copies of transmittals forms or cover letters (without attachments) directly to the Resident Project Representative.

3.03 PROCEDURES

A. Action Submittals

1. Contractor's Responsibilities

    a. Coordination of Submittal Times: Prepare and transmit each submittal sufficiently in advance of performing the related work or other applicable activities, or within the time specified in the individual work of other related Sections, so that the installation will not be delayed by processing times including disapproval and resubmittal (if required). Coordinate with other submittals, testing, purchasing, fabrication, delivery and similar sequenced activities. Extensions to the Contract Time will not be approved for the Contractor's failure to transmit submittals sufficiently in advance of the Work.
    b. The submittals of all shop drawings (including working drawings and product data) shall be sufficiently in advance of construction requirements to allow for possible need of re-submittals, including the specified review time for the Engineer.

c. No less than 30 calendar days will be required for Engineer's review time for shop drawings and O&M manuals involving only one engineering discipline. No less than 45 calendar days will be required for Engineer's review time for shop drawings and O&M manuals that require review by more than one engineering discipline. Resubmittals will be subject to the same review time.
d. Submittals of operation and maintenance data shall be provided within 30 days of approval of the related shop drawing(s).
e. Before submission to the Engineer, review shop drawings as follows:

1) make corrections and add field measurements, as required
2) use any color for its notations except red (reserved for the Engineer's notations) and black (to be able to distinguish notations on black and white documents)
3) identify and describe each and every deviation or variation from Contract documents or from previous submissions, except those specifically resulting from a comment from the Engineer on a previous submission
4) include the required Contractor's Certification statement
5) provide field measurements (as needed)
6) coordinate with other submittals
7) indicate relationships to other features of the Work
8) highlight information applicable to the Work and/or delete information not applicable to the Work

f. Submit the following number of copies:

1) Shop drawings (including working drawings and product data) – Submit no fewer than six, and no more than nine; five of which will be retained by the Engineer.
2) Samples – three
3) Site Usage Plan – three copies
4) Schedule of values – four copies
5) Payment application format – four copies

g. If Contractor considers any correction indicated on the shop drawings to constitute a change to the Contract Documents, provide written notice thereof to the Engineer immediately; and do not release for manufacture before such notice has been received by the Engineer.
h. When the shop drawings have been completed to the satisfaction of the Engineer, carry out the construction in accordance therewith; and make no further changes therein except upon written instructions from the Engineer.

2. Engineer’s Responsibilities

a. Engineer will not review shop drawings (including working drawings and product data) that do not include the Contractor's approval stamp and required certification statement. Such submittals will be returned to the Contractor, without action, for correction.
b. Partial shop drawings (including working drawings and product data) will not be reviewed. If, in the opinion of the Engineer, a submittal is incomplete, that submittal will be returned to the Contractor for completion. Such submittals may be returned with comments from Engineer indicating the deficiencies requiring correction.

c. If shop drawings (including working drawings and product data) meet the submittal requirements, Engineer will forward copies to appropriate reviewer(s). Otherwise, noncompliant submittals will be returned to the Contractor without action - with the Engineer retaining one copy.
d. Submittals which are transmitted in accordance with the specified requirements will be reviewed by the Engineer within the time specified herein. The time for review will commence upon receipt of submittal by Engineer.

3. Review of Shop Drawings (Including Working Drawings and Product Data) and Samples

a. The review of shop drawings, working drawings, data and samples will be for general conformance with the design concept and Contract Documents. They shall not be construed:

1) as permitting any departure from the Contract requirements
2) as relieving the Contractor of responsibility for any errors, including details, dimensions, and materials
3) as approving departures from details furnished by the Engineer, except as otherwise provided herein

b. The Contractor remains responsible for details and accuracy, for coordinating the work with all other associated work and trades, for selecting fabrication processes, for techniques of assembly, and for performing work in a safe manner.
c. If the shop drawings (including working drawings and product data) or samples as submitted describe variations and indicate a deviation from the Contract requirements that, in the opinion of the Engineer are in the interest of the District and are so minor as not to involve a change in Contract Price or Contract Time, the Engineer may return the reviewed drawings without noting an exception.
d. Only the Engineer will utilize the color "RED" in marking submittals.
e. Shop drawings will be returned to the Contractor with one of the following codes.

1) "APPROVED" - This code is assigned when there are no notations or comments on the submittal. When returned under this code the Contractor may release the equipment and/or material for manufacture.
2) "APPROVED AS NOTED" - This code is assigned when a confirmation of the notations and comments IS NOT required by the Contractor. The Contractor may release the equipment or material for manufacture; however, all notations and comments must be incorporated into the final product.
3) "APPROVED AS NOTED/RESUBMIT" - This combination of codes is assigned when notations and comments are extensive enough to require a resubmittal of the package. The Contractor may release the equipment or material for manufacture; however, all notations and comments must be incorporated into the final product. The resubmittal is to address all comments, omissions and non-conforming items that were noted. An additional box is checked to indicate whether the resubmission is for the complete package, or for parts of the package. If no box is checked, a complete resubmittal shall be provided. Review code may designate if a partial or full submittal is required. If full submittal is required, a complete resubmittal package addressing all comments shall be provided. If a partial submittal is designated, resubmittal shall only include information pertaining to those items noted in review comments requiring clarification and any portions of submittal impacted as a result of the response.

Resubmittal is to be received by the Engineer within 30 calendar days of the date of the Engineer's transmittal requiring the resubmittal.

4) "REJECTED" - This code is assigned when the submittal does not meet the intent of the Contract Documents. The Contractor must resubmit the entire package revised to bring the submittal into conformance. It may be necessary to resubmit using a different manufacturer/vendor to meet the requirements of the Contract Documents.
5) "RECEIPT ACKNOWLEDGED (Not subject to Engineer's Approval)" - This code is assigned to acknowledge receipt of a submittal that is not subject to the Engineer's or District's approval.

f. Repetitive Reviews: Shop drawings, O&M manuals and other submittals will be reviewed no more than twice at the District's expense. All subsequent reviews will be performed at the Contractor's expense. Reimburse the District for all costs invoiced by Engineer for the third and subsequent reviews, if requested by the District.

4. Electronic Transmission

a. Action Submittals may be transmitted by electronic means provided the following conditions are met:

1) The above-specified transmittal form is included.
2) All other requirements specified above have been met including, but not limited to, coordination by the Contractor, review and approval by the Contactor, and the Contractor's Certification.
3) The submittal contains no pages or sheets larger than 11 x 17 inches.
4) With the exception of the transmittal sheet, the entire submittal is included in a single file.
5) The electronic files are PDF format (with printing enabled).
6) In addition, transmit three hard-copy (paper) originals to the Engineer.
7) The Engineer's review time will commence upon receipt of the hard copies of the submittal.
8) For Submittals that require certification, corporate seal, or professional embossment (i.e., P.E.s, Surveyors, etc.) transmit at least two hard-copy originals to the Engineer. In addition, provide additional photocopied or scanned copies, as specified above, showing the required certification, corporate seal, or professional seal.

B. Informational Submittals

1. Contractor's Responsibilities

a. Number of copies: Submit three copies, unless otherwise indicated in individual Specification sections
b. Refer to individual technical Specification Sections for specific submittal requirements.

2. Engineer's Responsibilities

a. The Engineer will review each informational submittal within 15 days. If the informational submittal complies with the Contract requirements, Engineer will file

for the project record and transmit a copy to the District. Engineer may elect not to respond to Contractor regarding informational submittals meeting the Contract requirements.

3. Electronic Transmission

   a. Informational submittals may be transmitted by electronic means providing all of the following conditions are met:

      1) The above-specified transmittal form is included.
      2) The submittal contains no pages or sheets larger than 11 x 17 inches.
      3) With the exception of the transmittal sheet, the entire submittal is included in a single file.
      4) The electronic files are PDF format (with printing enabled).
      5) For Submittals that require certification, corporate seal, or professional embossment (i.e., P.E.s, Surveyors, etc.) transmit two hard-copy originals to the Engineer.

END OF SECTION

P.E. CERTIFICATION FORM

The undersigned hereby certifies that he/she is a professional engineer registered in the [State] [Commonwealth] of _____ and that he/she has been employed by

_____ to design
(Company Name)

_____
(Insert P.E. Responsibilities)

In accordance with Specification Section _____ for the

_____.
(Name of Project)

The undersigned further certifies that he/she has performed the said design in conformance with all applicable local, state and federal codes, rules and regulations; and, that his/her signature and P.E. stamp have been affixed to all calculations and drawings used in, and resulting from, the design.

The undersigned hereby agrees to make all original design drawings and calculations available to the

_____
(Insert Name of District)

or District's representative within seven days following written request therefor by the District.

_____	_____
P.E. Name	Company Name
_____	_____
Signature	Signature
_____	_____
P.E. Registration Number	Title

_____
Address

_____
Address

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SECTION 01310
CONSTRUCTION SCHEDULING

PART 1 GENERAL

1.01 PROGRAM DESCRIPTION

A. A Critical Path Method (CPM) construction schedule shall be used to control the Work and to provide a basis for determining job progress. The construction schedule shall be prepared and maintained by the Contractor. All work shall be done in accordance with the established CPM schedule. The Contractor and all subcontractors shall cooperate fully in developing the construction schedule and in executing the work in accordance with the CPM schedule.

B. The construction schedule shall consist of a computerized CPM network (diagram of activities) presented in a time-scaled graphic (print-out) with reports, as specified herein.

1.02 QUALIFICATIONS

A. The Contractor shall have the capability of preparing and utilizing the specified CPM schedule, or engage the services of a specialized scheduling professional to do so. Within seven days of the award of contract, provide a résumé or qualifications statement for the individual within the Contractor's organization, or the outside consultant, who is being proposed as the responsible party for development and maintenance of the CPM schedule. The résumé or qualifications statement shall demonstrate that the proposed responsible party has successfully developed and maintained CPM schedules for at least three construction projects of the same size or greater than this project. The proposed responsible party for the CPM schedule is subject to approval by the Engineer and District. If the proposed responsible party for the CPM schedule is not approved by the Engineer and/or District, Contractor shall resubmit a more-appropriate candidate for approval.

1.03 SUBMITTALS

A. Submit Interim, Preliminary, Baseline (also known as "as-planned") CPM schedules, revisions, and Monthly Status Reports, all including graphics, reports, and narratives, and an as-built schedule, as specified herein.

PART 2 PRODUCTS

2.01 SOFTWARE

A. Unless otherwise approved by the Engineer, the computer-based schedule shall be generated using Microsoft Project.

2.02 NETWORK REQUIREMENTS

A. Each schedule submittal shall contain the following identifying information:

1. Project Title, District's Contract Number, and the Engineer's Project Number

2. Contractor's name

3. All Contract milestones, as specified

4. The project calendar(s) (including work week and holidays)

5. Type of submittal (e.g., Interim, Preliminary, Baseline or Monthly Status Report)

6. A summary contract milestones

7. Data date and run (print) date

B. The network of activities shall show the order and inter-dependence of activities; and, show the sequence in which the work is to be accomplished, as planned by the Contractor. The basic concept of a network analysis diagram shall be followed to show how each activity is dependent on preceding activities (predecessors) and following activities (successors).

C. Detailed network activities shall include, but are not limited to,:

1. mobilization activities,

2. procurement activities (submittals, review and approval, fabrication, and delivery),

3. permitting and regulatory activities,

4. right-of-way activities (including utility agreements that require others to relocate existing utilities that affect the project),

5. construction activities (including demolition, rehabilitation, new construction and testing),

6. maintenance of existing facilities,

7. test and start-up activities (including testing, start-up, training, performance testing, and commissioning),

8. contract milestones (fixed and floating),

9. specified sequences, outages and coordination activities, and

10. any other activities needed to properly identify the scope of work and contract requirements.

D. All activities shall be sufficiently identified and/or described so that the scope of work of each activity is clear. All work tasks shall be broken down into appropriate scopes and durations to facilitate monitoring progress. Unless otherwise approved by the Engineer, no activities shall have durations of more than one month; except for off-site activities such as procurement and delivery of materials and equipment - or administrative or management activities that span the project duration that do not reflect earned progress.

E. Network activities shall be organized (grouped) by phases (or stages), physical areas, buildings, elevations, or other portions of the project.

F. Separate network activities shall be provided for each significant identifiable function in each trade area in each facility. Separate network activities shall be provided for subcontractors.

G. The number of network activities, sufficiency of description, and level of breakdown shall be subject to the Engineer's review and approval to confirm conformance with the specified requirements.

H. The format of the schedule network graphic shall be a time-scaled logic diagram - with a list of network activities and the specified data fields presented adjacent to the graphic display.

I. The following general requirements also apply to the network diagram.

1. The Critical Path (the sequence of project network activities that add up to the longest overall duration and thereby determines the shortest time possible to complete the project) shall be identified - preferably in 'red'.

2. Unless otherwise approved by the Engineer the Contractor's work schedule shall be based on 'normal work week' as defined in the Contract Documents – (typically 40 hours per week, consisting of five 8-hour days).

3. The graphics shall indicate the calendar(s) on which activity durations are based (i.e., 5-day workweek or 7 calendar day week). When multiple calendars or work weeks are used, the graphics shall clearly indicate which calendars are used where.

4. The project calendar shall include exclusions for holidays observed by the Contractor.

5. The project calendar shall include exclusions for the following holidays observed by the District:
   a. New Year’s Day
   b. Martin Luther King, Jr. Day
   c. Memorial Day
   d. Independence Day
   e. Labor Day
   f. Veterans Day
   g. Thanksgiving Day
   h. Christmas Day

J. Each network activity shall have the following information (fields) listed alongside the activity on the graphic display.

1. Activity ID – a manually assigned designation (numeric or alphanumeric). The Contractor should use a logical approach to assigning identification to network activities to facilitate grouping (sorting) of activities.

2. Activity Description

3. Original Duration – including allowances for adverse weather interruptions – normal for the project location. Normal weather shall mean seasonally average weather conditions, as recorded by NOAA.

4. Percent complete – the Contractor's estimated percent complete for each network activity as of the data date for the respective report.

5. Remaining Duration - a calculated value based on Original Duration of each network activity and the estimated percent of completion for each activity.

6. Early Start Date

7. Early Finish Date

8. Late Start Date

9. Latest Finish Date

10. Total Float

11. Cost – an estimated value representing the Contractor's estimate of the accumulated cost of all components of each network activity, including indirect costs and allocated profit and overhead (general conditions, permits, insurance, etc.)

2.03 SUBMITTAL REQUIREMENTS

A. Each schedule submittal shall include the following elements:

1. Graphics – unless otherwise approved by the Engineer, the network graphics shall be printed on 24-inch by 36-inch sheets; including a list of activities and the specified data fields.

2. Narrative

a. The Narrative shall consist of a written report by the Contractor providing an overview of the schedule – specific to each submittal.
b. The Narratives for developmental submittals, i.e., Interim and Preliminary, shall describe the Contractor's approach to executing the project Work.
c. The Narrative for the Baseline Schedule shall:

1) explain key activities and assumptions on which the schedule is based;
2) describe the Critical Path;
3) discuss key deliveries that might adversely affect the project schedule; and,
4) explain the Contractor's approach to adverse weather interruptions – normal for the project location. Normal weather shall mean seasonally average weather conditions, as recorded by NOAA.

d. The Narratives provided with Monthly Status Reports (updates) shall also identify:

1) any changes the Contractor has made to the CPM logic (including any added, modified or deleted activities,
2) any delays that have been encountered, and
3) remedial actions or recovery steps the Contractor will employ to arrest and/or recover from such delays.

B. Reports

1. The following reports are required to be submitted with Baseline Schedule, when a major revision is made to the schedule, and when requested by the Engineer.

a. Activity – a report listing all network activities, sorted by activity ID
b. Early Start – a report listing all network activities, sorted by Early Start date
c. Total Float – a report listing all network activities, sorted by Total Float (ascending from low to high).
d. Predecessor/Successor – a report of all activities, sorted by Activity ID that lists all predecessor and successor activities for each network activity.

2.04 ACCEPTABILITY

A. Submit the CPM schedule submittals, as specified, and resubmit as needed, until they are in compliance with Contract requirements.

B. The Engineer's review of the Contractor's construction schedule submittals will only be for conformance with the Contract requirements – including but not limited to contract time and work sequences specified in the contract documents. The Engineer's review of the schedule shall not include the Contractor's means and methods of construction or safety. The Engineer's concurrence, acceptance, or approval of the Contractor's schedule submittals will not relieve the Contractor from responsibility for complying with the Contract Scope, Contract Time or any other contract requirement. Any indication of concurrence, acceptance, or approval of the Contractor's schedule will only indicate a general conformance with the Contract Requirements.

C. Engineer's review of the Contractor's construction schedule submittals shall not relieve the Contractor from responsibility for any deviations from the Contract Documents unless the Contractor has in writing called Engineer's attention to such deviations at the time of submission and Engineer has given written concurrence to the specific deviations, nor shall any concurrence by the Engineer relieve Contractor from responsibility for errors and omissions in the submittals. Concurrence of the CPM Activity Network by the Engineer is advisory only and shall not relieve the Contractor of responsibility for accomplishing the Work within the Contract completion date(s).

D. Concurrence, acceptance, or approval of the Contractor's CPM schedule by the Engineer in no way makes the Engineer an insurer of the CPM schedule's success, nor liable for time or cost overruns resulting therefrom.

E. Failure to include any element of work required for the performance of this Contract will not excuse the Contractor from completing all Work required within the Contract completion date(s), notwithstanding the review of the network by the Engineer.

F. CPM schedules that contain activities with negative float, or which extend beyond the contract completion date, will not be acceptable.

G. Except where earlier completions are specified, CPM schedules which show completion of all work prior to the contract completion date may be indicated; however, in no event shall they constitute a basis for claim for delay by the Contractor.

PART 3 EXECUTION

3.01 IMPLEMENTATION SCHEDULE

A. Interim Schedule

1. Within 15 days following the receipt of the Effective Date of the Agreement, submit an Interim Schedule indicating the planned operations during the first 60 calendar days after Effective Date of the Agreement. In addition, the Contractor shall indicate its general approach for the balance of the project.

2. Within 15 days following the receipt of the Effective Date of the Agreement, meet with the Engineer to discuss and agree on the proposed standards for the CPM schedule. At this conference submit to the Engineer a preliminary network defining the planned operations during the first 60 calendar days after Effective Date of the Agreement. In addition, the Contractor shall indicate its general approach for the balance of the project.

3. While the Preliminary schedule is being developed, the Contractor shall update the Interim schedule on a monthly basis – indicating actual progress - until the Preliminary schedule is submitted.

B. Preliminary Schedule

1. Within 45 days following the receipt of Effective Date of the Agreement, submit a proposed Preliminary Schedule to the Engineer. The Preliminary Schedule shall consist of a draft computer-generated CPM-schedule showing the entire Scope of Work. The Preliminary Schedule shall not include any actual progress earned during development of the schedule (i.e., statused as of the Effective Date of the Agreement).

2. Within 15 days of submittal of the Preliminary Schedule (i.e., within 60 days of receipt of the Effective Date of the Agreement), meet with the Engineer to discuss the review comments.

3. Once the Preliminary Schedule is submitted, Contractor shall discontinue updating the Interim Schedule. Provide monthly updates of the Preliminary Schedule until concurrence, acceptance, or approval of the Baseline Schedule.

C. Baseline (as-planned) Schedule

1. With 10 days of the review meeting on the Preliminary Schedule submittal, the Contractor shall incorporate the Engineer's comments into the network and submit a Baseline Schedule. Resubmit the Baseline Schedule, as required until it is deemed acceptable as stated in Paragraph 2.04, above.

2. Upon concurrence, acceptance, or approval of the Contractor's initial Baseline Schedule, statused as of the Effective Date of the Agreement date, it shall be recognized as the basis against which the Contractor's progress shall be measured.

D. Monthly Status Reports

1. Monthly Status Reports shall include updated graphics and a narrative. In addition, if requested by the Engineer, Contractor shall provide copies of one or more of the standard reports listed in Paragraph 2.03.B.

2. Provide Monthly Status Reports (schedule updates) commencing approximately 30 days after submission of the Interim Schedule. Unless approved otherwise by the Engineer, the Monthly Status Reports shall be statused as of the end of each calendar month.

3. While the Preliminary Schedule is being developed, the Contractor shall update the Interim schedule on a monthly basis – indicating actual progress - until the Preliminary Schedule is submitted.

4. While the Baseline Schedule is being developed, the Contractor shall update the Preliminary Schedule on a monthly basis – indicating actual progress - until concurrence, acceptance, or approval of the Baseline Schedule.

5. Once the initial Baseline Schedule is complete, Monthly Status Reports shall be based on the Baseline Schedule.

E. As-Built Schedule

1. Upon achieving Substantial Completion, the Contractor shall submit an as-built schedule, showing all activities from the Effective Date of the Agreement through Substantial Completion. In addition, provide the reports listed in Paragraph 2.03.B. A Narrative is not required.

3.02 DELIVERABLES

A. Unless approved otherwise by the Engineer, all schedule submittals shall be printed in color on sheets 24-in by 36-in and may be divided into as many separate sheets as required.

B. Interim Schedule: Submit three copies to the Engineer.

C. Preliminary Schedule: Submit three hard (paper) copies to the Engineer.

D. Baseline Schedule: Submit three hard (paper) copies, one electronic copy (PDF), and a copy of the program files to the Engineer.

E. Monthly Status Reports: Submit three copies and one electronic copy on CD to the Engineer ; and if requested, an electronic copy of the program files for the respective update.

F. As-Built Schedule: Submit one hard copy; one electronic (PDF), and, if requested, an electronic copy of the program files.

3.03 PROGRESS REPORTING

A. Progress under the approved CPM schedule shall be reported monthly by the Contractor by submitting a Monthly Status Report. Unless otherwise approved by the Engineer, not less than seven days prior to the due date of the Monthly Status Report, the Contractor shall meet with the Engineer's representative to jointly evaluate the status of each network activity. Each

activity shall be updated to reflect the actual progress (percent complete) and the actual dates activities were started and completed, as applicable.

B. The Monthly Status Report shall include an update of the computer-generated network graphics and a Narrative report. The Narrative shall include:

1. A description of the progress during the reporting period in terms of completed activities

2. A summary of the Critical Path

3. An description or explanation of each delays to network activities

4. A description of problem areas, current and anticipated delaying factors and their anticipated effect on the performance of other activities and completion dates

5. An explanation of corrective action taken or proposed.

6. This report, as well as the CPM Status Report, will be discussed at each progress meeting.

3.04 RESPONSIBILITY FOR SCHEDULE COMPLIANCE

A. Whenever it becomes apparent from the current CPM schedule and CPM Status Report that delays to the critical path have resulted and the contract completion date will not be met, or when so directed by the Engineer, take some or all of the following actions at no additional cost to the District. Submit to the Engineer for approval, a written statement of the steps intended to take to remove or arrest the delay to the critical path in the approved schedule.

1. Increase construction manpower in such quantities and crafts,

2. Increase the number of working hours per shift, shifts per day, working days per week,

3. Increase the amount of construction equipment, and/or

4. Reschedule activities to maximize the concurrence of activities and comply with the revised schedule.

B. If when so requested by the Engineer, failure to submit a written statement of the steps intended to take or should fail to take such steps as approved by the Engineer, the Engineer may direct the Contractor to increase the level of effort in man-power (trades), equipment and work schedule (overtime, weekend and holiday work, etc.) to be employed by the Contractor in order to remove or arrest the delay to the critical path in the approved schedule and the Contractor shall promptly provide such level of effort at no additional cost to the District.

3.05 ADJUSTMENT OF CONTRACT SCHEDULE AND COMPLETION TIME

A. If the Contractor wants or needs to make changes in his/her execution of the construction schedule that would affect the approved CPM schedule, he/she shall notify the Engineer in writing stating what changes are proposed and the reasons for the changes. If the Engineer approves such changes, the Contractor shall revise and submit a revised schedule for approval - without additional cost to the District. The CPM schedule shall be adjusted by the Contractor only after prior approval of his/her proposed changes. Adjustments may consist of changing portions of the activity sequence, activity durations, division of approved activities, or other

adjustments as may be approved by the Engineer; however, the addition of extraneous, non-working activities and activities that add unapproved restraints to the CPM schedule will not be allowed.

B. Shop drawings that are not approved on the first submittal will require the addition of network activities for the resubmittals.

C. Equipment that does not pass the specified tests will require the addition of network activities for the retesting.

D. The contract completion time will be adjusted only for causes specified in this Contract. In the event the Contractor requests an extension of any contract completion date, he/she shall furnish such justification and supporting evidence as the Engineer may deem necessary to determine whether the Contractor is entitled to an extension of time under the provisions of this Contract. After receipt of such justification and supporting evidence, the Construction Manager's shall perform an assessment or evaluation of the appropriate change in contract time based upon the currently approved CPM schedule and on all data relevant to the extension. Inexcusable delays (attributable to the Contractor) and non-critical delays (delays to activities which, according to the CPM schedule, do not affect any contract completion date shown by the Critical Path) shall not be the basis for a change in contract time. The Engineer will provide a written recommendation to the District based on its assessment, with a copy to the Contractor. The Contractor shall not change any fixed contract milestones or required completion dates without the approval of the District, evidenced by the execution of a contract change order. However, the Contractor should make note of such requests for changes in contract time in the narrative of monthly schedule status reports.

E. Each request for change in any contract completion date shall be submitted by the Contractor to the Engineer in accordance with the notification requirements stipulated in the form of contract or general conditions. No time extension will be granted for requests that are not submitted in accordance with the Contract requirements.

F. Total float in the approved CPM network belongs to the project; i.e., either the District or Contractor may take advantage of available total float on a first-come, first-served basis. Therefore, without obligation to extend either the overall completion date, or any intermediate completion dates set out in the CPM network, the District may initiate changes to the work or delay work that absorb available total float existing at the time of the change or delay. District initiated changes or delays that affect the Critical Path on the approved CPM network shall be the sole grounds for extending (or contracting) contract completion dates or fixed milestones.

3.06 COORDINATING SCHEDULES WITH OTHER CONTRACT SCHEDULES

A. Coordinate this contract with the construction of the raw water transmission main, under a separate contract.

END OF SECTION

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SECTION 01370
SCHEDULE OF VALUES

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. Submit a Schedule of Values allocated to the various portions of the work, within 15 days after the Effective Date of the Agreement.

B. Upon request of the Engineer, support the values with data which will substantiate their correctness.

C. The accepted Schedule of Values shall be used only as the basis for the Contractor's Applications for Payment.

1.02 RELATED REQUIREMENTS

A. Application for Payment is included in Section 01026.

B. Standard General Conditions of the Construction Contract are included in the Front-End Documents provided by District.

1.03 FORM AND CONTENT OF SCHEDULE OF VALUES

A. Type schedule on an 8-1/2-in by 11-in or 8-1/2-in by 14-in white paper. Contractor's standard forms and automated printout will be considered for approval by the Engineer and the District upon Contractor's request. Identify schedule with:

1. Title of Project and location.

2. Engineer and Project number.

3. Name and Address of Contractor.

4. Contract designation.

5. Date of submission.

6. District Contract Number.

B. Schedule shall list the installed value of the component parts of the work in sufficient detail to serve as a basis for computing values for progress payments during construction.

C. Identify each line item with the number and title of the respective Section.

D. For each major line item list sub-values of major products or operations under the item.

E. For the various portions of the work:

1. Total value for mobilization/demobilization shall be limited to 2.5 percent of the base bid.

2. Each item shall include a directly proportional amount of the Contractor's overhead and profit.

3. Transport of excess clean soil (up to 3,000 cubic yards) to an off-site stockpile area shall be included in the Schedule of Values as a unit price line item. The unit price shall be inclusive of loading, transport, and unloading. Measurement of the volume for payment shall be based on uncompacted truck loads.

4. For items on which progress payments will be requested for stored materials, break down the value into:

   a. The cost of the materials, delivered and unloaded, with taxes paid. Paid invoices are required for materials upon request by the Engineer.
   b. The total installed value.

F. The sum of all values listed in the schedule shall equal the total Contract Sum.

1.04 SUBSCHEDULE OF UNIT MATERIAL VALUES

A. Submit a sub-schedule of unit costs and quantities for:

1. Products on which progress payments will be requested for stored products.

B. The form of submittal shall parallel that of the Schedule of Values, with each item identified the same as the line item in the Schedule of Values.

C. The unit quantity for bulk materials shall include an allowance for normal waste.

D. The unit values for the materials shall be broken down into:

1. Cost of the material, delivered and unloaded at the site, with taxes paid.

2. Copies of invoices for component material shall be included with the payment request in which the material first appears.

3. Paid invoices shall be provided with the second payment request in which the material appears or no payment shall be allowed and/or may be deleted from the request.

E. The installed unit value multiplied by the quantity listed shall equal the cost of that item in the Schedule of Values.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01380
PRE- AND POST-CONSTRUCTION VIDEO PHOTOGRAPHY

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals required to videotape all construction areas within the project area, as shown in the Drawings and as specified herein, prior to any construction work and after all construction work is finished.

1.02 QUALIFICATIONS

A. The photography shall be done by a competent camera operator who is fully experienced and qualified with the specified equipment.

B. The audio shall be recorded in the presence of the District or Engineer in a clear and easily understood manner.

1.03 COST OF PHOTOGRAPHY

A. The cost of the photography shall be a subsidiary obligation of the Contractor, and no separate payment will be made. Parties requiring additional copies will pay photographer directly.

1.04 AUDIO-VISUAL VIDEOS (DVDs)

A. DVD recordings shall not be made more than 60 days prior to construction or after substantial completion. No construction shall begin prior to review and approval of the videos covering the construction area by the Engineer. The Engineer shall have the authority to reject all or any portion of a DVD not conforming to specifications and order that it be redone at no additional charge. The Contractor shall reschedule unacceptable coverage within five days after being notified. The Engineer shall designate those areas, if any, to be omitted from or added to the audio-visual coverage. All DVDs and written records shall be immediately submitted to and become the property of the District.

B. The Contractor shall produce professional-grade videos (DVDs). The color audio-visual DVDs shall be reproduced by a responsible commercial firm regularly engaged in the business of color audio-video tape documentation.

PART 2 PRODUCTS

2.01 DVDs

A. The DVD shall be of professional quality.

2.02 AUDIO-VISUAL RECORDING

A. The audio-visual system and the procedures employed in its use shall be such as to produce a finished product that will meet professional standards. The video portion of the recording shall produce bright, sharp, clear pictures with accurate colors and shall be free from distortion or any other form of picture imperfection. All video recordings shall, by electronic means, display on the screen the time of day, the month, day and year of the recording. This time and date

information must be continuously and simultaneously generated with the actual recording. The audio portion of the recording shall be of high clarity and be free from distortion.

PART 3 EXECUTION

3.01 VIDEO RECORDING

A. The recordings shall contain coverage of all visible features within the construction zone of influence. These features shall include, but not be limited to, all roadways, pavement, retention ponds, railroad tracks, curbs, driveways, sidewalks, culverts, head-walls, retaining walls, landscaping, trees, fences, visible utilities, structures and all buildings. Of particular concern shall be the condition of existing vegetation, terrain, and structures and the existence or non-existence of any faults, fractures or defects. Panning, zoom-in and zoom-out rates shall be sufficiently controlled to maintain a clear view of the subjects.

3.02 FINAL PRODUCT

A. The final product shall be two sets of fully edited audio/video DVDs, one set pre-construction and one set post-substantial completion.

B. Three copies of each set shall be delivered to the Engineer.

END OF SECTION

SECTION 01390
CONSTRUCTION PHOTOGRAPHS

PART 1 GENERAL

1.01 REQUIREMENTS

A. Furnish a competent photographer to take construction record photographs monthly during the course of the Work.

1.02 PHOTOGRAPHY REQUIRED

A. Provide color photographs taken immediately prior to the cutoff date for each scheduled Application for Payment. Submit photographs within 14 days of the photograph dates.

B. For pipelines, duct banks, and other utilities, provide initial photographs of the entire pipeline route prior to any construction. Photographs shall be spaced at approximately 300-foot intervals along the route.

C. For cast-in-place structures, untrenched road crossings, and stream crossings, provide two photographs each month of each structure and crossing taken at each major stage of construction for each scheduled Application for Payment.

D. Views and quantities required:

1. Photography locations to be approved in advance by the Engineer.

2. Provide photos in digital format.

3. Provide at least 10 views of periodic construction photographs per week.

4. Provide aerial photography of the entire project site. Do not extend limits past the project boundary in order to provide the greatest level of detail of the entire work area. Provide three different views at the following periods of the Project.

a. Prior to commencement of the Work.

b. Each month of construction.

c. At project completion.

E. Negatives:

1. Photographs shall be taken with a digital camera.

2. The Contractor shall convey images to the Engineer on a thumb drive and electronic transmission as designated in Section 01300 Submittals.

1.03 COST OF PHOTOGRAPHY

A. The cost of the photography shall be a subsidiary obligation of the Contractor and no separate payment will be made. Parties requiring additional photography will pay photographer directly.

PART 2 PRODUCTS

2.01 FORMAT

A. Photos shall be submitted electronically in a PDF format.

B. Identify for each photo:

1. Name of Project.

2. Orientation of View.

3. Date and time of exposure.

4. Name and address of photographer.

5. Photographer’s numbered identification of exposure.

PART 3 EXECUTION

3.01 TECHNIQUE

A. Use 8.0 megapixel or higher digital camera.

3.02 VIEWS REQUIRED

A. Photograph from locations to adequately illustrate condition of construction and state of progress.

1. At successive periods of photography, take at least one photograph from the same overall views of work under way as previously photographed, as directed by Engineer.

2. Consult with the Engineer at each period of photography for instructions concerning views required.

3.03 USAGE RIGHTS

A. Obtain and transfer copyright usage rights from photographer to District for unlimited reproduction of photographic documentation.

3.04 DELIVERY OF IMAGES

A. Deliver images of the previous month photos to the Engineer to accompany the subsequent Application for Payment.

B. No construction shall start until pre-construction photographs are completed and submitted to Engineer in accordance with Section 01380.

3.05 DURATION AND PAYMENT

A. Monthly photos are required to the date of substantial completion of the project regardless of time overruns or extensions. No additional total payment will be made for the additional photos

except where the scope of work has been increased with a corresponding time increase. See Section 01025 for specifics on payment.

END OF SECTION

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SECTION 01400
QUALITY CONTROL

PART 1 GENERAL

1.01 QUALITY CONTROL PLAN

A. General: The Contractor shall furnish for approval by the District, the Contractor Quality Control (CQC) plan within 10 calendar days after award of contract. The plan shall identify personnel, procedures, instructions, records, and forms to be used. If the Contractor fails to submit an acceptable CQC plan within the time herein prescribed, the District may refuse to allow construction to start until such time as the Contractor submits an acceptable final plan. No progress payments will be made by the District until the CQC plan is accepted by the District.

B. The Contractor Quality Control Plan: This plan shall include, as a minimum, the following:

1. A description of the quality control organization, including chart showing lines of authority and acknowledgment that the Contractor's quality control staff shall report to the Project Manager or someone higher in the Contractor's organization.

2. The name, qualifications, duties, responsibilities, and authorities of each person assigned a quality control function.

3. A copy of a statement signed by an authorized official of the Contractor's firm, which describes the responsibilities and delegates the authorities of the CQC System Manager.

4. Procedures for scheduling and managing submittals, including those of subcontractors, off-site fabricators, suppliers and purchasing agents.

5. Control testing procedures for each specific test.

6. Reporting procedures including proposed reporting formats.

C. Acceptance of Plan: Acceptance of the plan by the District is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during the construction.

D. Notification of Changes: After acceptance of the CQC plan, the Contractor shall notify the District in writing of any proposed change. Proposed changes are subject to acceptance by the District.

1.02 QUALITY CONTROL ORGANIZATION

A. CQC System Manager: CQC System Manager shall be responsible for overall management of the CQC and have the authority to act in all CQC matters for the Contractor. The CQC System Manager for this Contract shall be fully qualified by experience and technical training, to ensure compliance with contract plans and specifications. This person shall demonstrate his/her ability to perform correctly the duties required of him/her to the satisfaction of the District, shall be physically at the project site whenever work is in progress, and shall be in charge of the Contractor's Quality Control program for this project. All the Contractor's submittals for approval shall be reviewed and modified or corrected as needed by the CQC System Manager

or his/her authorized assistants and approved correct prior to forwarding of such submittals to the District. The CQC System Manager may be a qualified employee, as described herein, of the Contractor. If the CQC System Manager is also the Contractor's superintendent, then the superintendent may also perform as the Contractor's Site Safety Representative but will not be allowed to perform more than these three roles on this project.

1.03 SUBMITTALS

A. Submittals shall be as specified in Section 01300. The CQC organization shall be responsible for certifying that all submittals are in compliance with the Contract requirements.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 CONTROL

A. Contractor Quality Control is the means by which the Contractor assures himself that the construction complies with the requirements of the Contract Plans and Specifications. The controls shall be adequate to cover all construction operations, including both onsite and offsite operations and will be keyed to the proposed construction sequence. The controls shall include at least three phases of inspection for all definitive features of work as follows:

1. Preparatory Inspection: This shall be performed prior to beginning any definable feature of work. It shall include a review of Contract requirements; a check to assure that all materials and/or equipment have been tested, submitted, and approved; a check to assure that provisions have been made to provide required control testing; examination of the work area to ascertain that all preliminary work has been completed, and a physical examination of materials, equipment, and sample work to assure that they conform to approved shop drawings or submittal data and that all materials and/or equipment are on hand.

2. Initial Inspection: This shall be performed as soon as a representative portion of the particular feature of work has been accomplished and shall include examination of the quality of workmanship and a review of control testing for compliance with contract requirements, use of defective or damaged materials, omissions, and dimensional requirements.

3. Follow-up Inspections: These shall be performed daily to assure continuing compliance with Contract requirements, including control testing, until completion of the particular feature of work. Such inspection shall be made a matter of record in the CQC documentation as required below. Final follow-up inspections shall be conducted and deficiencies corrected prior to the addition of new features of work.

3.02 TESTS

A. Test Procedures: The Contractor shall perform tests specified or required to verify that control measures are adequate to provide a product which conforms to Contract requirements. The Contractor shall procure the services of an industry recognized testing laboratory. A list of tests which the Contractor understands are to be performed shall be furnished as a part of the CQC plan to the District. The list shall give the test name, specification paragraph containing the test

requirements, and the personnel and laboratory responsible for each type of test. The Contractor shall perform the following activities and record and provide the following data:

1. Verify that testing procedures comply with Contract requirements.

2. Verify that facilities and testing equipment are available and comply with testing standards.

3. Verify that test instrument calibration data are checked against certified standards.

4. Verify that recording forms, including all of the test documentation requirements, have been prepared.

3.03 COMPLETION INSPECTION

A. At the completion of all work or any increment thereof established by a specified completion time, the CQC System Manager shall conduct a completion inspection of the work and develop a "punch list" of items which do not conform to the approved plans and specifications. Such a list shall be included in the CQC documentation and shall include the estimated date by which the deficiencies will be corrected. The CQC System Manager or his/her staff shall make a second completion inspection to ascertain that all deficiencies have been corrected and so notify the District. The completion inspection and any deficiency corrections required by this paragraph will be accomplished within the time stated for completion of the entire work or any particular increment thereof, if the project is divided into increments by separate completion dates.

3.04 DOCUMENTATION

A. The Contractor shall maintain current records of quality control operations, activities, and tests performed including the work of suppliers and subcontractors. These records shall be maintained on an acceptable form (sample form attached) and indicate a description of trades working on the project, the number of personnel working, the weather conditions encountered, any delays encountered, and acknowledgment of deficiencies noted along with the corrective actions taken on current and previous deficiencies. In addition, these records shall include factual evidence that required activities or tests have been performed including, but not limited to, the following:

1. Type and number of control activities and tests involved.

2. Results of control activities or tests.

3. Nature of defects, causes for rejection, etc.

4. Proposed remedial action.

5. Corrective actions taken.

B. These records shall cover both conforming and defective or deficient features and shall include a statement that supplies and materials incorporated in the work comply with the requirements of the Contract. Legible copies of these records shall be furnished to the District daily and not later than the day following the previous day.

3.05 NOTIFICATION OF NONCOMPLIANCE

A. The District or Engineer will notify the Contractor of any noncompliance with the foregoing requirements. The Contractor shall, after receipt of such notice, immediately take corrective action. Such notice, when delivered to the Contractor or the Contractor's representative at the site of the work, shall be deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, the District may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to any such stop orders shall be made the subject of claim for extension of time or for excess costs or damages by the Contractor.

END OF SECTION

(FORM FOLLOWS)

CONTRACTOR QUALITY CONTROL DAILY REPORT

REPORT NO. _____ CONTROL NO. _____ DATE _____

LOCATION OF WORK: _____

DESCRIPTION: _____

WEATHER _____; RAINFALL _____ INCHES; TEMP - MIN _____ MAX _____

1. Work Performed Today by Prime Contractor (Include Plant and Labor Breakdown): _____

2. Work Performed Today by Subcontractors (Include Plant and Labor Breakdown):

3. List Specific Inspection Performed and Results of these Inspections.
   (Include Corrective Actions):

4. List Type and Location of Tests Performed and Results of these Tests:

5. Verbal Instructions Received from District or Engineer on Construction Deficiencies or Re-testing Required: _____

6. Equipment on Site: _____

7. Personnel on Site: _____
   General: _____
   Electric: _____
   Paving: _____
   Other (Specify): _____

8. Remarks: _____

9. CERTIFICATION: I certify that the above report is complete and correct and that I, or my authorized representative, have inspected the work performed this day by the Prime Contractor and each subcontractor and have determined that all materials, equipment and workmanship are in strict compliance with the plans and specifications except as may be noted above.

_____
Contractor's Designated Quality Control System Manager

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SECTION 01410
TESTING AND TESTING LABORATORY SERVICES

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. The Contractor shall employ and pay for the services of an Independent Testing Laboratory to perform testing specifically indicated on the Contract Documents and may at any other time elect to have materials and equipment tested for conformity with the Contract Documents. Soil and concrete testing shall be scheduled by the Contractor

1. Cooperate with the laboratory to facilitate the execution of its required services.

2. Employment of the laboratory shall in no way relieve Contractor's obligations to perform the work of the Contract.

3. The Contractor shall submit the qualifications and experience of the proposed testing laboratory to the District and Engineer for approval prior to beginning any testing related work.

1.02 RELATED REQUIREMENTS

A. Conditions of the Contract: Inspections and testing required by laws, ordinances, rules, regulations, orders or approvals of public authorities.

B. Respective Sections: Certification of products.

C. Each Section listed: Laboratory tests required and standards for testing.

D. Testing Laboratory inspection, sampling and testing is required for but not limited to the following:

1. Earthwork (included in Section 02200).

2. Trenching, Backfilling and Compaction (included in Section 02221).

3. Concrete and reinforcement (included in Section 03300).

4. Grout (included in Section 03600).

1.03 LIMITATIONS OF AUTHORITY OF TESTING LABORATORY

A. Laboratory is not authorized to:

1. Release, revoke, alter or enlarge on requirements of Contract Documents.

2. Approve or accept any portion of the work.

3. Perform any duties of the Contractor.

1.04 CONTRACTOR'S RESPONSIBILITIES

A. Cooperate with laboratory personnel, provide access to work, to manufacturer's operations.

B. Secure and deliver to the laboratory adequate quantities of representational samples of materials proposed to be used and which require testing.

C. Provide to the laboratory the preliminary design mix proposed to be used for concrete and other materials mixes which require control by the testing laboratory.

D. Materials and equipment used in the performance of work under this Contract are subject to inspection and testing at the point of manufacture or fabrication. Standard requirements for quality and workmanship are indicated in the Contract Documents. The Engineer may require the Contractor to provide statements or certificates from the manufacturers and fabricators that the materials and equipment provided by them are manufactured or fabricated in full accordance with the standard specifications for quality and workmanship indicated in the Contract Documents. All costs of this testing and providing statements and certificates shall be a subsidiary obligation of the Contractor, and no extra charge to the District shall be allowed on account of such testing and certification.

E. Furnish incidental labor and facilities:

1. To provide access to work to be tested.

2. To obtain and handle samples at the project site or at the source of the product to be tested.

3. To facilitate inspections and tests.

4. For storage and curing of test samples.

F. Notify laboratory sufficiently in advance of operations to allow for laboratory assignment of personnel and scheduling of tests.

1. When tests or inspections cannot be performed after such notice, reimburse District for laboratory personnel and travel expenses incurred due to Contractor's negligence.

G. Employ and pay for the services of the same or a separate, equally qualified independent testing laboratory to perform additional inspections, sampling and testing required for the Contractor's convenience.

H. If the test results indicate the material or equipment complies with the Contract Documents, the District shall pay for the cost of the testing laboratory via the testing allowance. If the tests and any subsequent retests indicate the materials and equipment fail to meet the requirements of the Contract Documents, the Contractor shall pay for the laboratory costs directly to the testing firm or the total of such costs shall be deducted from any payments due the Contractor. Failed tests shall not be assessed to the testing allowance.

I. Provide District and Engineer with all testing reports.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 01445
PIPELINE TESTING AND CLEANING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and test and clean all new pipelines installed under this Contract as specified herein.

1.02 RELATED WORK

A. Buried pipelines are included in Division 2.

B. Above grade, chemical piping and exposed pipelines are included in Division 15.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. Furnish all necessary equipment and labor for cleaning and testing and chlorinating the pipelines. The procedures and methods shall be approved by the Engineer.

B. Make any taps and furnish all necessary caps, plugs, etc., as required in conjunction with testing pipelines. Furnish a test pump, gauges and any other equipment required in conjunction with carrying out the hydrostatic tests.

3.02 CLEANING PIPELINES

A. As pipe laying progresses and at the conclusion of the work, thoroughly clean all new pipelines by flushing with water or other means to remove all dirt, stones, pieces of wood or other material which may have entered during the construction period. If, after this cleaning, obstructions remain, they shall be removed.

3.03 TESTING PRESSURE PIPELINES

A. All pressure pipelines shall be pressure and leakage tested. The 30-inch diameter raw water transmission main (from the point of connection to piping installed by others through the influent flow metering facility at the ground storage tank) shall be subjected to a hydrostatic pressure of 150 psi. All distribution piping from the ground storage tank to the treatment cells (excluding distribution lateral piping located within the treatment cell boundaries) and all drain piping from the cells (excluding drain lateral piping located within the cell boundaries) shall be subjected to a hydrostatic pressure of 20 psi. The leakage test shall be conducted at the test pressure shall be maintained for at least two hours. The test pump and water supply shall be arranged to allow accurate measurement of the water required to maintain the test pressure. The amount of leakage which will be permitted shall be in accordance with AWWA C600.

B. Water required for testing will be provided by the District through pumping facilities and raw water transmission mains constructed by others under separate contracts.

END OF SECTION

SECTION 01465
EQUIPMENT TESTING AND STARTUP

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Provide a competent field services technician of the manufacturers of all equipment furnished under Divisions 13, 15 and 16 to supervise installation, adjustment, initial operation and testing, performance testing, final acceptance testing and startup of the equipment.

B. Perform specified equipment field performance tests, final acceptance tests and startup services.

1.02 RELATED WORK

A. Operation and Maintenance Data is included in Section 01730.

B. Performance and acceptance testing and startup requirements are included in the respective sections of Divisions 13, 15 and 16.

C. See the Agreement for Interim Milestone and Delayed Startup/Testing requirements of Substantial Completion.

1.03 SUBMITTALS

A. Submit name, address and resume of proposed field services technicians at least 30 days in advance of the need for such services.

B. Submit, in accordance with Section 01300, detailed testing procedures for shop tests, field performance tests and final acceptance tests as specified in the various equipment sections. Submittals shall include the following:

1. Test procedures shall be submitted at least 30 days in advance of the proposed test dates and shall include at least the following information:

    a. Name, classification, model and serial number of equipment to be tested, including reference to specifications section number and title.
    b. Testing schedule of proposed dates and times for testing.
    c. Summary of power, lighting, water, etc., needs and identification of who will provide them.
    d. Outline specific assignment of the responsibilities of the Contractor and manufacturers' factory representatives or field service personnel.
    e. Detailed description of step-by-step testing requirements, with reference to appropriate standardized testing procedures and laboratory analyses by established technical organizations (e.g., ASTM, WPCF Standard Methods, etc.).
    f. Samples of forms to be used to collect and record test data and to present tabulated test results.

2. Copies of test reports upon completion of specified shop, performance and acceptance tests. Test reports shall incorporate the information provided in the test procedures

submittals and modified to reflect actual conduct of the tests and the following additional information:

a. Copy of all test data sheets and results of lab analyses.
b. Summary comparison of specified test and performance requirements vs actual test results.
c. Should actual test results fail to meet specified test and performance requirements, describe action to be taken prior to re-testing the equipment.

3. Copies of the manufacturer's field service technician's report summarizing the results of their initial inspection, operation, adjustment and pre-tests. The report shall include detailed descriptions and tabulations of the points inspected, tests and adjustments made, quantitative results obtained, suggestions for precautions to be taken to ensure proper maintenance, and the equipment supplier's Certificate of Installation in the format specified herein.

1.04 REFERENCE STANDARDS

A. American Water Works Association (AWWA)

B. ASTM International

C. Water Environment Federation (WEF)

D. Standard Methods for the Examination of Water and Wastewater (Latest Revision)

E. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. Field service technicians shall be competent and experienced in the proper installation, adjustment, operation, testing and startup of the equipment and systems being installed.

B. Manufacturers' sales and marketing personnel will not be accepted as field service technicians unless they can prove their qualifications.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 PRELIMINARY REQUIREMENTS

A. After installation of the equipment has been completed and the equipment is presumably ready for operation, before it is operated by others, the manufacturer's field service technician shall inspect, operate, test and adjust the equipment. The inspection shall include at least the following points where applicable:

1. Soundness (without crack or otherwise damaged parts).

2. Completeness in all details, as specified and required.

3. Correctness of setting, alignment and relative arrangement of various parts.

4. Adequacy and correctness of packing, sealing and lubricants.

B. The operation, testing and adjustment shall be as required to prove that the equipment has been left in proper condition for satisfactory operation under the conditions specified.

C. Upon completion of this work, the manufacturer's field service technician shall submit a signed report of the results of their inspection, operation, adjustments and tests.

3.02 WITNESS REQUIREMENTS

A. Shop tests or factory tests may be witnessed by the District and/or District's representatives, as required by the various equipment specifications.

B. Field performance and acceptance tests shall be performed in the presence of the District, the District's designed personnel and/or District's representatives.

3.03 STARTUP AND ACCEPTANCE OF THE TREATMENT PLANT AND RELATED SYSTEMS

A. General Requirements

1. Successfully execute the step-by-step procedure of startup, normal operation, shutdown, and performance demonstration specified herein.

2. The startup and performance demonstration shall be successfully executed prior to Substantial Completion and acceptance by the District of the facility and its related systems.

3. All performance tests and inspections shall be scheduled at least 10 working days in advance or as otherwise specified with the District and the Engineer. All performance tests and inspections shall be conducted during the work week of Monday through Friday, unless otherwise specified.

B. Preparation for Startup

1. All mechanical and electrical equipment shall be checked to ensure that it is in good working order and properly connected. Preliminary run-ins of the pumps, and other remaining equipment shall be made. All systems shall be cleaned and purged as required. All pipes and equipment which are hydraulically checked shall be drained and returned to their original condition once the water testing is complete.

2. All instruments and controls shall be calibrated through their full range. All other adjustments required for proper operation of all instrumentation and control equipment shall be made.

3. Perform all other tasks needed for preparing and conditioning the facility for proper operation.

4. No testing or equipment operation shall take place until it has been verified by the Engineer that all specified safety equipment has been installed and is in good working order.

5. No testing or equipment operation shall take place until it has been verified by the Engineer that all lubricants, tools, maintenance equipment, spare parts and approved equipment operation and maintenance manuals have been furnished as specified.

C. Facilities Startup

1. Startup period shall not begin until all new treatment facilities and equipment have been tested as specified and are ready for operation. The District shall receive spare parts, safety equipment, tools and maintenance equipment, lubricants, approved operation and maintenance data and the specified operation and maintenance instruction prior to the startup with raw wastewater. All valve tagging shall also be complete prior to this startup.

2. Demonstrate a seven consecutive 24-hour day period of successful operation of the facility as a prerequisite of Substantial Completion and Acceptance. This testing will be the responsibility of the Contractor.

3. In the event of failure to demonstrate satisfactory performance of the facility on the first or any subsequent attempt, all necessary alterations, adjustments, repairs and replacements shall be made. When the facility is again ready for operation, it shall be brought on line and a new test shall be started. This procedure shall be repeated as often as necessary until the facility has operated continuously to the satisfaction of the District and Engineer, for the specified duration.

4. The District will furnish all operating personnel (other than manufacturer's or subcontractor’s service personnel) needed to operate equipment during the final test period after substantial completion; however, said personnel will perform their duties under Contractor's direct supervision. Until performance tests are completed and units and systems are accepted by the District as substantially complete, the Contractor shall be fully responsible for the operation and maintenance of all new facilities.

5. The District will provide all necessary electricity for startup. However, the Contractor shall provide all necessary personnel of the various construction trades, i.e., electricians, plumbers, etc, and field service personnel of the major equipment suppliers on an 8 hour per day basis at the facilities and on a 24 hour per day basis locally during the startup period. Major equipment suppliers shall include, but not be limited to, the following:

    a. Instrumentation and Control Equipment: unwitnessed and witnessed factory testing
    b. All Pumping Equipment
    c. Electrical Control Systems
    d. Generator Equipment
    e. HVAC and Plumbing

6. Do not, at any time, allow the facility to be operated in a manner which subjects equipment to conditions that are more severe than the maximum allowable operating conditions for which the equipment was designed.

EQUIPMENT SUPPLIER'S CERTIFICATE OF INSTALLATION

District _____

Project _____

Contract No. _____

EQUIPMENT SPECIFICATION SECTION _____

EQUIPMENT DESCRIPTION _____

I _____, Authorized representative of
(Print Name)

_____
(Print Manufacturer's Name)

hereby CERTIFY that _____
(Print equipment name and model with serial no.)

_____

installed for the subject project has (have) been installed in a satisfactory manner, has (have) been tested and adjusted, and is (are) ready for final acceptance testing and operation on :

Date_____

Time_____

CERTIFIED BY: _____
(Signature of Manufacturer's Representative)

Date:_____

END OF SECTION

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SECTION 01500
TEMPORARY FACILITIES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, equipment, materials, and incidentals necessary and provide separate temporary facilities for the Contractor's use and for the Engineer's RPR as specified herein and as shown on the drawings. Temporary offices shall be established on the job site where approved or directed by the District, adequately furnished and maintained in a clean, orderly conditions by the Contractor. The Contractor or an authorized representative shall be present in the field office at all times while work is in progress

B. Operate and maintain temporary facilities for the duration of the project and as directed by the District. All cost and use charges for temporary facilities shall be included in the Contract Price.

1.02 RELATED WORK

A. Control of Work is included in Section 01046.

1.03 SUBMITTALS

A. Submit shop drawings and product data, in accordance with Section 01300, showing materials of construction and details of installation for:

1. Site Plan: Show the proposed locations for temporary facilities including offices, temporary utilities, storage containers/buildings, vehicle access and parking areas, material laydown and staging areas, temporary fencing, and other security measures.

2. Temporary Fence: Layout drawings which indicate dimensions, access to fire hydrants, gate locations and opening sizes, and other site-specific requirements.

3. Project Sign: Layout, graphics, and wording.

B. Submittals shall be received by the Engineer no later than the date of the Preconstruction Meeting.

1.04 QUALITY ASSURANCE

A. Temporary facilities shall comply with all applicable state and local ordinances, codes and regulations.

B. Coordinate with authorities having jurisdiction to inspect (and test if required) temporary facilities.

C. Obtain all required permits for temporary facilities.

1.05 DEFINITIONS

A. Duration of the project: The period of time from the date of the Effective Date of the Agreement to the date of Final Completion, inclusive.

PART 2 PRODUCTS

2.01 MATERIALS

A. Temporary Fence: Fabric shall be No. 9 gauge galvanized wire woven in two-in diamond mesh with top and bottom twisted selvage. Intermediate and terminal posts shall be galvanized steel H or pipe, minimum 2-3/8-in OD line posts, 2-7/8-in OD corner and pull posts, and 1-5/8-in OD top rails.

B. Project Sign: Plywood shall be A-A EXT-APA grade, 1-in thick. Posts and braces shall be pressure treated lumber.

2.02 EQUIPMENT

A. Fire Extinguishers: Provide portable, UL-rated with class and extinguishing agent required by locations and classes of fire exposure. Provide at least one for each trailer/office.

B. Temporary Heat: Provide vented, self-contained, liquid propane gas or fuel oil heaters with individual space thermostatic control. Equipment shall be listed and labeled for type of fuel consumed and marked for intended use.

2.03 CONTRACTOR'S FIELD OFFICE

A. Provide a temporary field office(s) for the Contractor's use for the duration of the project. An authorized representative of the Contractor shall be present at all times while the Work is in progress. Instructions received at the Contractors field office from the Engineer shall be considered delivered to the Contractor.

B. Locate field office(s) in accordance with approved shop drawings and as directed by the District.

C. Establish and occupy field office within 30 days of the Effective Date of the Agreement, unless otherwise approved by the Engineer or District.

2.04 ENGINEER’S RESIDENT PROJECT REPRESENTATIVE FIELD OFFICE

A. The Contractor shall provide a fully operational office for the Engineer’s RPR within 30 days after insurance of the Effective Date of the Agreement.

B. Requirements for RPR’s Office in Contractor’s field office:

1. Office Size: 10 foot by 12-foot minimum divided into an office and bathroom.

2. Ceiling height shall be 8-feet.

3. Two (2) exterior entry doors to have a keyed lockset keyed alike.

4. Lighting: 50-foot candles at desktop height.

5. Automatic heating and mechanical cooling (air conditioning) equipment sufficient to maintain comfort conditions.

6. One 5-foot by 2-1/2-foot desk with chair.

7. One 6-foot by 2-1/2-foot folding table with 2 chairs.

8. One 6-foot high by 3-foot wide metal storage cabinet with key.

9. Two 4-foot high by 3-foot wide bookcase.

10. One 4-drawer file cabinet.

11. Wireless high-speed internet connection.

12. Bathroom with flush toilet, sink and mirror. Bathroom door shall be equipped with a lock.

13. Each room shall be provided with two (2) duplex convenience electrical outlets.

14. Two wastebaskets.

15. One wall mounted first aid kit.

16. Two smoke detectors with batteries.

17. One dry erase board 36”x60”, markers and eraser.

18. Cross-cut shredder with basket.

19. Fire extinguisher, UL rated, Class A complying with local codes.

20. Two 8-outlet surge protectors with 1800-joule energy rating.

21. Extension power cords for connection of equipment herein.

22. Hewlett Packard All-in-One color inkjet scan, fax, copier, printer with multi sheet scan and fax input, minimum 600 dpi B&W resolution, able to input and output letter and legal-size paper, or equal.

2.05 TEMPORARY POWER AND LIGHT

A. Contractor shall be responsible for providing temporary power until such time that permanent service can be installed. Power service for bypass pumping activities, if required, will not be provided and shall be provided by the Contractor.

B. The Contractor shall provide connections to existing facilities sized to provide service required for power and lighting. The Contractor shall pay the costs of fuel for heating.

C. The Contractor shall provide properly configured NEMA polarized outlets to prevent insertion of 110-120 Volt plugs into higher voltage outlets. For connection of power tools and equipment, provide outlets equipped with ground-fault circuit interrupters, reset button and pilot light.

D. The Contractor shall provide grounded extension cords. Use heavy duty cords where exposed to abrasion and traffic. The Contractor shall provide waterproof connectors to connect separate lengths of electric cords if more than one length is required.

E. The Contractor shall provide general service incandescent lamps as required for adequate illumination. The Contractor shall provide guard cages or tempered glass enclosures where exposed to breakage. The Contractor shall provide exterior fixtures where exposed to moisture.

2.06 WEATHER PROTECTION

A. Contractor shall furnish, install and maintain temporary heat and enclosures to provide adequate working areas for personnel during the cold weather months.

B. The Contractor shall furnish temporary heating units (UL or FM listed) to maintain reasonable temperatures within temporary enclosures.

C. Weather protection shall comply with M.G.L. Chapter 149 Section 44G.

2.07 TEMPORARY AIR, STEAM AND WATER

A. Provide all air, steam and water, including temporary piping and appurtenances required for cleaning and testing pipelines and equipment. Remove temporary piping and appurtenances upon approval of equipment being tested.

2.08 SANITARY FACILITIES

A. Provide self-contained, single occupant toilet units of the chemical, aerated recirculation, or combustion type, properly vented and fully enclosed in a fiberglass or other approved non-absorbent shell.

2.09 CONSTRUCTION AIDS

A. Provide temporary elevators, hoists, cranes, scaffolding and platforms as necessary to perform the Work. Provide temporary stairs where ladders are not adequate. Protect permanent stairs from damage from construction operations.

2.10 TEMPORARY FENCE

A. Provide temporary fence as shown on the Drawings, as specified herein, and as the Contractor requires for site security.

1. Provide six-ft high chain link fence with at least two vehicle and two pedestrian access gates. Gates shall be equipped with locking hardware and padlocks. Furnish two sets of keys to Engineer and District. Coordinate with local first responders for access during non-work hours.

2. Fence installation shall comply with ASTM F567. Post spacing shall not exceed 8-ft on center. Posts shall be set plumb in concrete footings.

3. Perform daily inspections of fence and immediately repair or replace damaged or compromised sections and as directed by the Engineer.

4. A temporary fence shall be installed prior to the removal of the existing fence. At no time shall the site note have complete fencing around the site.

2.11 WASTE MANAGEMENT

A. Provide covered dumpster, minimum four-cubic yards, dedicated for field office waste. Provide separate covered dumpster of adequate size for construction debris. Empty dumpsters on a regular basis and as directed by the Engineer. Dumpsters shall not exceed their capacities at any time.

2.12 PROJECT SIGNS

A. Furnish and install the project signs indicated in Specification 01580. Signs shall be placed as directed by the District; and, shall remain maintained in good condition for the life of the construction period.

B. Remove signs at final acceptance, unless otherwise directed.

2.13 REMOVAL AND RESTORATION

A. Remove each temporary facility complete when need for its service has ended and as approved by the District. Coordinate removal of temporary facilities with authorities having jurisdiction.

B. Restore all improvements damaged by the installation, operation, and removal of the temporary facilities. Obtain prior approval from District and Engineer for restoration work. Comply with the restoration requirements of Section 01046.

END OF SECTION

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SECTION 01520
CONSTRUCTION AIDS

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. Furnish, install and maintain required construction aids, and remove on completion of the Work.

1.02 RELATED REQUIREMENTS

A. Summary of Work is included in Section 01010.

PART 2 PRODUCTS

2.01 MATERIALS

A. Materials may be new or used, suitable for the intended purpose, but must not violate requirements of applicable codes and standards.

2.02 CONSTRUCTION AIDS

A. Provide construction aids and equipment required by personnel and to facilitate execution of the Work; Scaffolds, staging, ladders, stairs, ramps, runways, platforms, railings, hoists, cranes, chutes and other such facilities and equipment.

1. Refer to respective sections for particular requirements for each trade.

B. When permanent stair framing is in place, provide temporary treads, platforms and railings, for use by construction personnel.

C. Maintain facilities and equipment in first-class condition.

2.03 TEMPORARY ENCLOSURES

A. Provide temporary weather-tight enclosure of exterior walls for successive areas of building as work progresses, as necessary to provide acceptable working conditions, provide weather protection for materials, allow for effective temporary heating and to prevent entry of unauthorized persons.

1. Provide temporary exterior doors with self-closing hardware and padlocks.

2. Other enclosures shall be removable as necessary for work and for handling of materials.

PART 3 EXECUTION

3.01 PREPARATION

A. Consult with the Engineer, review site conditions and factors which affect construction procedures and construction aids, including adjacent properties and public facilities which may be affected by execution of the Work.

3.02 GENERAL

A. Comply with applicable requirements specified in sections of Divisions 2 through 16.

B. Relocate construction aids as required by progress of construction, by storage or work requirements and to accommodate legitimate requirements of District and other Contractors employed at the site.

3.03 REMOVAL

A. Completely remove temporary materials, equipment and services:

1. When construction needs can be met by use of permanent construction.

2. At completion of work.

B. Clean and repair damage caused by installation of or by use of temporary facilities.

1. Remove foundations and underground installations for construction aids.

2. Grade areas of site affected by temporary installations to required elevations and slopes and clean the area.

C. Restore permanent facilities used for temporary purposes to specified condition or in kind if not specified.

END OF SECTION

SECTION 01562
DUST CONTROL

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Perform dust control operations, in an approved manner, whenever necessary or when directed by the Engineer and District, even though other work on the project may be suspended. Dust control shall be generally accomplished by the use of water; however, the use of calcium chloride may be used when necessary to control dust nuisance. Cost of dust control shall be included in base bid price.

B. Calcium chloride shall conform to AASHTO M144, Type I except the requirements for "total alkali chlorides" and other impurities shall not apply.

C. Methods of controlling dust shall meet all air pollutant standards as set forth by Federal and State regulatory agencies.

END OF SECTION

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SECTION 01580
PROJECT IDENTIFICATION AND INFORMATIONAL SIGNS

PART 1 GENERAL

1.01 REQUIREMENTS

A. Furnish, install and maintain project identification and informational signs.

B. Remove sign on completion of construction.

C. Allow no other signs to be displayed.

1.02 RELATED WORK

A. Finishes are provided in Division 9.

1.03 SUBMITTALS

A. Submit in accordance with the requirements of Section 01300.

1.04 INFORMATIONAL SIGNS

A. Painted signs with painted lettering, or standard products.

1. Size of signs and lettering: as required by regulatory agencies, or as appropriate to usage.

2. Colors: as required by regulatory agencies, otherwise of uniform colors throughout Project.

B. Erect at appropriate location to provide required information.

1.05 QUALITY ASSURANCE

A. Sign Painter: Professional Experience in type of work required.

B. Finishes, Painting: Adequate to resist weathering and fading for scheduled construction period.

PART 2 PRODUCTS

2.01 SIGN MATERIALS

A. Structure and Framing: May be new or used, wood or metal, in sound condition structurally adequate to work and suitable for specified finish.

B. Sign Surfaces: Exterior softwood plywood with medium density overlay, standard large sizes to minimize joints.

1. Thickness: As required by standards to span framing members, to provide even, smooth surface without waves or buckles.

C. Rough Hardware: Galvanized

D. Paint: Exterior quality, as specified in Division 9.

1. Use Bulletin colors for graphics.

2. Colors for structure, framing, sign surfaces and graphics: As selected by the Engineer.

PART 3 EXECUTION

3.01 MAINTENANCE

A. Maintain signs and supports in a neat, clean condition; repair damages to structure, framing or sign.

3.02 REMOVAL

A. Remove signs, framing, supports and foundations at completion of project.

END OF SECTION

SECTION 01600
DELIVERY, STORAGE, AND HANDLING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section specifies the general requirements for the delivery handling, storage and protection for all items required in the construction of the work. Specific requirements, if any, are specified with the related item.

1.02 TRANSPORTATION AND DELIVERY

A. Transport and handle items in accordance with manufacturer's instructions.

B. Schedule delivery to reduce long term on-site storage prior to installation and/or operation. Under no circumstances shall equipment be delivered to the site more than one month prior to installation without written authorization from the Engineer.

C. Coordinate delivery with installation to ensure minimum holding time for items that are hazardous, flammable, easily damaged or sensitive to deterioration.

D. Deliver products to the site in manufacturer's original sealed containers or other packing systems, complete with instructions for handling, storing, unpacking, protecting and installing.

E. All items delivered to the site shall be unloaded and placed in a manner which will not hamper the Contractor's normal construction operation or those of subcontractors and other contractors and will not interfere with the flow of necessary traffic.

F. Provide necessary equipment and personnel to unload all items delivered to the site.

G. Promptly inspect shipment to assure that products comply with requirements, quantities are correct and items are undamaged. For items furnished by others (i.e., District, other contractors), perform inspection in the presence of the Engineer. Notify Engineer verbally, and in writing, of any problems.

H. If any item has been damaged, such damage shall be repaired at no additional cost to the District.

1.03 STORAGE AND PROTECTION

A. Store and protect products in accordance with the manufacturer's instructions, with seals and labels intact and legible. Storage instruction shall be studied by the Contractor and shall be their responsibility. Instruction shall be carefully followed and a written record of this kept by the Contractor. Arrange storage to permit access for inspection.

B. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.

C. Cement and lime shall be stored under a roof and off the ground and shall be kept completely dry at all times. All structural, miscellaneous and reinforcing steel shall be stored off the ground or otherwise to prevent accumulations of dirt or grease and in a position to prevent

accumulations of standing water and to minimize rusting. Beams shall be stored with the webs vertical. Precast concrete shall be handled and stored in a manner to prevent accumulations of dirt, standing water, staining, chipping or cracking. Brick, block and similar masonry products shall be handled and stored in a manner to reduce breakage, cracking and spalling to a minimum.

D. All mechanical and electrical equipment and instruments subject to corrosive damage by the atmosphere if stored outdoors (even though covered by canvas) shall be stored in a weather-tight building to prevent injury. The building may be a temporary structure on the site or elsewhere, but it must be satisfactory to the Engineer. Building shall be provided with adequate ventilation to prevent condensation. Maintain temperature and humidity within range required by manufacturer.

1. All equipment shall be stored fully lubricated with oil, grease and other lubricants unless otherwise instructed by the manufacturer.

2. Moving parts shall be rotated a minimum of once weekly to ensure proper lubrication and to avoid metal-to-metal "welding". Upon installation of the equipment, the Contractor shall start the equipment, at least half load, once weekly for an adequate period of time to ensure that the equipment does not deteriorate from lack of use.

3. Lubricants shall be changed upon completion of installation and as frequently as required thereafter during the period between installation and acceptance. New lubricants shall be put into the equipment at the time of acceptance.

4. Prior to acceptance of the equipment, the Contractor shall have the manufacturer inspect the equipment and certify that its condition has not been detrimentally affected by the long storage period. Such certifications by the manufacturer shall be deemed to mean that the equipment is judged by the manufacturer to be in a condition equal to that of equipment that has been shipped, installed, tested and accepted in a minimum time period. As such, the manufacturer will guaranty the equipment equally in both instances. If such a certification is not given, the equipment shall be judged to be defective. It shall be removed and replaced at the Contractor's expense.

E. All paint and other coating products shall be stored in areas protected from the weather. Follow all storage requirements set forth by the paint and coating manufacturers.

END OF SECTION

SECTION 01700
CONTRACT CLOSEOUT

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section specifies administrative, verification and procedural requirements for project closeout, including but not limited to:

1. Final cleaning (Section 01710).

2. Operation, instrumentation and control adjustments (Section 13).

3. Project Record Documents (Section 01720).

4. Spare parts and maintenance materials (spare paint, lubricants, special tools) (applicable Sections in Divisions 09 through 16).

5. Record Shop Drawings (Section 01300).

6. Warranties, guarantees, and bonds (Section 01740) and applicable Sections in Technical Divisions 10 through 16.

7. Reconciliation of final accounting, final change order, final payment application and Contractor's releases.

8. Permit close-outs including Certificate of Occupancy or Certificate of Completion.

1.02 RELATED WORK

A. Operation and Maintenance (O&M) data and manuals (Section 01730) and applicable Sections in Technical Divisions.

B. Certified Surveyor documentation submittals (Section 01050).

1.03 CLOSEOUT PROCEDURES

A. Provide all deliverables as specified, prior to submitting the final payment application.

B. Provide submittals to Engineer that are required by governing or other authorities having applicable jurisdiction including but not limited to permit close out information, certificates of occupancy, etc.

C. Submit Application for Final Payment identifying total adjusted Contract Sum, previous payments and sum remaining due, following submittal and approval of Record Documents and Record Drawings.

D. Submit Contractor's Final Release and Release of Liens with final payment application.

1.04 FINAL CLEANING

A. Contractor to complete final cleaning prior to submittal of the final application for payment.

B. Contractor to comply with requirements as specified in Section 01710.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01710
CLEANING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Execute cleaning, during progress of the work, and at completion of the work, as required by General Conditions.

1.02 RELATED WORK

A. Standard General Conditions of the Construction Contract with District.

1.03 DISPOSAL AND CLEANING

A. The Contractor shall conduct cleaning and disposal operations to comply with codes, ordinances, regulations and anti-pollution laws.

PART 2 PRODUCTS

2.01 MATERIALS

A. The Contractor shall use only those cleaning materials which will not create hazards to health or property and which will not damage surfaces.

B. The Contractor shall use only those cleaning materials and methods recommended by manufacturer of the surface material to be cleaned.

C. The Contractor shall use cleaning materials only on surfaces recommended by cleaning material manufacturer.

PART 3 EXECUTION

3.01 DURING CONSTRUCTION

A. The Contractor shall execute periodic cleaning to keep the work, the site and adjacent properties free from accumulations of waste materials, rubbish and windblown debris, resulting from construction operations.

B. The Contractor shall provide on-site containers for the collection of waste materials, debris and rubbish.

C. The Contractor shall remove waste materials, debris and rubbish from the site periodically and dispose of at legal disposal areas away from the site.

3.02 DUST CONTROL

A. The Contractor shall clean interior spaces prior to the start of finish painting and continue cleaning on an as-needed basis until painting is finished.

B. The Contractor shall schedule operations so that dust and other contaminants resulting from cleaning process will not fall on wet or newly-coated surfaces.

3.03 FINAL CLEANING

A. The Contractor shall employ skilled workmen for final cleaning.

B. The Contractor shall remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels and other foreign materials from sight-exposed interior and exterior surfaces.

C. The Contractor shall broom clean exterior paved surfaces; rake clean other surfaces of the grounds.

D. Prior to final completion, or District occupancy, conduct an inspection of sight-exposed interior and exterior surfaces and all work areas, to verify that the entire work is clean.

END OF SECTION

SECTION 01720
PROJECT RECORD DOCUMENTS

PART 1 GENERAL

1.01 SCOPE

A. The Contractor shall keep and maintain, at the job site, a copy of contract documents, marked up to indicate all changes made during the course of a project, as specified herein.

1.02 RELATED REQUIREMENTS

A. Contract close-out submittals are included in Section 01700.

B. Warranties and warranty bonds are included in Section 01740.

C. As-built construction schedules are included in Section 01310.

D. As-built wiring diagrams are included in Section 01730.

E. As-built surveys are included in Section 01050.

F. Record shop drawings are included in Section 01300.

G. Construction photographs are included in Section 01380.

1.03 REQUIREMENTS INCLUDED

A. Contractor shall maintain a record copy of the following documents, marked up to indicate all changes made during the course of a project:

1. Contract Drawings
2. Record Drawings
3. Specifications
4. Addenda
5. Change orders and other modifications to the contract
6. Engineer’s and District’s Supplemental Instructions Forms or written instructions
7. Approved shop drawings, working drawings, and samples
8. Field test records
9. Construction photographs

B. Contractor shall assemble copies of the following documents for turnover to the Engineer at the end of the project, as specified.

1. District's Supplemental Instructions Forms, Change Orders, Design Modifications, and RFIs

2. Field Test records

3. Permits and permit close-outs (final approvals)

4. Certificate of Occupancy or Certificate of Completion, as applicable

5. Laboratory test reports (e.g., bacteriological and primary & secondary water quality)

6. Certificates of Compliance for materials and equipment

7. Record Shop Drawings

8. Samples

9. Record Drawings and Specifications

C. RECORD DRAWINGS

1. The Contractor shall annotate (mark-up) the Contract Drawings to indicate all project conditions, locations, configurations, and any other changes or deviations that vary from the original Contract Drawings. This requirement includes, but is not limited to, buried or concealed construction, and utility features that are revealed during the course of construction. Special attention shall be given to recording the locations (horizontal and vertical) and material of all buried utilities that are encountered during construction – whether or not they were indicated on the Contract Drawings. The record information added to the drawings may be supplemented by detailed sketches, if necessary, clearly indicating, the Work, as constructed.

2. These annotated Contract Drawings constitute the Contractor's Record Drawings and are actual representations of as-built conditions, including all revisions made necessary by change orders, design modifications, requests for information and District's Supplemental Instructions Forms.

3. Record drawings shall be accessible to the District and Engineer at all times during the construction period.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 MAINTENANCE OF RECORD DOCUMENTS AND SAMPLES

A. Store documents and samples in Contractor's field office apart from documents used for construction.

1. Provide files and racks for storage of the record documents.

2. Provide locked cabinet(s) or secure storage space for storage of samples.

B. File documents and samples in accordance with Construction Specifications Institute (CSI) format.

C. Maintain documents in a clean, dry, legible, condition and in good order. Do not use record documents for construction purposes.

D. Make documents and sample available for inspection by the Engineer or District at all times.

E. Up-to-date Record Drawings may be a pre-requisite of processing periodic monthly pay applications, if so specified under the section for progress payments.

3.02 MARKING METHOD

A. Use the color Red (indelible ink) to record information on the Drawings and Specifications,

B. Label each document "PROJECT RECORD" in neat large printed letters.

C. Unless otherwise specified elsewhere, notations shall be affixed to hardcopies of documents.

D. Record information contemporaneously with construction progress.

E. Legibly mark drawings with as-built information:

1. Elevations and dimensions of structures and structural elements.

2. All underground utilities (piping and electrical), structures, and appurtenances

a. Changes to existing structure, piping and appurtenance locations.
b. Record horizontal and vertical locations of underground structures, piping, utilities and appurtenances, referenced to permanent surface improvements.
c. Record actual installed pipe material, class, size, joint type, etc.

3.03 RECORD INFORMATION COMPILATION

A. Do not conceal any work until the required information is acquired.

B. Drawings: Legibly mark to record actual construction.

C. Do not conceal any work until the required information is acquired.

D. Items to be recorded include, but are not limited to:

1. Location of internal utilities and appurtenances concealed in the construction – referenced to visible and accessible features.

2. Field changes of dimensions and/or details;

    a. Interior equipment and piping relocations.
    b. Architectural and structural changes, including relocation of doors, windows, etc.
    c. Architectural schedule changes.

3. Changes made by District's Supplemental Instructions Form, change order, design modification, and RFI, and approved shop drawings.

4. Details not indicated on the original contract drawings.

5. Specifications - legibly mark each section to record: Manufacturer, trade name, catalog number, and supplier of each product and item of equipment actually installed, and changes made by District's Supplemental Instructions Form, Change Order, RFI, and approved shop drawings.

6. Coordinates and elevations of each valve and fitting.

7. All underground duct banks with elevations and dimensions, horizontal and vertical locations of underground duct banks, and manholes along duct banks.

8. Depths of various elements of foundations in relation to finish first floor datum

9. All underground piping with elevations and dimensions. Changes to piping location. Horizontal and vertical locations of all underground utilities, valves, and appurtenances, referenced to permanent surface improvements. Actual installed pipe material, class, etc. All pipes shall be labeled using the method as per the contract drawings.

10. All underground cable elevations and horizontal locations of underground cables.

11. All existing and new structures clearly identified.

12. All elevations of new structures (including weirs) clearly indicated.

13. Architectural schedule changes according to Contractor's records and shop drawings

14. Location, elevation, and datum of Benchmark used.

15. Easements as shown on approved paving and drainage drawings.

16. Locations, elevations, sizes, types and material of the following must be accurately shown and labeled (as applicable).

    a. Manholes (including specialty lining material, pipe invert, manhole rim, and bottom elevations).
    b. Valves.
    c. Water and sewer services.
    d. Fire Hydrant and all associated structures.
    e. Fittings.

17. All water and sewer mains must be identified on the record drawings by their size, material, and DR/SDR classification. Horizontal locations and top of pipe elevations must

also be labeled every 100 linear feet. All valves shall be labeled using the method as per the contract drawings.

18. All new hydrant locations shall be identified based upon the Florida State Plane Coordinate System.

E. Specifications - legibly mark each Section to record:

1. Manufacturer, trade name, catalog number, and Supplier of each product and item of equipment actually installed.

2. Changes made by District's Supplemental Instructions Form, Change Order, RFI, and approved shop drawing.

F. Shop Drawings (after final review and approval):

1. Five sets of record drawings for each process equipment, piping, electrical system and instrumentation system.

3.04 SUBMITTAL

A. If specified under the section for progress payments, monthly applications for payment will be contingent upon up-to-date Record Drawings. If requested by the Engineer or District, Contractor shall provide a copy of the Record Drawings, or present them for review prior to processing monthly applications for payment.

B. Upon substantial completion of the WORK and prior to final acceptance, the Contractor shall finalize and deliver a complete set of Record Drawings to the Engineer conforming to the construction records of the Contractor. The set of drawings shall consist of corrected and annotated drawings showing the recorded location(s) of the Work. Unless specified otherwise elsewhere, Record Drawings shall be in the form of a set of prints with annotations carefully and neatly superimposed on the drawings in red.

C. Upon substantial completion of the Work and prior to final acceptance, the Contractor shall finalize and deliver a complete set of Record Documents to the Engineer conforming to the construction records of the Contractor. The set of documents shall consist of corrected and annotated documents showing the as-installed equipment and all other as-built conditions not indicated on the Record Drawings.

D. The information submitted by the Contractor into the Record Drawings and Record Documents will be assumed to be correct, and the Contractor shall be responsible for the accuracy of such information, and shall bear the costs resulting from the correction of incorrect data. Final Record Drawings shall be certified by a surveyor licensed in the State of Florida.

E. Delivery of Record Drawings and Record Documents to the Engineer will be a prerequisite to Final payment.

F. The Contractor shall maintain a copy of all books, records, and documents pertinent to the performance under this Agreement for a period of five years following completion of the contract.

END OF SECTION

SECTION 01730
OPERATION AND MAINTENANCE DATA AND ASSET MANAGEMENT

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section includes procedural requirements for compiling and submitting operation and maintenance data required to complete the project.

1.02 RELATED WORK

A. Submittals are included in Section 01300.

B. Contract closeout is included in Section 01700.

C. Warranties and Warranty Bonds are included in Section 01740.

1.03 OPERATING MANUALS

A. The Manufacturer shall provide specific operation and maintenance instructions for all electrical, mechanical, and instrumentation & controls equipment furnished under various technical specifications Sections.

B. Six complete sets of operation and maintenance manuals approved by the Engineer covering all equipment furnished under Divisions 13, 15 and 16 shall be delivered at least 30 days prior to scheduled start-up directly to the District. One set of originals must be part of the six sets of operation and maintenance instructions required, including original manuals covering components manufactured by others.

C. An electronic copy of the manual will be provided with each hard copy submittal.

D. Separate manuals shall be provided for each type of equipment, or each Section number. Each manual shall contain the following specific requirements. Manuals that do not meet the requirements will be rejected and Equipment Supplier/Manufacturer will bear all expenses to resubmit the manual to meet the following requirements.

1. Format and Materials

a. Binders:

1) Commercial quality three ring binders with durable and cleanable plastic covers
2) Maximum ring width capacity: 3 inches
3) When multiple binders are used, correlate the data into related consistent groupings/volumes.

b. Identification: Identify each volume on the cover and spine with typed or printed title "OPERATING AND MAINTENANCE INSTRUCTIONS". Include the following:

1) Title of Project.
2) Identify the general subject matter covered in the manual.

3) Identify structure(s) and/or location(s), of the equipment provided.
4) Specification Section number.

c. 20 lb loose leaf paper, with hole reinforcement
d. Page size: 8-1/2 inch by 11 inch
e. Provide heavy-duty fly leafs (section separators), matching the table of contents, for each separate product, each piece of operating equipment, and organizational sections of the manual.
f. Provide reinforced punched binder tab; bind in with text.
g. Reduce larger drawings and fold to the size of text pages - but not larger than 11 inches x 17 inches - or provide a suitable clear plastic pocket (with drawing identification) for such folded drawings/diagrams.

2. Contents:

a. A table of contents/Index, divided into section reflective of the major components provided.
b. Specific description of each system and components
c. Name, address, telephone number(s) and e-mail address(es) of vendor(s) and local service representative(s)
d. Equipment Supplier/Manufacturer shall clearly strike out portions of manual that do not apply to the project. Manual will be rejected until inapplicable information is deleted and only applicable information is clearly indicated
e. Specific on-site operating instructions (including starting and stopping procedures)
f. Safety considerations
g. Project specific operational procedures and recommended log sheet(s).
h. Project specific maintenance procedures
i. Manufacturer's operating and maintenance instructions – specific to the project
j. Copy of each wiring diagram
k. Copy of approved shop drawing(s) and Contractor's coordination/layout drawing(s)
l. List of spare parts and recommended quantities
m. Product Data: Mark each sheet to clearly identify specific products and component parts and data applicable to installation. Delete inapplicable information.
n. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams
o. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified.
p. Warranties and Warranty Bonds, as specified in the General Conditions
q. Equipment attributes sheet for submittal of nameplate data
r. Electronic copy of manual on CD

3. Transmittals

a. Prepare separate transmittal sheets for each manual. Each transmittal sheet shall include at least the following: Contractor's name and address, District's name, project name, project number, submittal number, description of submittal and number of copies submitted.
b. Submittals shall be transmitted or delivered directly to the office of the Engineer, as indicated in the Contact Documents or as otherwise directed by the Engineer.
c. Provide copies of transmittals (only, i.e., without copies of the respective submittal) directly to the Resident Project Representative.

E. Manuals for Equipment and Systems - In addition to the requirements listed above, for each System, provide the following:

1. Overview of system and description of unit or system and component parts. Identify function, normal operating characteristics and limiting conditions. Include legible performance curves, with engineering data and tests and complete nomenclature and commercial number of replaceable parts.

2. Panelboard circuit directories including electrical service characteristics, controls and communications and color-coded wiring diagrams as installed.

3. Operating procedures: include start-up, break-in and routine normal operating instructions and sequences; regulation, control, stopping, shut-down and emergency instructions; and summer, winter and any special operating instructions.

4. Maintenance Requirements

   a. Procedures and guides for trouble-shooting; disassembly, repair, and reassembly instructions
   b. Alignment, adjusting, balancing and checking instructions
   c. Servicing and lubrication schedule and list of recommended lubricants
   d. Manufacturer's printed operation and maintenance instructions
   e. Sequence of operation by instrumentation and controls manufacturer
   f. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance

5. Control diagrams by controls manufacturer as installed (as-built)

6. Contractor's coordination drawings, with color coded piping diagrams, as installed (as-built)

7. Charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams. Include equipment and instrument tag numbers on diagrams.

8. List of original manufacturer's spare parts and recommended quantities to be maintained in storage

9. Test and balancing reports, as required

10. Additional Requirements as specified in individual product specification

11. Design data for systems engineered by the Contractor or its Suppliers

F. Manual for Materials and Finishes - In addition to the requirements listed above, for each material or finish, provide the following:

1. Building Products, Applied Materials and Finishes: Include product data, with catalog number, size, composition and color and texture designations. Provide information for re-ordering custom manufactured products.

2. Instructions for Care and Maintenance: Include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods and recommended schedule for cleaning and maintenance.

3. Moisture Protection and Weather Exposed Products: Include product data listing, applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance and repair.

4. Additional Requirements: As specified in individual product specifications.

G. Electronic Transmission of O&M Manuals

1. Unless otherwise approved by the Engineer, O&M manuals may not be transmitted by electronic means other than by CD-ROM or USB flash drive. Electronic O&M manuals shall meet the following conditions:

   a. The above-specified transmittal form is included.
   b. All other requirements specified above have been met, including, but not limited to, coordination by the Contractor, review and approval by the Contactor.
   c. The submittal contains no pages or sheets large than 11 x 17 inches.
   d. With the exception of the transmittal sheet, the entire submittal is included in a single file.
   e. Files are Portable Document Format (PDF) – with the printing function enabled.
   f. The Vendor provided equipment, sub-system, or system manuals shall be in PDF format, compliant with the Adobe PDF Specification Version 1.7. The manual shall be Searchable Image. The Optical Character Recognition of the image shall be at a 95% confidence level. The manuals shall be linked and bookmarked as follows:

      1) Provide links from all Table of Contents, List of Tables, List of Figures, etc., entries to the actual occurrence in the body of the manual.
      2) Create bookmarks for all linked Table of Content entries.

   g. All drawings shall be in PDF format, compliant with the Adobe PDF Specification Version 1.7. The manual shall be PDF Searchable Image. The Optical Character Recognition of the image shall be at a 95% confidence level. The drawings shall be linked as follows:

      1) External links from the Drawing Index (if it exists) to each drawing.
      2) External links from references within drawings to other drawings.

   h. All scanned manufacturer's O&M manuals must be quality checked after scanning to ensure the page are not crooked and all information is legible.

2. When electronic copies are provided, transmit two hard copy (paper) originals to the Engineer with an electronic copy on CD-ROM.

3. The electronic copy of the O&M manual shall be identical in organization, format and content to the hard copies of the manual.

4. The electronic O&M Manual shall be bookmarked identically to the paper manual table of contents to allow quick access to information. Electronic submittals that require extensive scrolling will not be accepted. The document shall be indexed and searchable.

H. Quick Reference Sheets for Equipment

1. For each item of equipment furnished under Divisions 15 and 16 provide the following:

a. A minimum of one 8 ½ x 11-inch laminated quick reference sheet. Sheets shall be three hole punched and may be double sided.
b. Each quick reference sheet shall include the following minimum information:
1) Safety Procedures:

a) Brief descriptions of each piece of equipment and components;
b) Starting and stopping procedures;
c) Special operating instruction;
d) Routine maintenance procedures;
e) Calibration procedures;
f) Pump curves;
g) Trouble shooting procedures; and
h) Name, address, and telephone numbers of local service representative.

c. Provide three copies of quick reference sheets for review by the Engineer.
d. After quick reference sheets have been approved, provide four copies of laminated quick reference sheets to the Engineer in one commercial coiled three-ring binder with durable and cleanable plastic cover.

1.04 SERVICES OF MANUFACTURERS' REPRESENTATIVE

A. A. All electrical, mechanical, and instrumentation & controls equipment furnished under various technical specifications Sections shall include the cost of a competent representative of the manufacturers of all equipment to supervise the installation, adjustment and testing of the equipment; and, to instruct the District's operating personnel on operation and maintenance. This supervision may be divided into two or more time periods to suit the Contractor’s schedule and/or the District’s personnel availability.

B. See the detailed specifications for additional requirements for furnishing the services of manufacturer's representatives.

C. The manufacturer’s representative shall certify that the installation of the equipment is satisfactory; that the unit has been satisfactorily tested; that the equipment is ready for operation; and, that the operating personnel have been suitably instructed in the operation, maintenance, care, and safe operation of the equipment. The Equipment Manufacturer’s Certificate of Installation, Testing, and Instruction attached to this Section shall be used for this certification.

D. For other materials furnished under other specification Sections, furnish the services of approved representative(s) of the manufacturer when, in the opinion of the Engineer, some evident product failure or malfunction makes such services necessary.

1.05 EQUIPMENT ATTRIBUTE INFORMATION

A. Equipment Attribute Worksheets as presented at the end of this Section shall be provided for all equipment meeting the asset definition as follows:

1. Asset Definition

a. Maintenance is recommended
b. Assets have a value greater than $1,000
c. Assets are complete and usable, and perform a distinct function independently (i.e., they pump waste, remove solids, etc.)

B. This asset definition is intended to give a general indication of which equipment must be included in the Equipment Attribute Worksheets. The Engineer will provide the specific list of equipment that the Vendor must provide information for:

C. The information requirements are shown in detail in the table. The data requirements include nameplate data, manufacturer and supplier information, information specific to the type of equipment, and recommended preventative maintenance activities.

D. An electronic copy of the Equipment Attribute Worksheets must be delivered in Excel format and submitted to the Engineer on CD-ROM and submitted with the O&M manuals. It is not necessary to submit printed copies of the Equipment Attribute Worksheets.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 SUBMITTAL SCHEDULE

A. Operation and maintenance manuals shall be delivered directly to the office of the Engineer, as follows:

1. Provide preliminary copies of each manual to the office of the Engineer, no later than 30 days following approval of the respective shop drawings.

2. Provide final copies of each completed manual prior to testing.

3. Provide a letter that grants the Engineer and District to the limited right to use and reproduce each manual (in it its entirety or any portion thereof) from the respective equipment manufacturer(s). Such limited right shall allow the Engineer and District to use each manual or and portion thereof for:

a. The potential assembly of a comprehensive facility operation and maintenance manual for the sole benefit of the District; and,
b. Supplemental training of the District's personnel and operators, over and above the required vendor's training, regarding operation of the facility as a system.

B. The Engineer will review Operation and Maintenance manuals submittals for operating equipment for conformance with the requirements of the applicable specification Section. The review will generally be based on the O&M Manual Review Checklist appended to this Section.

C. If during test and start-up of equipment, any changes were made to the equipment, provide two hard copies of as-built drawings or any other amendments for insertion, by the Contractor, in the previously transmitted final manuals. In addition, provide one revised electronic version including the as-built drawings and any other amendments. The manuals shall be completed, including updates, if any, within 30 days of start-up and testing of the facility.

3.02 VENDOR TRAINING/INSTRUCTIONS (TO DISTRICT'S PERSONNEL)

A. Before final initiation of operation, Contractor's vendors shall train/instruct District's designated personnel in the operation, adjustment, and maintenance of products, equipment and systems at times convenient to the District.

B. Unless specified otherwise under the respective equipment specification section, vendor training/instruction shall consist of eight hours of training for each type of equipment. Such training/instruction shall be scheduled and held at times to accommodate the work schedules of District's personnel, including splitting the required training/instruction time into separate sessions and/or presented at reasonable times other than the Contractor's "normal working hours" or the District's normal day shift.

C. Use operation and maintenance manuals as basis for instruction. Train/instruct the District's personnel, in detail, based on the contents of manual explaining all aspects of operation and maintenance of the equipment. If the respective equipment is inter-related to the operation of other equipment, all interlock, constraints, and permissives shall be explained.

D. At least two weeks prior to the schedule for vendor training, a detailed lesson plan, representative of the material to be covered during instruction, shall be submitted to the Engineer for approval. Lesson plans shall consist of in-depth outlines of the training material, including a table of contents, resume of the instructor, materials to be covered, start-up procedures, maintenance requirements, safety considerations, and shut-down procedures.

E. Prepare and insert additional data in each Operation and Maintenance Manual when the need for such data becomes apparent during training/instruction.

F. Vendor's training/instruction will be considered acceptable based on the completed District's Acknowledgement of Manufacturer's Instruction as indicated on the Equipment Manufacturer's Certification of Installation, Testing, and Instruction appended to this Section.

G. Training Video

1. All equipment suppliers shall supply to the Engineer three copies of a training video specific to the equipment furnished for the project. The film shall be of a high quality, with both picture and sound.

2. The training video shall be organized so as to show and identify each element of the equipment; including a clear explanation of its function, troubleshooting criteria; disassembly and reassembly

3. Portions of the training video shall be recorded at the on-site O&M training sessions conducted by the equipment manufacturer’s representative.

4. The video shall be submitted to the Engineer for approval not less than 30 calendar days after the start-up of the equipment.

5. The video recording should be playable on VCD recorded discs using MPEG-1 video (MP3 audio) and thereby able to be replayed through Windows Media Player, QuickTime or RealPlayer on PCs and most DVD players. VCD stored on CD-ROMs have the capacity to hold up to 74/80 minutes on a 650MB/700MB CD respectively, of video with stereo quality sound. All video and audio should be of the highest quality. All CD-OMS shall bear a label identifying the Equipment(s) trained on, general Training topic (i.e., Maintenance, Operations, Storage, or O&M, etc.), the date of the video, trainer and his affiliation (i.e. John Doe, XYZ Company), and video file one of how many on the topic (Video 1 of 2) if the video exceeds the recording time of the CD.

3.03 VIDEOGRAPHY OF VENDOR TRAINING/INSTRUCTION

A. Audio/video (A/V) record (in DVD format) training/instructions as they are being provided to the District's personnel. Such recording shall include the entire training/instruction session(s) as well as all questions and answers. A/V recording shall be performed by a professional organization experienced in the production of such recordings. Self-recording by the Contractor may be considered, provided that Contractor can demonstrate, in advance, proficient examples of such recordings.

B. To avoid audio problems, training/instruction shall be held in a location sufficiently removed from construction activity, insulated from the noise of construction activity, or during a time when construction activity is not occurring in the vicinity.

C. The audio portion of the A/V recording should be done with a microphone (wired or wireless) attached to the trainer/instructor to maximize the quality of speech.

D. Each A/V recording should have "chapters" to segregate the distinct portions of the training/instruction, or have visual cues at the start of a change in subject.

E. Two copies of the A/V recordings shall be submitted to the Engineer on DVD disk(s). The DVDs will become the property of the District.

END OF SECTION

O&M Manual Review Checklist

Submittal No.: _____

Project No.: _____

Manufacturer: _____

Equipment Submitted: _____

Specification Section: _____

Date of Submittal:

	General Data	
1.	Are the area representative's name, address, e-mail address and telephone number included?	
2.	Is the nameplate data for each component included?	
3.	Are all associated components related to the specific equipment included?	
4.	Is non-pertinent data crossed out or deleted?	
5.	Are drawings neatly folded and/or inserted into packets?	
6.	Are all pages properly aligned and scanned legibly?	
7.	Is the .PDF document bookmarked according to the table of contents?	
	Operations and Maintenance Data	
8.	Is an overview description of the equipment and/or process included?	
9.	Does the description include the practical theory of operation?	
10.	Does each equipment component include specific details (design characteristics, operating parameters, control descriptions, and selector switch positions and functions)?	
11.	Are alarm and shutdown conditions specific to the equipment provided on this project clearly identified? Does it describe possible causes and recommended remedies?	
12.	Are step procedures for starting, stopping, and troubleshooting specific to the equipment provided included?	
13.	Is a list of operational parameters to monitor and record specific to the equipment provided included?	
14.	Is a proposed operating log sheet specific to the equipment provided included?	
15.	Is a spare parts inventory list included for each component?	
16.	Is a lubrication schedule for each component specific to the equipment provided included - or does it clearly state “No Lubrication Required"?	
17.	Is a maintenance schedule for each component specific to the equipment provided included?	
18..	Is a copy of the warranty information included?	

Review Comments

Is the submittal fully approved (yes/no)? _____

If not, the following points of rejection must be addressed and require resubmittal by the Contractor:

Item No.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____

Reviewed By: _____ Date: _____

Legend

1 = OK

2 = Not Adequate

3 = Not Included

Note: This submittal has been reviewed for compliance with the Contract Documents.

SECTION 01740
WARRANTIES AND WARRANTY BONDS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section specifies general administrative and procedural requirements for warranties and warranty bonds required by the Contract Documents, including Equipment Supplier/Manufacturer's standard warranties on products and special warranties.

1.02 RELATED WORK

A. General closeout requirements are included in Section 01700 Contract Closeout.

B. Specific requirements for warranties for the work and products and installations that are specified to be warranted are included in the individual Sections.

1.03 SUBMITTALS

A. The individual Equipment Supplier/Manufacturer shall submit written warranties to the District prior to the date fixed by the Equipment for Substantial Completion. If the Certificate of Substantial Completion designates a commencement date for warranties other than the date of Substantial Completion for the work, or a designated portion of the work, submit written warranties upon request of the District. See the Agreement for Interim Milestone and Delayed Startup/Testing requirements of Substantial Completion.

B. When a designated portion of the work is completed and occupied or used by the District, by separate agreement with the Equipment Supplier/Manufacturer (as applicable) during the construction period, submit properly executed warranties to the District via the Equipment within 15 days of completion of that designated portion of the Work.

C. When a special warranty is required to be executed by the Equipment Supplier/Manufacturer, prepare a written document that contains appropriate terms and identification, ready for execution by the required parties. Submit a draft to the District via the Equipment for approval prior to final execution.

D. Forms for special warranties are included at the end of this Section. Prepare a written document utilizing the appropriate form, ready for execution by the Contractor, or the Contractor and subcontractor, or Equipment Supplier/Manufacturer. Submit a draft to the District for approval prior to final execution.

E. Refer to individual Sections for specific content requirements, and particular requirements for submittal of special warranties.

F. At Final Completion the Contractor shall compile two copies of each required warranty and bond properly executed by the Equipment Supplier/Manufacturer. Organize the warranty documents into an orderly sequence based on the table of contents of the Project Manual.

G. Bind warranties and bonds in heavy-duty, commercial quality, durable three-ring vinyl covered loose-leaf binders, thickness as necessary to accommodate contents and sized to receive 8-1/2-inch by 11-inch paper.

H. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Project Manual, with each item identified with the number and title of the Section in which specified and the name of the product or work item.

I. Provide heavy paper dividers with celluloid covered tabs for each separate warranty. Mark the tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address and telephone number of the installer or Equipment Supplier/Manufacturer.

J. Identify each binder on the front and the spine with the typed or printed title "WARRANTIES AND WARRANTY BONDS", the project title or name and the name, address and telephone number of the Equipment Supplier/Manufacturer.

K. When operating and maintenance manuals are required for warranted construction, provide additional copies of each required warranty, as necessary, for inclusion in each required manual.

1.04 WARRANTY REQUIREMENT

A. Related Damages and Losses: When correcting warranted work that has failed, remove and replace other work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted work.

B. Reinstatement of Warranty: When work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.

C. Replacement Cost: Upon determination that work covered by a warranty has failed, replace or rebuild the work to an acceptable condition complying with requirements of Contract Documents. The Equipment Supplier/Manufacturer is responsible for the cost of replacing or rebuilding defective work regardless of whether the District has benefited from use of the work through a portion of its anticipated useful service life.

D. District's Recourse: Written warranties made to the District are in addition to implied warranties, and shall not limit the duties, obligations, rights and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the District can enforce such other duties, obligations, rights, or remedies.

E. Rejection of Warranties: The District reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.

F. The District reserves the right to refuse to accept work for the Project where a special warranty, certification, or similar commitment is required on such work or part of the work, until evidence is presented that entities required to countersign such commitments are willing to do so.

G. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the Equipment Supplier/Manufacturer (as applicable) of the warranty on the work

that incorporates the products, nor does it relieve Equipment Supplier/Manufacturer and subcontractors required to countersign special warranties with the Contractor.

1.05 MANUFACTURERS CERTIFICATIONS

A. Where required, the Contractor shall supply evidence, satisfactory to the Equipment, that the Equipment Supplier/Manufacturer can obtain manufacturers' certifications as to the Contractor's installation of equipment.

1.06 DEFINITIONS

A. Standard Product Warranties are preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the District.

B. Special Warranties are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for the District.

1.07 EQUIPMENT WARRANTIES

A. All equipment supplied under this Contract shall be guaranteed to be free from defects in workmanship, design, and/or materials for a period of two years unless otherwise specified. The period of such warranties shall start on the date the particular equipment is placed in use by the District and provided that the equipment demonstrates satisfactory performance during the 30-day operational period after equipment startup. If the equipment does not perform satisfactorily during the 30-day startup operational period, the start of the warranty period shall be delayed until the equipment demonstrates proper operation. Warranties and guarantees shall be indicated on the Warranty for Equipment Item form appended to this Section. The Equipment Supplier/Manufacturer shall repair or replace without charge to the District any part of equipment which is defective or showing undue wear within the warranty period, or replace the equipment with new equipment if the mechanical performance is unsatisfactory; furnishing all parts, materials, labor, etc., necessary to return the equipment to its specified level.

B. The equipment shall be warranted to be free from defects in workmanship, design and materials. If any part of the equipment should fail during the warranty period, it shall be replaced in the equipment(s) and the equipment and/or unit(s) restored to service at no expense to the District.

C. Obtain equipment warranties in accordance with Section 01740 from each of the respective Equipment Supplier/Manufacturer for all the equipment specified under Divisions 13, 15 and 16 of these Specifications. The form of warranty is included at the end of this Section.

D. The Equipment Supplier/Manufacturer’s warranty period shall run concurrently with the Contractor's warranty or guarantee period.

1.08 FINAL GUARANTEE

A. All work shall be guaranteed by the Contractor for a period of one year from and after the date of final acceptance of the work by the District.

B. If, within the guarantee period, repairs or changes are required in connection with guaranteed work, which, in the opinion of the Equipment, is rendered necessary as the result of the use of materials, equipment or workmanship which are inferior, defective, or not in accordance with the terms of the Contract, promptly upon receipt of notice from the District and without expense to the District, replace any part of equipment which is defective or showing undue wear within the warranty period, or replace the equipment with new equipment if the mechanical performance is unsatisfactory.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

WARRANTY FOR EQUIPMENT ITEM

LOCATION OF PROJECT:_____

DISTRICT:_____

PROJECT NUMBER:_____

EQUIPMENT ITEM:_____

SECTION NO. / ITEM NO.:_____

SUPPLIER/MANUFACTURER:_____

SUPPLIER/MANUFACTURER's ADDRESS: _____

SUPPLIER/MANUFACTURER'S REFERENCE NO.:_____

The undersigned guarantees that the above equipment is of good merchantable quality, free from defects in material or workmanship, fully meets the type, quality, design and performance requirements defined in the Contract Documents of the above project, and that the equipment will in actual operation satisfactorily perform the functions for which installed.

The undersigned agrees to repair, replace, or otherwise make good, any defect in workmanship or materials in the above described equipment which may develop within a period of two years from the date of final acceptance by the District of the above-named project.

COMPANY_____

COMPANY ADDRESS_____

_____

BY_____

TITLE_____

SIGNED_____

DATE_____

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SECTION 02100
SITE PREPARATION

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials and equipment required and perform all site preparation, complete as shown on the Drawings and as specified herein.

B. Obtain all permits required for site preparation work prior to proceeding with the work, including clearing and tree removal.

C. The areas to be cleared, grubbed and stripped within public rights-of-way and utility easements will be minimized to the extent possible. No unnecessary site preparation within these areas will be performed.

1.02 RELATED WORK

A. Refer to Florida Department of Transportation Standards for sodding requirements.

1.03 SUBMITTALS

A. Submit to the Engineer, in accordance with Section 01300, copies of all permits required prior to clearing, grubbing, and stripping work.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 CLEARING

A. Cut and remove all timber, trees, stumps, brush, shrubs, roots, grass, weeds, rubbish and any other objectionable material resting on or protruding through the surface of the ground within the limits of clearing shown on the Drawings.

B. Preserve and protect trees and other vegetation outside of the limits of clearing.

3.02 GRUBBING

A. Grub and remove all stumps, roots in excess of 1-1/2-in in diameter, matted roots, brush, timber, logs, concrete rubble and other debris encountered to a depth of 18-in below original grade or 18-in beneath the bottom of foundations, whichever is deeper.

B. Refill all grubbing holes and depressions excavated below the original ground surface with suitable materials and compact to a density conforming to the surrounding ground surface.

3.03 DISPOSAL

A. Dispose of material and debris from site preparation operations by hauling such materials and debris offsite. No rubbish or debris of any kind shall be buried on the site.

B. No on-site disposal of cleared and grubbed materials by open-air burning will be permitted by the District.

3.04 PROTECTION

A. Trees and other vegetation designated on the Drawings or directed by the Engineer to remain will be protected from damage by all construction operations by erecting suitable barriers, guards and enclosures, or by other approved means. Conduct clearing operations in a manner to prevent falling trees from damaging trees and vegetation designated to remain and to the work being constructed and so as to provide for the safety of workers and others.

B. Maintain protection until all work in the vicinity of the protected trees and vegetation has been completed.

C. Do not operate heavy equipment or stockpile materials within the branch spread of existing trees.

D. Immediately repair any damage to existing tree crowns, trunks, or root systems. Roots exposed and/or damaged during the work will immediately be cut off cleanly inside the exposed or damaged area. Treat cut surfaces with an acceptable tree wound paint and topsoil spread over the exposed root area.

E. When work is completed, remove all dead and downed trees. Live trees will be trimmed of all dead and diseased limbs and branches. All cuts will be cleanly made at their juncture with the trunk or preceding branch without injury to the trunk or remaining branches. Cuts over one-in. in diameter will be treated with an acceptable tree wound paint.

F. Restrict construction activities to those areas within the limits of construction designated on the Drawings, within public rights-of-way, and within easements provided by the District. Adjacent properties and improvements thereon, public or private, which become damaged by construction operations will be promptly restored to their original condition, to the full satisfaction of the property District.

END OF SECTION

SECTION 02140
DEWATERING AND DRAINAGE

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Design, furnish, install, operate, monitor, maintain and remove a temporary dewatering system where applicable to lower and control water levels at least two ft below trench and structure excavation subgrades, including launch/exit shafts, and one ft below trenchless casing invert to permit construction to proceed in-the-dry.

B. Furnish, operate, maintain and remove temporary surface water control measures to prevent surface water from entering excavations.

C. Retain the services of a professional engineer registered in the State of Florida to prepare dewatering and drainage system designs and submittals described herein.

D. Work shall include the design, equipment, materials, installation, protection, and monitoring of geotechnical instrumentation required to monitor the performance of the dewatering and drainage system as required herein.

E. Collect and properly dispose of all discharge water from the dewatering operations.

F. Obtain permits required for discharge of groundwater from dewatering operations.

G. Repair damage caused by dewatering and drainage system operations.

1.02 RELATED WORK

A. Submittals are included in Section 01300.

B. Site Preparation is included in Section 02100.

C. Jack and Bore is included in Section 02157.

D. Excavation Support and Protection is included in Section 02311.

E. Geotechnical Instrumentation is included in Section 02495.

1.03 DESIGN REQUIREMENTS

A. The Contractor is responsible for the proper design and implementation of methods for controlling surface water and groundwater.

B. The discharges of groundwater from the Contractor’s dewatering operations shall be in accordance with the requirements of an NPDES permit for construction activities obtained by the Contractor from the FDEP or in accordance with a “Generic Permit for Discharge of Groundwater from Dewatering Operations” obtained by the Contractor from FDEP.

C. The primary purpose of the groundwater control system is to preserve the natural undisturbed condition of the subgrade soils in the areas of the proposed excavations. Prior to excavation, the

Contractor shall lower the groundwater to at least two ft below pipe trench bottom and two ft below the lowest excavation subgrade elevation (including launch and exit shafts). The Contractor shall lower the groundwater to at least one ft below trenchless casing inverts. Additional groundwater lowering may be necessary beyond the requirements above, depending on construction methods and equipment used and the prevailing groundwater and soil conditions. Dewatering shall be sufficient to control piezometric pressures to avoid any heave or destabilization of the excavation bottoms. The Contractor is responsible for lowering the groundwater as necessary to complete construction in accordance with the plans and specifications at no additional cost to the District.

D. Design deep wells, well points and sumps, and all other groundwater control system components to prevent loss of fines from surrounding soils. Sand filters shall be used with all dewatering installations unless screens are properly sized by the Contractor's design engineer to prevent passage of fines from surrounding soils.

E. The Contractor shall be responsible for damage to properties, buildings or structures, pipelines and other utility installations, pavements and work that may result from dewatering or surface water control operations.

F. Design review and field monitoring activities by the District or by the Engineer shall not relieve the Contractor of his/her responsibilities for the work.

1.04 SUBMITTALS

A. Dewatering and drainage system design plans shall be prepared and stamped by an experienced licensed professional engineer registered in the state of Florida and retained by the Contractor. The Contractor shall submit an original and three copies of the licensed professional engineer's certification on the PE form specified in Section 01300. The Contractor shall submit documentation of experience and qualifications as required herein.

B. The plan shall include a description of the proposed dewatering system and include the proposed installation methods to be used for dewatering and drainage system elements and for observation wells. The plan shall include equipment, drilling methods, holes sizes, filter sand placement techniques, sealing materials, development techniques, the number and location of dewatering points, observations wells and piezometers, etc. Include the dewatering system design calculations in the plan.

C. The plan shall identify the anticipated areas influenced by the dewatering system and address impacts to adjacent existing and proposed structures.

D. Coordinate dewatering and drainage submittals with the excavation and support of excavation submittals. The submittal shall show the areas and depths of excavation to be dewatered.

E. Do not proceed with any excavation or dewatering activities until the dewatering submittals have been reviewed by the Engineer for conformance with the Contract Documents and for general compatibility with the work and with accepted engineering practices.

1.05 QUALITY ASSURANCE

A. Regulations: Perform all work in accordance with current applicable regulations and codes of all Federal, State and local agencies.

B. The Contractor shall have at least five years of experience with dewatering system operations comparable to the dewatering operations required for the performance of the Work, employing labor and supervisory personnel who are similarly experienced in this type of Work.

C. The Contractor's dewatering and drainage system design engineer shall be licensed in the State of Florida and have a minimum of five years of professional experience in the design and construction of dewatering and drainage systems and shall have completed not less than five successful dewatering and drainage projects of equal type, size, and complexity to that required for the work.

1.06 DEFINITIONS

A. Where the phrase "in-the-dry" is used in this Section, it shall be defined as an excavation subgrade where the groundwater level has been lowered to at least two ft below excavation subgrade and one-ft casing invert, is stable with no ponded water, mud, or muck, is able to support construction equipment without rutting or disturbance and is suitable for the placement and compaction of fill material, pipe or concrete foundations.

PART 2 PRODUCTS

2.01 MATERIALS

A. Observation wells and piezometers shall consist of minimum two-in I.D, Schedule 40 PVC pipe and machine slotted PVC wellpoints, and maximum slot size 0.010-in.

B. Piping, pumping equipment and all other materials required to provide control of surface water and groundwater shall be suitable for the intended purpose.

C. Standby pumping systems and a source of standby power shall be maintained at all sites.

PART 3 EXECUTION

3.01 GENERAL

A. Control surface water and groundwater such that excavation to final grade is made in-the-dry, the natural undisturbed condition of the subgrade soils is maintained, and softening and/or instability or disturbance due to the presence or seepage of water does not occur. All construction and backfilling shall proceed in-the-dry and flotation of completed portions of work shall be prohibited.

B. Methods of groundwater control may include but are not limited to perimeter trenches and sump pumping, perimeter groundwater cutoff, well points, ejectors, deep wells and combinations thereof.

C. Where groundwater levels are above the proposed bottom of excavation level, a pumped dewatering system will be required for pre-drainage of the soils prior to excavation, and for maintaining the lowered groundwater level and controlling piezometric pressures, until construction has been completed to such an extent that the structure, pipeline or fill will not be floated or otherwise damaged.

D. It is expected that the type of system, spacing of dewatering units and other details of the work will have to be varied depending on soil/water conditions at a particular location.

E. All work included in this Section shall be done in a manner which will protect adjacent structures and utilities and shall not cause loss of ground or disturbance.

F. Install, monitor and report data from observation wells. Evaluate the collected data relative to groundwater control system performance and modify systems as necessary to dewater the site in accordance with the Contract requirements.

G. Locate groundwater control system components where they will not interfere with construction activities adjacent to the work area or interfere with the installation and monitoring of geotechnical instrumentation including observation wells. Excavations for sumps or drainage ditches shall not be made within or below 1H:1V slopes extending downward and out from the edges of existing or proposed foundation elements or from the downward vertical footprint of the pipe.

3.02 SURFACE WATER CONTROL

A. Construct surface water control measures, including dikes, ditches, sumps and other methods to prevent, as necessary, flow of surface water into excavations and to allow construction to proceed without delay.

3.03 EXCAVATION DEWATERING

A. At all times during construction, provide and maintain proper equipment and facilities to promptly remove and properly dispose of all water entering excavations. Excavations shall be maintained in-the-dry.

B. Excavation dewatering shall maintain the subgrade in a natural undisturbed condition and until the fill, structure or pipes to be built thereon have been completed to such extent that they will not be floated or otherwise damaged by allowing water levels to return to natural elevations.

C. Pipe, masonry, and concrete shall not be placed in water or be submerged within 24 hours after being installed. Water shall not flow over new masonry or concrete within four days after placement.

D. In no event shall water rise to cause unbalanced pressure on structures until the concrete or mortar has set at least 24 hours. Prevent flotation of the pipe by promptly placing backfill.

E. Dewatering shall at all times be conducted in such a manner as to preserve the natural undisturbed condition of the subgrade soils at the proposed bottom of excavation.

F. If the subgrade of the trench or excavation bottom becomes disturbed due to inadequate dewatering or drainage, excavate below normal grade as directed by the Engineer and refill with bedding rock or other material as approved by the Engineer at no additional cost to the District.

G. It is expected that the initial dewatering plan may have to be modified to suit the variable soil/water conditions to be encountered during construction. Dewater and excavate, at all times, in a manner which does not cause loss of ground or disturbance to the bearing soil or soil which supports overlying or adjacent structures or instability of the excavation.

H. If the method of dewatering does not properly dewater the excavation as specified, install additional groundwater observation wells as directed by the Engineer and do not place any pipe or structure until the readings obtained from the observation wells indicate that the groundwater has been lowered as specified within the excavation limits.

I. Dewatering units used in the work shall be surrounded by suitable filter sand and no fines shall be removed by pumping. Pumping from the dewatering system shall be continuous until pipe or structure is adequately backfilled. Stand-by pumps shall be provided.

J. Existing or new sanitary sewers shall not be used to dispose of drainage.

3.04 WELL POINT SYSTEMS

A. Where necessary, install a vacuum wellpoint system or deep wells around the excavation to dewater the excavation. Each wellpoint and/or well and riser pipe shall be surrounded by a sand or gravel filter. Sand shall be of such a gradation that, after initial development of the wellpoints or wells, the quantity and size of soil particles discharged shall be negligible.

B. Wellpoint systems shall be capable of operating continuously under the highest possible vacuum.

C. Installation of wellpoint systems or wells shall be in accordance with the final reviewed submittal in the presence of the Engineer.

3.05 DEEP WELLS

A. Where necessary, install a deep well system around the excavation to dewater the excavation. Each well shall be surrounded by a sand or gravel filter with adequate gradation such that after development, the quantity and size of soil particles is negligible. Sufficient number of wells shall be installed to lower the groundwater level to allow excavation to proceed in-the-dry.

B. Installation of deep wells shall be in accordance with the approved submittal in the presence of the Engineer.

3.06 OBSERVATION WELLS

A. Install observation wells as required under this Section or in accordance with the approved submittal to monitor groundwater levels beneath and around the excavated areas until adjacent structures and pipelines are completed and backfilled.

B. Observation Well Locations and Depths:

1. Observation wells required shall be installed to a depth of at least five ft below the deepest level of excavation, unless otherwise approved by the Engineer, or to whatever depth is necessary to indicate that the groundwater control system designed by the Contractor’s engineer is performing as intended. Additional observation wells may be required by the Engineer if deemed necessary to monitor the performance of the Contractor’s groundwater control system.

2. Locations and depths of observation wells are subject to approval by the Engineer.

C. Protect the observation wells at ground surface by providing a lockable box or outer protective casing with lockable top and padlock. Design the surface protection to prevent damage by vandalism or construction operations and to prevent surface water from infiltrating.

1. Provide two copies of keys for each padlock to the Engineer for access to each well.

2. Observation wells shall be developed so as to provide a reliable indication of groundwater levels. Wells shall be re-developed if well clogging is observed, in the event of apparent erroneous readings, or as directed by the Engineer.

3. Submit observation well installation logs, top of casing elevation, and well locations to the Engineer within 24 hours of completion of well installation.

D. Observation Well Maintenance:

1. The Contractor shall maintain each observation well until adjacent structures and pipelines are completed and backfilled. Clean out or replace any observation well which ceases to be operable before adjacent work is completed.

2. It is the Contractor's obligation to maintain observation wells and repair or replace them at no additional cost to the District, whether or not the observation wells are damaged by the Contractor's operations or by third parties.

E. Monitoring and Reporting of Observation Well Data:

1. The Contractor shall begin monitoring of groundwater levels in work areas prior to initial operation of drainage and dewatering system. Daily monitoring in areas where groundwater control is in operation shall continue until the time that adjacent structures and pipelines are completed and backfilled and until the time that groundwater control systems are turned off.

2. The Contractor is responsible for processing and reporting observation well data to the Engineer on a daily basis. Data is to be provided to the Engineer on a form, which shall include the following information: observation well number, depth to groundwater, total depth to well, top of casing elevation, groundwater level elevation and date and time of reading.

3.07 REMOVAL OF SYSTEMS

A. At the completion of the excavation and backfilling work, and when approved by the Engineer, wellpoints, pumps, generators, other equipment and accessories used for the groundwater and surface water control systems shall be removed from the site. All materials and equipment shall become the property of the Contractor. All areas disturbed by the installation and removal of groundwater control systems and observation wells shall be restored to their original condition.

B. Leave in place any casings for deep wells, wellpoints or observation wells located within the zone below 1H:1V planes extending downward and out from the downward vertical footprint of the pipe, or where removal would otherwise result in ground movements causing adverse settlement to adjacent ground surface, utilities or existing structures.

C. Where casings are pulled, holes shall be filled with sand. Where left in place, casings should be filled with cement grout and cut off a minimum of three ft below finished ground level or one ft below foundation level so as not to interfere with finished structures or pipelines.

D. When directed by the Engineer, observation wells should be left in place for continued monitoring. When so directed, cut casings flush with final ground level and provide protective lockable boxes with locking devices. The protective boxes shall be suitable for the traffic and for any other conditions to which the observation wells will be exposed.

E. All deep wells, observation wells, and piezometers shall be properly installed and abandoned per SJRWMD requirements.

END OF SECTION

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SECTION 02157
JACK AND BORE

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, equipment, materials, and incidentals required and install pipe and casing pipe by jacking at the location shown on the Drawings.

B. Prior to installing the casing, retain at Contractor's own expense the services of a qualified civil and/or geotechnical engineer licensed in the state of Florida. The aforementioned engineer shall, prior to submittal as required under Paragraph 1.03 below, approve and affix his/her stamp to the Contractor's drawings and design concept for the jacking. The drawings and design concept shall include but not be limited to the dewatering, soil stabilization, jacking pits, jacks, reaction blocks, excavation and support systems and installation schedule. The Contractor's engineer shall avail himself of all the available information contained on the contract drawings and herein and shall be responsible for making whatever additional investigations of the site and the conditions thereon that he/she may deem necessary. The Contractor's engineer shall be responsible for the inspection of the jack and bore for conformance to his/her drawings and design concepts.

C. Continuously keep the jacking pits' subgrade free from ground and surface waters during the operation and shall be prepared to implement additional groundwater control on short notice if directed by the Engineer. Observed water levels prior to construction are to be lowered to at least 2-ft below the invert elevation of the jacking pits. Dewatering will be necessary not only for the pits, but along the entire length of the casing and must be addressed in the submittal per paragraph 1.03, B. Groundwater control along and at the face of the jacking sleeve shall include chemical grout stabilization as required. Failure on the part of the Engineer to direct the implementation of additional dewatering efforts shall in no way relieve the Contractor from his responsibility to comply with all requirements of this specification.

D. Be fully responsible for inspecting the location where the pipes are to be installed and shall familiarize himself with the conditions under which the work will be performed and with all necessary details as to the orderly prospective of the work. The omission of any details for the satisfactory installation of the work in its entirety which may not appear herein, shall not relieve the Contractor of full responsibility.

E. Prepare to work at night and on Saturday and Sunday, if required to complete the work and upon receiving the approval granted by the District for any work to be performed outside of the approved project working hours. After the operation has begun, work continuously (24 hours a day) until the complete length of pipe has been installed. Standby pumping systems and a source of standby power shall be maintained at all times.

F. If any movement or settlement occurs which causes or might cause damage to existing structures or utilities over, along or adjacent to the work, immediately stop any or all work except that which assists in making the work secure and in preventing further movement, settlement or damage. Resume jacking only after all necessary precautions have been taken to prevent further movement, settlement or damage and shall repair the damage, at Contractor's own cost and to the satisfaction of the Engineer. Reference Section 02495 for instrumentation and monitoring requirements.

G. Follow all OSHA regulations regarding confined space for casing installation. Obtain all permits required associated with OSHA regulations and requirements for confined space entry.

H. No rescue shafts shall be allowed.

1.02 RELATED WORK

A. Excavation Support and Protection is included in Section 02311.

B. Dewatering and Drainage is included in Section 02140.

C. Geotechnical Instrumentation is included in Section 02495.

1.03 SUBMITTALS

A. Shop Drawings: Submit shop drawings and product data for materials to be used for jacking operations.

B. Design Calculations: Submit design calculations detailing equipment and construction methods to be used for jacking operations as specified herein and as shown on the contract drawings. The submittal shall specifically include the following and shall be signed and sealed by the Contractor's engineer:

1. Control of groundwater and surface drainage.

2. Method of soil stabilization and/or groundwater control at the face.

3. Method of face excavation.

4. Method of excavation removal.

5. Maintenance of alignment and grade.

6. Materials and installation of casing pipe.

7. Grouting outside of casing pipe.

8. Grouting between casing pipe and carrier pipe.

9. Bulkheads.

10. Schedule.

11. Lubricant for decreased jacking friction and pumping system.

C. Submit the Contractor's qualifications as described herein.

D. Submit the Contractor's Florida professional engineer's qualifications as described herein.

E. Daily surveyor reports of casing pipe position and control point monitoring, conducted by the Contractor's surveyor, shall be provided in writing to the Engineer.

F. The design calculations are to be submitted for informational purposes. Acceptance of the submitted material by Engineer does not indicate acceptance of responsibility for the means and methods of construction. Contractor shall be totally responsible for the entire jacking operation.

1.04 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

2. ASTM C32 - Standard Specification for Sewer and Manhole Brick (Made from Clay or Shale)

3. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar

4. ASTM C150 - Standard Specification for Portland Cement

5. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes

B. American Water Works Association (AWWA)

1. AWWA C200 - Steel Water Pipe 6-in (150mm) and Larger

2. AWWA C203 - Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied

3. AWWA C206 - Field Welding of Steel Water Pipe

C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. Regulations: Perform all work in accordance with current applicable regulations and codes of all Federal, State, and local agencies.

B. The Contractor shall have at least five 5 years' experience with compatible work to the Work shown and specified, employing labor and supervisory personnel who are similarly experienced in this type of work. Compatible work shall include jack and bore of at least 48-inch-diameter casing pipe at least 150 feet long below roadways.

C. The Contractor's engineer shall be a professional engineer, registered in the State of Florida, with 5-years demonstrated experience in the design and installation of jacking sleeves, pipes and appurtenances.

1.06 DEFINITIONS

A. Casing pipe shall mean the outer sleeve that is installed by jacking method.

B. Carrier Pipe shall mean the pipe inserted within the casing pipe and which acts as the conveyor for water.

C. Launch shaft shall mean the shaft in which the jacking equipment is installed and from which both the casing pipe and the carrier pipe are launched.

D. Exit shaft shall mean the shaft at the point where the carrier pipe emerges from the casing pipe.

PART 2 PRODUCTS

2.01 MATERIALS

A. The 48-inch O.D. steel casing pipe shall have a minimum yield strength of 35,000 psi, have a 0.5-in minimum wall thickness as shown on the Drawings and conform to AWWA C200 and ASTM A139. Steel sleeves shall be painted inside and outside with two coats bitumastic enamel coating paint in accordance with AWWA C203. The pipe shall be equipped with grout holes as specified herein. The casing pipe shall be designed to withstand applicable loading.

B. Steel pipe casing shall be furnished in lengths of the Contractor's choice. The casing shall have beveled ends with a single or double v-groove and shall be field joined by full-penetration butt welding all around prior to jacking. Alternatively, Permalok connectors may be used.

C. Steel pipe casing shall have 2-inch grout holes such that grout ports are provided at 4-foot-maximum intervals along the length of the completed crossings. The grout holes shall be spaced at 120 degrees on center (three holes at each interval) orientated with one hole at the crown. Two-inch steel half-couplings shall be welded over the holes in the pipe casing, and shall have threaded steel plugs.

D. Pipe shall be as shown on the Drawings and as specified in Division 2.

E. End seals may consist of brick bulkheads (minimum 8" thick) which shall be of sound, uniformly burned brick conforming to ASTM C32, Type C end seals with stainless steel bands as manufactured by Pipeline Seal and Insulator, Inc, or Cascade CCES casing end seals with stainless steel bands.

F. Mortar shall consist of 1 part cement, 1/4 part lime and 2 parts sand. Sand shall comply with ASTM C144; lime shall comply with ASTM C207, Type S; cement shall comply with ASTM C150, Type II.

G. The Contractor shall furnish and install 304 SS casing spacers on the carrier pipes as described below. The casing spacers shall be Cascade Model CCS3200-8 CTR or approved equal. Casing spacers shall be spaced a maximum of seven feet apart along the length of the carrier pipe with one casing spacer within three feet of each side of a pipe joint and the rest evenly spaced. Spacers are to be installed within two feet of the end of casing pipe. Wood skids are not permitted. In cases where the casing and carrier pipe are installed in close proximity to facilities with stray current, such as gas lines, high voltage power transmission lines, etc., the spacers shall be provided with composite contacts to prevent transmitting the stray current to the carrier pipe.

H. Grout for pressure injection between the casing and the earth shall be a mixture of Portland cement and bentonite or similar commercial product that shall harden to a minimum compressive strength of 500 psi. The grout shall be readily pumpable. The shop drawings shall include both the proposed grout and the pumping system.

I. Cement grout used to fill the space between the casing and the carrier pipes shall consist of a mixture of about 1-part cement to 3 parts sand which shall be subject to increase or decrease in the amount of cement necessary, as determined by the Engineer, to provide good flowing characteristics. Cement grout shall have a minimum pH of 12 and shall be free of fly ash.

J. Lubricant for decreasing jacking friction between the jacked casing pipe and earth shall be bentonite slurry or similar commercial product.

PART 3 EXECUTION

3.01 LAUNCH AND EXIT SHAFTS

A. Refer to Section 02311 – Excavation Support and Protection for shaft requirements.

B. Trench boxes shall not be used as support of excavation for any launch or exit shafts.

3.02 JACKING OPERATIONS

A. Casing pipes near existing roads and utility easements where so shown shall be installed to the limits shown in accordance with the approved encroachment agreement or permit.

B. The Contractor shall provide all material, equipment, and facilities required for installing, positioning, and jacking the casing pipe.

C. The casing pipe at each location shown on the Drawings shall be jacked in one continuous 24-hour-per-day operation. In no event shall jacking or lubricant injection be discontinued for sufficient period to cause the partially jacked sleeve to "freeze" in place.

D. Proper alignment and elevation of the casing shall be consistently maintained throughout the jacking operation. Tolerances for installation of the casing pipes shall be as follows:

1. Vertical - plus or minus 0.50 feet.

2. Horizontal - plus or minus 0.50 feet.

E. Jacking shall not commence until the Contractor has installed, initialized, and is prepared to record readings from all geotechnical instrumentation as required by Section 02495 - Geotechnical Instrumentation.

F. The Contractor shall be fully responsible for minimizing the occurrence of voids outside the casing pipe. All voids shall be filled with cement grout.

G. Removal of material from the casing face shall be by hand-mining or augering. The jacking shield shall be of steel construction as described in Paragraph 2.01 with an open face shield and the appropriate configuration to allow for the installation of a breasting system. The breasting system should be removable and replaceable in the event that obstructions are encountered. An auger and cutting head may be utilized in lieu of hand-mining for soil removal during jack and bore. The auger and cutting head arrangement shall not extend past the leading edge of casing and a soil plug shall be maintained inside the casing at all times to reduce the potential for soil loss above the casing during jacking. The auger and cutting head shall be removable from the pipe in the event an obstruction is encountered.

H. The Contractor shall excavate only from within the shield/casing to minimize the volume of the voids outside the jacked casing pipe and shall constantly exercise care in the removal of the excavation.

I. Each new section of casing pipe shall be butt-welded to the section previously jacked into position.

J. Groundwater shall be controlled at all times. If groundwater is expected to be above or within the casing level, a groundwater control system consisting of vertical or horizontal wells or well points shall be installed and operated such that the groundwater level is lowered to at least the casing invert level at the face. Groundwater control along and at the face of the casing pipe shall include grout stabilization as required. Dewatering design and operations shall be in accordance with Section 02140 - Dewatering and Drainage.

K. The Contractor shall use a jacking ring consisting of either steel or concrete construction. This jacking ring will allow the jacking pressure to be distributed evenly around the wall of the casing pipe.

L. The Contractor shall also use a jacking frame. The frame shall be fabricated from structural steel members and shall be designed to distribute the stresses from the jacks evenly to the jacking ring.

M. The Contractor shall use thrust blocks adequately designed to carry the thrust of the jacks to the soil without excessive soil deflection and in such a manner as to avoid any disturbance of adjacent structures or utilities and to jack the casing reliably in the correct alignment. Refer to Section 02311 – Excavation Support and Protection for thrust block design requirements.

N. Jacking pressures used shall be uniformly distributed through the jacking frame and parallel to the axis of the pipe. Extreme care shall be taken so that crushing or other damage to the joints of the casing pipe will not occur.

O. The Contractor shall have a redundant lubricant injection system connected for immediate use in the event the primary system fails during the jacking operation. Lubricant injection shall be continuous until the casing is fully installed.

P. The alignment of the casing pipe shall be checked at least daily by the Contractor’s surveyor as the casing progresses and daily written reports provided to the Engineer. Adjustments shall be made immediately if any misalignment occurs.

Q. If work is stopped for any reason, the exposed face of the excavation shall be fully protected with a bulkhead satisfactory to the Engineer.

R. The carrier pipe shall not be direct jacked.

S. The carrier pipe shall not be installed until leakage into the casing pipe, after removal of all dewatering pumping systems, does not exceed 20 gallons per hour/100 linear feet of finished casing pipe.

T. The Contractor shall be responsible for damages resulting from subsidence, collapsed casings, or ground losses into the jacked pipe casing and for the refilling of voids resulting there from with grout. Where such ground losses are so severe that they result in damage to underground or

surface pavement, existing utilities or structures, the Contractor shall be solely responsible for remedying such damage. Where the filling of voids cannot be effectively carried out from below, the Engineer reserves the right to order the Contractor, at no additional cost to the District, to make openings from the surface for the purpose of backfilling the voids. If in the judgment of the Engineer, a portion of the casing and/or pipe requires reinforcing because of such collapse, the Engineer may direct the Contractor to furnish and place such reinforcement at no additional cost to the District. Reinforcement may also be directed when the stability of the soil adjacent to the casing and/or pipe has been affected by the loss of ground.

U. The Contractor shall be responsible for all effects on existing utilities resulting from such ground loss, including all costs and all coordination with affected utilities.

V. Maximum allowable deflection of the inside diameter of the casing in any direction from a true circle shall be 1.0 percent of the inside diameter. Deflection shall be measured at not more than 50-foot-intervals.

3.03 GROUTING

A. Immediately following the jacking operation, pressure grout the jacked section to fill all voids existing outside of the casing pipe. Grouting shall be performed from the interior of the casing pipe through grouting holes. Lubricant shall be displaced by the grout. Grouting shall be started in the lowest connections and shall proceed until grout begins to flow from upper connections. The void shall be completely filled. Displaced lubricant shall be disposed of off-site in accordance with applicable regulations and codes of all Federal, State, and local agencies.

B. Grout pressure shall not exceed one-half of the existing overburden pressure.

C. Apparatus for mixing and placing grout shall be capable of mixing effectively and stirring the grout and then forcing it into the grout connections in a continuous uninterrupted flow.

D. After grouting is complete, pressure shall be maintained by means of stopcocks or other suitable devices until the grout has set sufficiently in the judgment of the Engineer, or for a minimum of 24 hours, whichever is longer. After the grout is set, grout holes shall be completely filled with dense concrete and finished neatly without evidence of voids or projections.

3.04 CARRIER PIPELINE INSTALLATION IN CASING AND FILLING OF ANNULAR SPACE

A. Casing spacers designed and certified by Cascade, or an approved equal, shall be capable of withstanding the forces to pull the pipe sections into the casing and to support the full weight of the pipe. The casing spacers shall prevent any movement or displacement of the pipe during grouting.

B. After the carrier pipe has been installed in the casing, shimmed, blocked, and tested, seal the ends of the casing around the pipeline with bulkheads and completely fill the space between the casing and the pipeline with cement grout or cellular concrete. Cement grout or concrete shall be pumped through 2-inch-minimum unjointed HDPE pipes extending through one bulkhead into the top of the casing at maximum 40-foot intervals. One pipe shall be located so as to be within 10 feet of the opposite bulkhead. This operation shall be performed in at least two stages to help prevent flotation. To ensure that the casing is completely full, two 2-inch-minimum unjointed HDPE pipes shall be installed near the crown of the casing from the midpoint of the casing to each end, and 2-inch openings shall be provided in each bulkhead at the tunnel crown

location. Grout or concrete shall be pumped into the casing until it flows from the top of the casing in the HDPE pipe and bulkhead openings at both ends. Leave the HDPE pipe in place and cut off at the end of the casing.

END OF SECTION

SECTION 02200
EARTHWORK

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and perform all earthwork, which includes clearing and stripping; excavating, placing, and compacting fill and backfill; structural excavating and backfilling, transportation of excess clean soils to a designated stockpile area; disposal of unsuitable, waste and surplus materials; restoration of excavation and trench surfaces; and all subsidiary work necessary to complete the grading of the developed areas to conform with the lines, grades, and slopes as shown on the Drawings and as specified herein.

B. The work shall include, but not necessarily be limited to; excavation for structures, foundations, pipes, paving; embankments; grading; and all related work such as sheeting, bracing and dewatering.

C. Furnish and install temporary excavation support systems, including sheeting, shoring and bracing, to insure the safety of personnel and protect adjacent structures, piping, etc., in accordance with Federal, State and local laws, regulations and requirements. Temporary excavation support systems shall be in accordance with Section 02311.

D. Furnish and install temporary dewatering and surface water control systems and operate to dewater and maintain excavations in a dry condition. Control drainage into excavations and remove seepage water and rainwater. Dewatering and surface water control shall be in accordance with Section 02140.

E. Examine the site and review the available geotechnical data report prior to submitting their proposal, taking into consideration all conditions that may affect his work. The District and Design Engineer do not assume responsibility for variations of subsurface conditions at locations other than places shown and at the time the investigations were made.

F. Protect existing structures and utilities to remain.

1.02 RELATED WORK

A. Submittals is included in Section 01300.

B. Dewatering and Drainage is included in Section 02140

C. Excavation Support and Protection is included in Section 02311.

D. Jack and Bore is included in section 02157.

E. Geotechnical Instrumentation is included in Section 02495.

1.03 SUBMITTALS

A. Submit, in accordance with Section 01300, the proposed methods of construction, including earthwork operations, excavation limits, slopes, fill material moisture conditioning and handling,

compaction equipment, backfilling and filling and compaction for the various portions of the work, and material sources for the various portions of the work. Review will be for information only. Contractor shall remain responsible for adequacy and safety of construction means, methods, and techniques.

B. Furnish the Engineer a representative sample weighing approximately 50 pounds of each fill material, filter sand and crushed stone contained in sealed five-gallon containers, at least 30 calendar days prior to the date of anticipated use of such material for approval.

C. Submit laboratory test results for all fill materials (maximum density, gradation, Atterberg limits, sand equivalent, etc., as applicable) at least 72 hours prior to importing or placing any fill.

1.04 DEFINITIONS

A. Percent Compaction is the required in-place dry density of the material, expressed as a percentage of the maximum dry density of the same material, as determined in the laboratory by AASHTO T-180 (Standard Proctor). The percent compaction requirements for earthwork will be evaluated as follows: The in-place density as compacted by the Contractor will be determined by the field density test using the sand-cone method, drive cylinder method, or the nuclear method. The maximum dry density of the fill at the location of the in-place density test will be estimated using a one-point compaction test and full-curve compaction tests (family of curves) of representative fill materials. The one-point compaction data will be used by the Engineer in conjunction with the representative compaction curves to estimate the maximum dry density of the compacted fill at the location of the in-place density test. The percent compaction in-place will be calculated as the ratio (in percent) of the in-place dry density to the estimated maximum dry density of the compacted fill at the location of the in-place density test.

B. Optimum Moisture Content is the moisture content (percent by dry weight) corresponding to the maximum dry density of the same material as determined by AASHTO T-180 (Standard Proctor).

C. Moisture-Sensitive Soil is on-site soil containing more than 12 percent fines (silt- or clay-sized particles) based on the fraction passing the No. 200 sieve.

D. Structures: Buildings, wet wells, manholes and below grade vaults, pipelines and utilities, pavements, and slabs-on-grade both above and below ground.

E. Unsuitable Soil: Includes existing fill materials, organic soils, weak native soils, or clays with a plasticity index of greater than 30.

F. Objectionable Material: Includes topsoil, organic matter, contaminated soil, construction debris, perishable materials, snow, ice, frozen earth, and rocks or lumps of cemented soils over six inches in maximum dimension.

G. Overexcavation: Removal of Unsuitable Soil or Objectionable Material at or below the normal grade of the excavation or subgrade as indicated on the Drawings.

H. Subgrade: Required surface of subsoil, borrow fill or compacted fill. This surface is immediately beneath site improvements, especially dimensioned fill, paving, or other surfacing material.

I. Finished Grade: Required final grade elevation indicated on the Drawings. Spot elevations shall be precedent over proposed contours.

J. Coverage: Pass of compaction equipment over the complete surface area of exposed lift or subgrade to receive compaction.

1.05 STATUTORY REQUIREMENTS

A. All excavation, trenching, sheeting, bracing, etc. shall conform to the requirements of the Florida "Trench Safety Act" (CS/SB 2626) which incorporates, by reference, OSHA excavation safety standards, 29 CFR 1926 Subpart P.

B. Three working days prior to starting any excavation, the Contractor shall notify 811 and underground utility owners who are not members of the notification centers.

1.06 PROTECTION

A. All existing facilities which include but are not limited to structures, utilities, pavements, sidewalks, curbing, driveway aprons, fencing, landscaping and other improvements in the vicinity of the Contractor's operations shall be adequately protected. If necessary, curbing, driveway aprons and fencing shall be removed and restored or replaced after backfilling. All existing facilities damaged by the construction shall be replaced with material fully equal to that existing prior to construction to the satisfaction of the District.

B. Design, furnish, install, monitor and maintain excavation support as required and as specified in Section 02311.

C. Furnish, install, monitor and maintain settlement monitoring as required and as specified in Section 02495.

D. Furnish, install, monitor and maintain dewatering and drainage systems as required and as specified in Section 02140.

E. Excavations within the zone of influence of any existing structures or utility will require the use of excavation support system as specified in Section 02311. The zone of influence is defined as a line extending at least 2 feet beyond of edge of the foundation, then outward and downward at a slope of one horizontal to one vertical. No excavation below the foundation of existing structures is allowed.

F. Excavations below the level of the base of any adjacent foundation or retaining wall shall not be permitted unless the design of the excavation and bracing includes an analysis of the stability of the structure supported by the foundation and as necessary, incorporates required bracing / underpinning of the foundation.

1.07 QUALITY ASSURANCE

A. At all structures, prior to the placement of bedding material, concrete work mats, structural fill or structural concrete, coordinate with the soils testing laboratory to verify the suitability of the existing subgrade soil.

B. Prior to and during the placement of backfill and fill coordinate with the soils testing laboratory to perform in-place soil density tests to verify that the backfill/fill material has been placed and compacted in accordance with the compaction requirements specified elsewhere. At least 48 hours notice shall be provided prior to placement of backfill and fill.

C. Subgrades shall not be covered with fill nor fill placed without the observation, testing, and approval by the Soils Testing Laboratory. Earthwork activities performed without properly scheduled inspection are subject to removal and replacement or additional testing as directed by the Engineer at no expense to the District.

D. Materials will be tested and observed as described in the following paragraphs. Cooperate by allowing free access to the work for selection of test materials and observations.

1. Materials to be used in the work shall be tested by a certified independent laboratory, engaged by the Contractor and acceptable to the Engineer, to demonstrate conformance with the requirements of these Specifications. Such testing will be paid for by the Contractor. Deliver test reports and material certifications to the Engineer before using any material in the work.

2. If field test results are not in conformance with the requirements of these Specifications, all costs involved in correcting deficiencies in compacted materials to the satisfaction of the Engineer and costs of re-testing after correction of deficiencies shall be borne by the Contractor.

3. Earthwork activities performed without properly scheduled inspection are subject to removal and replacement or additional testing as directed by the Engineer at no expense to the District.

4. Testing methods shall comply with the latest applicable ASTM or equivalent AASHTO Standards specified.

5. During the placement of bedding, backfill and fill, the Contractor shall perform in-place soil density testing to confirm that fill material has been compacted in accordance with the requirements of this Section. The Engineer may designate areas to be tested. Contractor shall notify Engineer at least 72 hours in advance of scheduled compaction testing. In place soil density tests on backfill/fill material shall be as required by City, State, or Federal Codes, and the project geotechnical data report, but in no instance shall less than those listed below:

    a. Structures and Embankments. At least one density and moisture content test for each 2,500 square feet of surface area for each lift of fill at embankment, structure and manhole locations
    b. Trench Excavations. At least one nuclear density and moisture content test shall be conducted at a maximum of 50-ft intervals for each lift of fill placed or as directed by the Engineer.
    c. The Engineer may designate additional areas to be tested.

6. Materials which have been previously tested may be subjected to further testing from time to time and may be rejected if it is determined that they do not conform to the requirements of these Specifications. Rejected materials shall be removed from the work immediately when so directed by the Engineer, notwithstanding the results of previous testing.

E. The Engineer or District may conduct additional soil testing. Cooperate fully in obtaining the information desired and allowing free access to the work.

1.08 CONSTRUCTION CONTROL

A. The Contractor is responsible for all construction layout and reference staking necessary for the proper control and satisfactory completion of all structures, cutting, filling, grading, drainage, fencing, embankment improvements, curbing, and all other appurtenances required for the completion of the construction work and acceptance of the Contract as specified and as shown on the Drawings.

B. All construction layout and staking shall be performed by a professional land surveyor or professional engineer licensed by the State, experienced and skilled in construction layout and staking of the type required under this Contract, and acceptable to the Engineer and District.

PART 2 PRODUCTS

2.01 MATERIALS

A. Common Fill: Common Fill materials shall be soils having a group classification of SP, SP-SM, SP-SC, GM, or GC in accordance with the Unified Soil Classification per ASTM D2487. SM and SC may be used if they are effectively blended on-site with the cleaner sands to reduce the fines contents to no more than 20 percent passing the No. 200 sieve. Perform lab testing to verify fines content of blended soils. Particles larger than two-inch in diameter shall not be allowed in these materials. These materials shall be free of roots, vegetative matter, topsoil, waste, construction materials, highly micaceous silt, frozen soil, marl, hardpan, or other objectionable material. Stone blocks, broken concrete, masonry rubble, or other similar materials shall not be allowed.

B. Select Common Fill: Select common fill materials shall be soils having a group classification of SP, SP-SM, SP-SC, GM, or GC in accordance with the Unified Soil Classification per ASTM D2487. SM and SC may be used if they are effectively blended on-site with the cleaner sands to reduce the fines contents to no more than 20 percent passing the No. 200 sieve. Perform lab testing to verify fines content of blended soils. Particles larger than three-fourths-inch in diameter shall not be allowed in these materials. These materials should be free of roots, vegetative matter, topsoil, waste, construction materials, highly micaceous silt, frozen soil, marl, hardpan, or other objectionable material. Stone blocks, broken concrete, masonry rubble, or other similar materials shall not be allowed.

C. Structural Fill – Structural fill shall consist of a mineral soil free of organic material, loam, debris, frozen soil or other deleterious material which may be compressible or which cannot be properly compacted. Shell and shell fragment content larger than the No. 10 I.S. Standard sieve size shall be no more than 10 percent by dry weight as measured by particle size analysis (ASTM D422). Structural fill should consist of materials with the following gradation:

Sieve Size	Percent Finer by Weight
3-in	100
No. 4	20 to 90
No. 40	5 to 75
No. 200	0 to 12

Structural fill a maximum dry density of at least 98 pcf as determined by AASHTO T-180.

D. Unsuitable Materials: Unsuitable materials are soil, soil-aggregate and rock having a classification of MH, ML, CH, CL or PT, along with materials having an organic content exceeding five percent by weight. Soils with a plasticity index greater than 10%, or a liquid limit greater than 40% shall not be used.

E. Crushed Stone:

1. Crushed stone shall conform to No. 89 Stone of the Florida Department of Transportation (FDOT) Standard Specifications for Roads and Bridges, latest edition and all addenda and supplements thereto.

F. Filter Fabric:

1. Filter fabric shall be used as necessary or where indicated on the Drawings and shall conform to the following requirements:

   a. Minimum grab strength of 120 lbs per ASTM D1682.
   b. Apparent opening size to be equal to or greater than the U.S. Standard Sieve No. 100 (0.210 mm) per ASTM D4751.
   c. Percent open area not to exceed about 25 percent. The percent open area is defined as the ratio of the sum of 20 or more individual open areas (times 100) to the sum of the corresponding 20 or more individual total areas.
   d. Coefficient of permeability shall not be less than 0.2 cm/sec.
   e. Filter fabric shall be Mirafi, Type 140N; Dupont, Type PAR, Style 3401 or equal product by Amoco.

PART 3 EXECUTION

3.01 PREPARATION

A. All excavation, backfill and grading necessary to complete the work shall be made by the Contractor and the cost thereof shall be included in the contract price.

B. The Contractor shall take all the necessary precautions to maintain the work area in a safe and workable condition.

C. The Contractor shall protect the work area at all times by flagging, marking, lighting and barricading. It shall also be the Contractor's responsibility to preserve and protect all existing above and underground structures, pipe lines, conduits, cables, drains or utilities. Failure of the Drawings to show the existence of these obstructions shall not relieve the Contractor from this responsibility. The cost of repair of any damage which occurs to these obstructions during or as a result of construction shall be borne by the Contractor without additional cost to the District.

D. Clearing and Stripping. The ground surface beneath all planned Structures and in all areas requiring excavation or filling shall initially be cleared and stripped of all organic material and debris. These materials shall be removed from the site and disposed of by the Contractor.

3.02 EXCAVATION

A. Excavations shall be made to the grade indicated on the Drawings and in widths sufficient for laying the pipe, construction of the structure, bracing and for dewatering and drainage facilities. Excavations for structures shall be suitably wide for construction of the structures, including excavation supports, dewatering and drainage systems and working clearances.

B. Excavation shall be performed in-the-dry and shall be accomplished by methods which preserve the natural undisturbed condition of the subgrade soils.

C. Moisture Sensitive Soils are particularly susceptible to disturbance due to construction operations. When excavation is to end in such soils, use a smooth-edge bucket to excavate the last one foot of depth.

D. If the bottom of any excavation is taken out below the limits shown on the Drawings, specified, or directed by the Engineer, it shall be refilled at no additional cost to the District with structural fill or screened gravel.

E. Subgrade soils that have become soft, loose, "quick," or otherwise unsatisfactory as a result of inadequate excavation, dewatering or other construction methods, in the opinion of the Engineer, shall be removed and replaced with structural fill or screened gravel, as acceptable to the Engineer at the Contractor's expense.

F. Exposed subgrades for foundations shall be proof rolled with at least two overlapping coverages of a vibratory drum roller with a minimum of a 10-ton static drum weight. Proofrolling in confined areas may be accomplished with hand operated vibratory equipment approved by the Engineer. Proofrolling shall be conducted in the presence of the Engineer. The Engineer shall waive this requirement if, in his/her opinion, the subgrade will be rendered unsuitable by such proofrolling.

G. Perform overexcavation at the request of the Engineer to remove Unsuitable Soil, Objectionable Material, or other materials as determined by the Engineer to such depth and width as the Engineer may direct and shall be replaced with suitable material as directed by the Engineer for which compensation will be made in accordance with Article 11 of the General Conditions.

H. Excavation for all pipe lines beneath structures and excavation for all footings shall be carried out with the excavating equipment operating from the subgrade for the structure. The excavation shall be carried out "in-the-dry" and in a manner which will preserve the undisturbed state of the subgrade soils.

I. When excavations have reached the required subgrade, including any allowances for working mats or base materials, prior to the placement of working mats or base materials, notify the soils testing laboratory to verify the suitability of the existing subgrade soils for the anticipated foundation and structural loadings. If the existing subgrade soils are determined to be unsuitable, direction will be provided by the Engineer regarding removal and replacement with suitable materials. If Contractor believes that such direction would increase Contractor's cost and would thereby entitle Contractor to a change in Contract cost, Contractor shall notify the

Engineer in accordance with the applicable article(s) in the General Conditions pertaining to changes in the work.

3.03 SUBGRADE PREPARATION

A. Maintain the excavated subgrade "in-the-dry".

B. Prior to placement of fill, remove all objectionable material which shall include but not be limited to pavement, topsoil, organic matter, contaminated soil, construction debris, perishable materials, snow, ice, frozen earth, and rocks or lumps of cemented soils over six inches in maximum dimension.

C. For subgrades consisting of granular soils, proof compact the final subgrade using at least four coverages of a vibrator plate compactor.

D. Where existing subgrade contains a significant amount of clay or cohesive soils, over-excavate sufficiently below the bottom of structure for placement of a lean concrete working mat. Remove all loose or soft material from the subgrade immediately prior to placing the lean concrete working mat.

E. Soft subgrades or unusable material shall be removed and replaced with compacted structural fill.

F. Notify the Engineer to observe the subgrade following subgrade preparation and prior to fill placement. If the existing subgrade soils are determined to be unsuitable, direction will be provided by the Engineer regarding removal and replacement with suitable materials.

3.04 FILLING PLACEMENT AND COMPACTION PROCEDURES

A. Fill and backfill materials shall be placed in lifts to suit the specified compaction requirements to the lines and grades required, making allowances for settlement and placement of cover materials (i.e., topsoil, sod, etc.). Soft spots or uncompacted areas shall be corrected.

B. Fill and backfill shall not be placed and compacted when the materials are too wet to properly compact (i.e., the in-place moisture content of the soil at that time is no more than three percentage points above the optimum moisture content of that soil as determined by the laboratory test of the moisture-density relation appropriate to the specified level of compaction).

C. Structural Fill and Embankment Fill shall be constructed to the lines and grades required, making allowances for settlement and placement of cover materials (i.e. topsoil, sod, etc.). Soft spots or uncompacted areas shall be corrected.

D. All structure water-tightness tests and dampproofing/waterproofing shall be completed prior to placing fill or backfill around structures.

E. If the subgrade slopes more than 10%, the subgrade shall be stepped to produce a stable, horizontal surface for the placement of fill materials. The existing subgrade slope shall then be scarified to a depth of at least six inches.

F. Fill slopes should be compacted by slope rolling and trimming, or should be overfilled and trimmed back to plan grade to expose a firm, smooth surface free of loose material.

G. Fill lifts shall not contain stones with a dimension larger than two-thirds the specified loose measure lift thickness.

H. Compaction in open areas may be accomplished by any of the following methods: compaction equipment, fully loaded ten-wheel trucks or front end loaders, tractor dozers weighing at least 30,000 lbs or heavy vibratory rollers. Compaction in confined areas (including areas within a 45 degree angle extending upward and outward from the base of a wall) and in areas where the use of large equipment is impractical, shall be accomplished by hand operated vibratory equipment or mechanical tampers. Lift thickness shall not exceed six in. (measured before compaction) when hand operated equipment is used.

I. On-Site Fill Material shall be moisture conditioned prior to placement unless the Contractor demonstrates to Engineer in-place moisture conditioning methods that can achieve the required moisture content.

J. Compaction of each specified lift of fill materials shall be conducted by a minimum of four complete coverages with acceptable compaction equipment to a specified density which is expressed as a percentage of the maximum dry density as determined by AASHTO T-180, unless specified otherwise.

K. Fill required beneath foundations or slabs on grade (except sidewalks) shall be structural fill. Place and compact structural fill in even lifts having a maximum thickness (measured before compaction) of eight in.

L. Fill and backfill material placed immediately adjacent to and within 10-ft of all structures shall be select common fill. All structure water-tightness tests and dampproofing / waterproofing shall be completed prior to placing fill or backfill around structures. Place and compact select fill in even lifts having a maximum thickness (measured before compaction) of eight in. uniformly around the structure. Select common fill placed from the springline to one foot above pipes shall be placed in six-in. lifts.

M. Common fill may be used in areas beyond those designated for select fill unless shown or specified otherwise. Common fill shall be placed in even lifts having a maximum thickness (measured before compaction) of 12-in.

3.05 COMPACTION REQUIREMENTS

A. Perform in place testing of compacted fill lifts to measure in-place density and water content (AASHTO T-180).

B. Beneath foundations and slabs on grade (except sidewalks): Compact the top eight in. of existing subgrade (and each layer of fill if applicable) to a minimum of 98 percent maximum dry density (AASHTO T-180) at or near its optimum moisture content (minus two to plus three percent).

C. 10-ft around structures: Compact each layer of fill or backfill to a minimum of 98 percent maximum dry density (AASHTO T-180) at or near its optimum moisture content (minus two to plus three percent).

D. Embankments (except under roadways and earth dam structures), lawn or unimproved areas: Compact each layer of fill or backfill to a minimum of 95 percent maximum dry density (AASHTO T-180) at or near its optimum moisture content (minus one to plus four percent).

E. Sidewalks: Compact each layer of fill to a minimum of 95 percent modified proctor (AASHTO T-180) at or near its optimum moisture content (minus two to plus three percent).

F. Roads, paved areas and roadway embankments: Compact each layer of fill or backfill to a minimum of 95 percent maximum dry density (AASHTO T-180) at or near its optimum moisture content (minus two to plus three percent).

3.06 DISPOSAL OF UNSUITABLE, WASTE AND/OR SURPLUS EXCAVATED MATERIAL

A. Unsuitable Soil, Objectionable Material, and waste material shall be removed and disposed of off-site at the Contractor’s expense. Materials may be temporarily stockpiled in an area within the limits of construction that does not disrupt construction activities, create any nuisances or safety hazards, or otherwise restrict access to the work site.

B. Excess clean soils shall be hauled from the project site and unloaded at a designated stockpile site within Camp Blanding.

3.07 GRADING

A. Grading shall be performed to the lines and grades shown on the Drawings. All objectionable material encountered within the limits indicated shall be removed and disposed of. Subgrades shall be completely and continuously drained and dewatered throughout the grading process. Install temporary drains, drainage ditches, etc., to intercept or divert surface water which may affect the execution or condition of grading work.

B. If at the time of grading it is not possible to place any material in its proper section of the Work, it shall be stockpiled in approved areas for later use. No extra payment will be made for the stockpiling or double handling of excavated material.

C. In cut areas, all loose or protruding rocks in slopes shall be removed to line or finished grade of the slope. All cut and fill slopes shall be uniformly dressed to the slope, cross-section and alignment shown on the Drawings unless otherwise directed by the Engineer.

3.08 RIPRAP AND SLOPE STABILIZATION

A. Prior to installation of riprap, install erosion control blankets on slopes in accordance with manufacturer's instructions. The area to be covered shall be properly prepared, before the blanket is applied. When the blanket is unrolled, the netting shall be on top and the fibers in contact with the soil over the entire area. Blankets shall be butted snugly at the ends and side and stapled. Blankets shall be placed a minimum of three rows (of four foot) wide (total 12-ft width) and stapled together in accordance with manufacturer's instructions. Staples shall be driven vertically into the ground, spaced approximately two linear yards apart, on each side and one row in the center alternately spaced between each side. Adjoining blankets shall not be overlapped and shall utilize a common row of staples to attach.

B. Riprap shall be placed in conjunction with the construction of the embankment with only sufficient lag in the construction of the riprap protection as may be necessary to allow for proper

construction of the portion of the embankment protected and to prevent mixture of embankment and riprap material. Bank run gravel shall be placed and graded to a depth of six in. to obtain a continuous uninterrupted bed of the required thickness within the required limits. It shall be compacted by a minimum one coverage by a crawler-type tractor with a total weight, including blade and equipment, of not less than 30,000 lbs.

C. Riprap shall be hand-placed (not dumped) on the compacted gravel bed. Stones shall be laid so that the maximum dimension is perpendicular to the bed. Stones shall be placed so that the weight of each stone is carried by the underlying material and not by the adjacent stones. Large stones shall be placed at the bottom of the slope. Spaces between stones shall be filled with spalls of suitable size to construct a solid, stable slope, free from large voids and defects which might not protect embankments against erosion.

END OF SECTION

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SECTION 02221
EXCAVATION, BEDDING AND BACKFILL FOR PIPE

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall furnish all labor, materials, equipment and incidentals necessary to perform all excavation (unclassified), backfill, fill, grading and slope protection required to complete the piping work shown on the Drawings and specified herein.

B. Excavation shall extend to the width and depth shown on the Drawings or as specified herein and shall provide suitable room for installing pipe, structures and appurtenances.

C. Furnish and place all sheeting, bracing and supports and remove from the excavation all materials which the Engineer may deem unsuitable for backfilling. The bottom of the excavation shall be firm, dry and in all respects, acceptable. If conditions warrant, deposit gravel for pipe bedding, or refill for excavation below grade, directly on the bottom of the trench immediately after excavation has reached the proper depth and before the bottom of the trench has become softened or disturbed by any cause whatever. The length of open trench shall be closely related to the rate of pipe laying. All excavation shall be made in open trenches.

D. All excavation and related sheeting, shoring, and bracing shall conform to the requirements of the Florida Trench Safety Act, (C5/5B 2626), which incorporates by reference, OSHA's excavation safety standards (29 CFR 1926.650 Subpart P).

1.02 RELATED WORK

A. Dewatering and Drainage is included in Section 02140.

B. Excavation Support and Protection is included in Section 02311.

1.03 SUBMITTALS

A. Submit, in accordance with Section 01300, complete product data for materials specified in this Section.

B. For each bedding and backfill material obtained from other than onsite sources, the Contractor shall notify the Engineer of the source of the material and shall furnish the Engineer, for approval, a representative sample weighing approximately 50 pounds, at least seven calendar days prior to the date of anticipated use of such material.

C. Submit laboratory test results for all fill (offsite and onsite) materials (maximum density, gradation, Atterberg limits, sand equivalent, etc., as applicable) at least five days prior to importing or placing any fill.

1.04 DEFINITIONS

A. Percent Compaction is the required in-place dry density of the material, expressed as a percentage of the maximum dry density of the same material, as determined in the laboratory by AASHTO T-180 (Standard Proctor).

B. Optimum Moisture Content is the moisture content (percent by dry weight) corresponding to the maximum dry density of the same material as determined by AASHTO T-180 (Standard Proctor).

C. Moisture-Sensitive Soil is on-site soil containing more than 12 percent fines (silt- or clay-sized particles) based on the fraction passing the No. 200 sieve.

1.05 QUALITY ASSURANCE

A. Prior to and during the placement of backfill and fill, coordinate with the soils testing laboratory to perform in-place soil density tests to verify that the backfill/fill material has been compacted in accordance with the compaction requirements specified. The Engineer may designate areas to be tested.

PART 2 PRODUCTS

2.01 MATERIALS

A. Common Fill: Common Fill materials shall be soils having a group classification of SP, SP-SM, SP-SC, GM, or GC in accordance with the Unified Soil Classification per ASTM D2487. SM and SC may be used if they are effectively blended on-site with the cleaner sands to reduce the fines contents to no more than 20 percent passing the No. 200 sieve. Perform lab testing to verify fines content of blended soils. Particles larger than two-inch in diameter shall not be allowed in these materials. These materials shall be free of roots, vegetative matter, topsoil, waste, construction materials, highly micaceous silt, frozen soil, marl, hardpan, or other objectionable material. Stone blocks, broken concrete, masonry rubble, or other similar materials shall not be allowed.

B. Select Common Fill: Select common fill materials shall be soils having a group classification of SP, SP-SM, SP-SC, GM, or GC in accordance with the Unified Soil Classification per ASTM D2487. SM and SC may be used if they are effectively blended on-site with the cleaner sands to reduce the fines contents to no more than 20 percent passing the No. 200 sieve. Perform lab testing to verify fines content of blended soils. Particles larger than 3/4-inch in diameter shall not be allowed in these materials. These materials should be free of roots, vegetative matter, topsoil, waste, construction materials, highly micaceous silt, frozen soil, marl, hardpan, or other objectionable material. Stone blocks, broken concrete, masonry rubble, or other similar materials shall not be allowed.

C. Unsuitable Materials: Unsuitable materials are soil, soil-aggregate and rock having a classification of MH, ML, CH, CL or PT, along with materials having an organic content exceeding five percent by weight. Soils with a plasticity index greater than 10%, or a liquid limit greater than 40% shall not be used.

D. Bedding Rock: Bedding rock shall be washed and graded crushed limestone or shell and conform to the gradation requirements of FDOT No. 89 stone.

PART 3 EXECUTION

3.01 GENERAL

A. All excavation, backfill and grading necessary to complete the work shall be made by the Contractor and the cost thereof shall be included in the contract price.

B. The Contractor shall take all the necessary precautions to maintain the work area in a safe and workable condition.

C. The Contractor shall protect the work area at all times by flagging, marking, lighting and barricading. It shall also be the Contractor's responsibility to preserve and protect all existing above and underground structures, pipe lines, conduits, cables, drains or utilities. Failure of the Drawings to show the existence of these obstructions shall not relieve the Contractor from this responsibility. The cost of repair of any damage which occurs to these obstructions during or as a result of construction shall be borne by the Contractor without additional cost to the District.

3.02 EXCAVATION

A. Excavations for the installation of structures, pipes, and electrical ducts shall be made to the depths indicated on the Drawings. Normal grade for excavation of pipes shall be six inches below the invert of the pipe. The minimum trench width shall extend 24 inches beyond the outside diameter of the pipe as indicated on the Drawings and shall be sufficient for installing structures, pipes, or ducts, for bracing and supporting and for pumping and drainage facilities.

B. The bottom of the excavations shall be firm and dry and in all respects acceptable to the Engineer. Excavate unsuitable soil material from the bottom of the trench to a depth determined by the Engineer and replace with rock bedding.

C. Where pipe or ducts are to be laid in bedding rock, the trench may be excavated by machinery to, or just below, the designated subgrade provided that the material remaining in the bottom of the trench is no more than slightly disturbed.

D. Where the pipes or ducts are to be laid directly on the trench bottom, the lower part of the trenches shall not be excavated to the trench bottom by machinery. The last of the material being excavated shall be done manually in such a manner that will give a flat bottom true to grade so that pipe or duct can be evenly and uniformly supported along its entire length. Bell holes shall be made as required manually so that there is no bearing surface on the bells and pipes are supported along the barrel only.

E. All rocks, roots, and organic muck, clay, or silt lenses removed in the preparation of the excavation for common fill shall be disposed of off-site by the Contractor as excess excavation. Soils which cannot qualify as common fill after preparation, such as muck soil, high organic soil, or non-granular soil high in silt and clay content shall also be disposed of off-site by the Contractor as excess excavation.

F. Failure of the Contractor to prepare excavated material to qualify as backfill shall not relieve the Contractor from his obligation to furnish common fill for backfill, regardless of the circumstances. The Engineer shall be the sole judge of whether excavation will qualify as

backfill after proper preparation and whether or not such preparation performed by the Contractor is satisfactory. Should the Contractor's preparation not be satisfactory, the Contractor shall use imported fill for backfill at no additional cost to the District.

G. No more than 100 linear feet of trench shall be open in advance of the pipe laying unless prior approval is given by the Engineer after consideration of ground conditions and/or location by the Engineer.

3.03 DISPOSAL OF MATERIALS

A. Excavated material shall be stacked without excessive surcharge on the trench bank or obstructing free access to hydrants and gate valves. Inconvenience to traffic and abutters shall be avoided as much as possible. Excavated material shall be segregated for use in backfilling as specified below.

B. Excess excavation, excavation which is unsuitable for common fill or select fill backfill, and all removed extraneous materials as identified herein shall be disposed of offsite by the Contractor.

C. The balance of the stockpiled excess material shall be disposed of offsite by the Contractor at a permitted site.

D. The Contractor shall locate and make all arrangements for disposal of excess and unsuitable materials. All handling, hauling, and disposal costs shall be included in the bid price. Stockpile areas shall be prepared and seeded. Disposal shall be in compliance with all applicable regulations.

E. Excess excavation which meets the requirements of common fill shall be stockpiled in a common readily accessible area, graded and/or covered for rain runoff, and used as a source of imported material until all the needs for imported material are identified, at which time the balance of the stockpiled excess material shall be disposed.

3.04 SHEETING AND BRACING

A. Sheeting and bracing shall be installed as specified in Section 02311.

3.05 STAGE 1 BEDDING

A. Pressure pipes shall be bedded using bedding rock by the following procedures:

1. Beginning at the bottom of the trench, bedding rock shall be placed and compacted to springline of the pipe, from the centerline of the pipe to the trench wall. Lift thickness shall not exceed six inches. Each lift shall be compacted using at least two passes with a vibratory plate compactor.

B. Above Stage 1, fill shall be placed and compacted as described below under "Backfilling."

C. Where stone bedding is used, an impermeable groundwater barrier at 100-foot intervals along the trench shall be used. The impermeable groundwater barrier shall consist of a 10 mil sheet of polyethylene covering the full cross sectional area of the gravel, embedded six inches into the trench sides and bottom, and extending to the top of the bedding rock. The

barrier shall be offset a minimum of two feet from any culvert or pipe joint. Ends and splice points shall be lapped a minimum of 12 inches.

3.06 STAGE 2 BACKFILLING

A. Where pipes are located under paved roadways, driveways, sidewalks, or FDOT right-of-ways, the trench above the Stage 1 bedding, as described above, shall be backfilled and thoroughly compacted with select common fill from the springline to 12 inches above the pipe crown. Select common soil shall be placed and compacted in layers not to exceed six inches to 98 percent maximum density per AASHTO T-180. Moisture content of the soil shall be within minus three percent to plus two percent of the optimum. Above 12 inches over the crown of pipe, the backfill shall consist of Flowable Fill – Excavatable Design with a Maximum of 28-day compressive strength of 100 psi (full depth) per FDOT Standard Specifications and as shown on the Drawings.

B. Where pipes are not located under roadways, driveways, sidewalks, or FDOT rights-of-way, the trench above the Stage 1 bedding, as described above, shall be backfilled and thoroughly compacted with select common fill from the springline of the pipe to a height of 12 inches above the crown of the pipe. Compact select common soil in layers not to exceed six inches to 98 percent maximum density per AASHTO T-180. Remainder of trench may be backfilled with select common fill or common fill in layers not to exceed 12-inches to 95 percent maximum density per AASHTO T-180. Moisture content of the soil shall be within minus three percent to plus two percent of the optimum.

3.07 MARKING TAPE

A. Where pipes are not located under roadways, driveways, or sidewalks, a polyethylene double safe detectable marking tape shall be installed continuously in the backfill along the entire length of all PVC water mains for identification and detection purposes. For pipe sizes smaller than 12 inches, a single four-inch-wide stripe along the top of the pipe shall be provided.

B. The tape shall be as manufactured by Thor Enterprises or equal. The polyethylene tape shall meet the requirements of ASTM D 1248, Type I, Class A, Grade E 1 for polyethylene plastics molding and extrusion materials. The tape shall have a minimum tensile strength of 1750 psi, a minimum elongation of 250 percent, not less than 50 gauge solid aluminum core and a nominal thickness of five mils. The tape shall be composed of two-mil clear film reverse printed laminated to aluminum, foil laminated to two-mil clear film and reverse printed. Minimum total thickness four mils.

C. The warning tape shall be printed on one side in black letters (typical for all lettering) and shall be fade resistant olive-green color as follows:

CAUTION: BURIED RAW WATER MAIN BELOW

Minimum marking tape widths shall be as follows:

Pipe Inside Diameter, Inches	Minimum Tape Width, Inches	No. of Tape Strips
12 and Less	4	1
14-20	4	2
24 & Larger	4	3

D. The Contractor shall submit typical samples of the printed marking tape to the Engineer for approval prior to installation (minimum length to show repeat of message).

E. The marking tape shall be placed in the trench backfill directly above and centered over the pipeline. The marking tape shall be installed between 12 and 18 inches above the top of the pipe. The Contractor shall exercise care to prevent damage to the polyethylene tape when placing the remaining backfill.

F. Where the pipeline passes through a manhole, vault or other underground structure, the polyethylene marking tape shall be placed on top of that portion of the pipeline, located inside the structure and shall be secured to the pipeline with adhesive tape.

G. Openings for air valves and similar appurtenances shall be provided by making an X shaped cut in the polyethylene and temporarily folding back the film. After the polyethylene is installed over the appurtenance, the slack shall be taped securely to the appurtenance and the cut in the polyethylene shall be repaired with adhesive tape.

3.08 RESTORING TRENCH SURFACE

A. Where the trench occurs adjacent to paved street, in shoulders or sidewalks, the Contractor shall thoroughly consolidate the backfill and shall maintain the surface as the work progresses. If settlement takes place, he shall immediately deposit additional fill to restore the level of the ground.

B. The surface of any driveway or any other area which is disturbed by the trench excavation and which are not a part of the paved highway shall be restored by the Contractor to a condition at least equal to that existing before work began.

C. In Sections where the pipelines pass through grassed areas, the Contractor shall, at his own expense, remove and replace the soil, or shall loam and sod the surface to the satisfaction of the Engineer. The depth of loam replaced shall be at least equal to that removed by the Contractor in his trenching operations, but in no event, shall it be placed less than four inches in depth. Sod disturbed in front of existing developed lots shall be replaced to match the existing sod.

END OF SECTION

SECTION 02264 - SCRIM REINFORCED TARP

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract apply to this Section.

1.2 SUMMARY

A. Section includes scrim reinforced tarps for lining of the treatment cells. On the drawings, scrim reinforced tarp may also be referred to as “Reinforced Polyethylene Liner” or “RPE”.

B. Related Requirements:
   1. Section 02100 - Site Preparation
   2. Section 02200 - Earthwork

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at project site. Attendees include the Owner, Engineer, Contractor, and Installer.

1.4 ACTION SUBMITTALS

A. Within 30 calendar days following the Effective Date of the Agreement, submit the following:

   1. Manufacturer's background information.
   2. Information on factory size, equipment, personnel, number of shifts per day and production capacity per shift.
   3. List of material properties and samples of scrim reinforced tarp with attached certified test results.
   4. Manufacturer's quality control program and manual including description of laboratory facilities.
   5. A list of ten completed facilities where the scrim reinforced tarp is used including:

      a. Name and purpose of facility, its location and date of installation.
      b. Name of Owner, project manager, design engineer and installer.
      c. Tarp thickness and surface area.
      d. Information on performance of the facility.

6. Shop Drawing, including:

    a. Details of overlap and seaming of the tarp, anchoring, and other construction details as well as any variance or additional details that deviate from the Drawings.

7. Installation schedule.
8. A manual that specifically defines the quality control and quality assurance program during installation including manufacturer's installation instructions.
9. Copy of quality control certificates in conformance with Paragraph 2.4.

1.5 INFORMATIONAL SUBMITTALS

A. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

B. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures and quality control and quality assurance.

C. Manufacturer’s quality control program and manual, including use of spark testing and a description of laboratory facilities including GAI-LAP and ISO 9001 or compatible; 2008 Certifications.

D. List of ten completed facilities totaling a minimum of one million square feet, for which the Manufacturer has manufactured scrim reinforced tarp geomembrane. The following information shall be provided for each facility:

1. Name and purpose of facility, its location and date of installation.
2. Name of Owner, project manager, design professional and Installer.
3. Geomembrane thickness and surface area.
4. Information on performance of the facility.

E. Geomembrane Quality Control Documentation:

1. Certification of Quality Control Requirements.
2. Certification of conformance to material requirements.

F. Installer capabilities:
1. Installer to provide list of at least three similar completed projects.
2. Confirm minimum of 200,000 square feet of scrim reinforced tarp geomembrane installation. Include:

    a. Name and purpose of facility, its location and date of installation.
    b. Name of Owner, Engineer, Manufacturer and names and telephone numbers of contacts at the facility who can discuss the project.
    c. Thickness of geomembrane and surface area of the installed geomembrane.
    d. Type of seaming, patching and tacking equipment.
    e. A copy of the Manufacturer’s certification or approval letter.

G. Field Personnel Information:

1. Resume of the installation supervisor to be assigned to the project.

    a. Confirm installation or supervising installation and seaming of a minimum of 200,000 square feet of scrim reinforced tarp geomembrane.
2. Resume of the master seamer to be assigned to the project.

    a. Confirm installation of a minimum of 1,000 lineal feet of geomembrane seaming using the type of seaming apparatus proposed for use on this project.

3. Resume of the quality control personnel to be assigned to the Project along with pertinent experience information.
4. A list of personnel performing field seaming operations along with pertinent experience information.

H. In addition to Manufacturer and Installer requirements, include conformance testing of the material delivered to the site and field quality control during installation.

I. Perform conformance testing requirements to assure that the supplied material conforms to this Section and to the Manufacturer's Quality Control certificates. Submit the results of all geosynthetic conformance test to the Engineer prior to shipping the materials to the project site.

J. Testing agency qualifications: Independent laboratory accredited by GSI.

1.6 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a GRI accredited independent Quality Assurance Laboratory (QAL) to perform conformance testing on the scrim reinforced tarp geomembrane prior to installation.

B. Sampling: Sample obtained from roll of geomembrane:
1. One per lot number or one per 100,000 square feet, whichever is greater. Lot number defined as a continuous production process without changes to raw material or methods.

C. Testing:

1. Geomembrane testing in accordance with GRI-GM 13.
2. Oven ageing in accordance with ASTM D5721.
3. UV resistance in accordance with ASTM D7238.
4. Seam tests in accordance with GRI-GM 19.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Package and ship to prevent damage of the geomembrane rolls.

B. Store rolls in accordance with manufacturer's requirements and to prevent puncture, dirt, grease, water, moisture, mud, mechanical abrasions, and excessive heat that may damage the geomembrane material.

1.8 FIELD CONDITIONS

A. Weather:

1. Ambient temperature above 32 degrees F or below 104 degrees F unless otherwise authorized by the Engineer.
2. Dry, free of standing or ponding water in the subgrade.
3. No excessive winds which could interfere with geomembrane placement.

1.9 WARRANTY

A. The tarp manufacturer shall warrant the material, against manufacturing defect and material degradation (on a prorated basis) for a period of ten years from the date of installation. The manufacturer shall replace any material which fails from the above causes within the warranty period. The manufacturer shall furnish a written warranty covering the requirements of this Paragraph.

B. Warrant the tarp against defects in installation and workmanship for the period of two years commencing with the date of Final Acceptance. The guarantee shall include the services of qualified service technicians and all materials required for the repairs at no expense to the Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: The use of a manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration.

B. Manufacture scrim reinforced tarp from a virgin polyethylene. The tarp shall be produced by laminating two sheets of high strength polyethylene film with a black layer of molten polyethylene. A layer of 900 denier polyester scrim reinforcement laid in a diagonal pattern spaced 3/8 inch apart with an additional machine direction scrim every 3 inch across the width shall be placed between the sheets.

C. The up-side of the tarp shall be black and contain UV inhibitors and thermal stabilizers.

D. Tarp Minimum Properties:

1. Thickness (ASTM D1777): 0.020 inches (nominal).
2. Weight Per MSF: 74 lbs.
3. Tensile Strength (ASTM 7003): 75 lbf.
4. Elongation Break (ASTM D7003): 700 percent.
5. Grab Tensile (ASTM D7004): 114 lbf.
6. Trapezoid Tear (ASTM D4533): 70 lbf.
7. Hydrostatic Resistance (ASTM D751): 120 psi.
8. Maximum Use Temperature: 180 F.
9. Minimum Use Temperature: -70 F.

E. The scrim reinforced tarp shall be Dura-Skrim R20BDV or equal.

2.2 SOURCE QUALITY CONTROL

A. Documentation: Prior to installation commencement of any tarp material, the Contractor shall provide to the Owner the following information certified by the manufacturer for the delivered tarp.

1. Each roll or panel delivered to the Project site shall have the following identification information:

    a. Manufacturer's name.
    b. Product identification.
    c. Thickness.
    d. Roll or panel number.
    e. Roll or panel dimensions.

2. Quality control certificates signed by the manufacturer's quality assurance manager. Each certificate shall have roll or panel identification number, sampling procedures, frequency and test results. At a minimum the following test results shall be provided every 100,000 square feet of manufactured tarp in accordance with test requirements specified in the "Conformance Testing" Article in Part 2.

    a. Resin Density.
    b. Resin Melt Index.
    c. Thickness.
    d. Carbon Black Content.

2.3 TESTS AND INSPECTIONS

A. Have conformance testing performed by an independent QAL approved by the Owner and retained by the Contractor. Contractor, at the direction of the Engineer, will obtain samples from the delivered material, mark the machine direction and identification number.

1. Take one sample per 100,000 square feet of material, or one sample per lot, whichever results in the greater number of conformance tests.
2. Increase sampling frequency as deemed necessary by the CQA Manager. Conduct the following conformance tests at the laboratory:

    a. Resin Density (ASTM D1505).
    b. Carbon Black Content (ASTM D1603).
    c. Melt Index (ASTM D1238).
    d. Thickness (ASTM D1777).
    e. Tensile Strength (ASTM D751).

B. Have all conformance test results reviewed by the CQA Manager and accepted or rejected, prior to the deployment. All test results shall meet, or exceed, the property values listed in "Materials" Article in Part 2.

1. The course of action for failing tests shall be approved by the CQA Manager.
2. In case of failing test results, the Contractor may request that other samples be retested by the QAL with manufacturers' technical representative present during the testing procedures. The costs for retesting including engineering, analyses and all associated expenses shall be paid for by the Contractor.
3. The Contractor may also have the sample retested at two different laboratories approved by the Owner. If both laboratories report passing results, the material shall be accepted. If both laboratories do not report passing results, all material from the lot representing the failing sample will be considered out of specification and rejected.
4. The manufacturer may obtain additional samples from rolls or panels immediately before and after the failing roll or panel or as directed by the CQA Manager and have them tested by the QAL at his/her own expense. If these rolls or panels pass, then only the failing roll or panel will be rejected. If they fail, then the entire lot will be rejected.

PART 3 - EXECUTION

3.1 PREPARATION

A. General: Prior to installation:

1. Have protective cover material, tarp subgrade, inspected by the Engineer for compliance with the specifications.
2. Confirm all testing and survey information for the protective cover has been obtained.

3.2 INSTALLATION

A. Panel Placement:
1. Take care shall be taken to keep the tarp clean and free from debris prior to installation.
2. Install tarp in a manner to ensure it is not damaged in any way. Comply with the following procedures:

    a. In order to protect against wind uplift, weight tarps with 50 lb sandbags placed every 20 feet on centers or by other means approved by the Engineer. Install sandbags immediately after placement of tarp. Sandbags shall be made with UV resistant material that is equal to the UV resistance of the tarp.
    b. Do not leave tools on the tarp.

3. Weather Conditions:

    a. Do not install tarp at an ambient temperature below 40 degrees F or above 104 degrees F unless otherwise authorized, in writing.
    b. Do not install tarp during precipitation, excessive moisture, in an area of ponded water, or excessive winds.

B. Method of Placement:

1. Install in accordance with the approved shop drawings prepared by the Manufacturer. Design layout to minimize field joining.

2. Do not use equipment to deploy tarp that causes excessive rutting of the protective cover surface. Excessive rutting is defined as more than 3-inches. If rutting occurs, suspend all tarp placement activities and repair the ruts and immediately employ an alternative method for tarp deployment.
3. The Engineer shall inspect each panel, after placement and prior to seaming, for damage and/or defects. Defective or damaged panels shall be replaced or repaired, as approved by the Engineer.
4. Prohibit personnel working on the tarp from smoking, wearing damaging shoes or involving themselves in any activity that may damage the tarp.
5. Do not allow vehicular traffic across the tarp.
6. Keep tarp free of debris, unnecessary tools and materials, and uncluttered in appearance.

C. Field Seams:

1. Lay out and overlap individual panels of tarp or multiple panels that are factory welded by a minimum of 4 inches prior to seaming. Place uphill panel over the downhill panel similar to roof shingling in order to limit leakage. Clean and prepare area to be seamed in accordance with the installer's quality control seaming procedures.
2. Fusion weld the seams.
3. Weather Conditions: Proceed with seaming only under the following weather conditions:

    a. Ambient temperature higher than 40 degrees F and lower than 104 degrees F.
    b. No precipitation or other excessive moisture, such as fog or dew.
    c. No excessive winds.

4. These weather conditions shall be fulfilled during the seaming process.

3.3 FIELD QUALITY CONTROL

A. Repair Procedures:

1. Repair any portion of the tarp exhibiting signs of damage or defect. The final decision, as to the appropriate repair procedure, shall be made by the Engineer.
2. Repair Procedures:

    a. Patching, used to repair large holes, tears, undispersed raw materials and contamination by foreign matter.
    b. Capping, used to repair large lengths of failed seams.

B. Repair Verification:

1. Have all repairs reviewed by the Engineer.

3.4 DISPOSAL OF WASTE MATERIAL

A. Upon completion of installation, dispose of all trash, waste material and equipment used in connection with the performed work and leave the premises in a neat and acceptable condition.

END OF SECTION 02264

SECTION 02270
EROSION AND SEDIMENTATION CONTROL

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and perform all installation, maintenance, removal and area cleanup related to erosion and sedimentation control work as shown on the Drawings and as specified herein. The work shall include, but not necessarily be limited to; installation of temporary access ways and staging areas, silt fences, stone filter boxes, stone filter berms, sediment removal and disposal, device maintenance, removal of temporary devices, temporary mulching, excelsior matting installation and final cleanup.

1.02 RELATED WORK

A. Dust control is included in Section 01562.

B. Earthwork is included in Section 02200.

C. Sodding and seeding is included in Section 02900.

1.03 SUBMITTALS

A. Submit, in accordance with Section 01300, within 10 days after award of Contract, technical product literature for all commercial products, including straw mulch tackifier, to be used for erosion and sedimentation control.

1.04 QUALITY ASSURANCE

A. Be responsible for the timely installation and maintenance of all sedimentation control devices necessary to prevent the movement of sediment from the construction site to off-site areas or into the stream system via surface runoff or underground drainage systems. Measures in addition to those shown on the Drawings necessary to prevent the movement of sediment off site shall be installed, maintained, removed, and cleaned up at the expense of the Contractor. No additional charges to the District will be considered.

B. Sedimentation and erosion control measures shall conform to the requirements outlined in all applicable local, state and federal permits.

PART 2 PRODUCTS

2.01 MATERIALS

A. Silt fences and turbidity barriers shall conform to FDOT “Standard Plans for Road Construction” and “Standard Specifications for Road and Bridge Construction” (latest editions).

B. Straw mulch shall be utilized on all newly graded areas to protect areas against washouts and erosion. Straw mulch shall be comprised of threshed straw of oats, wheat, barley, or rye that is free from noxious weeds, mold or other objectionable material. The straw mulch shall contain at least 50 percent by weight of material to be 10-in or longer. Straw shall be in an air-dry condition and suitable for placement with blower equipment.

C. Latex acrylic copolymer or organic tackifier shall be a commercial product specifically manufactured for use as straw mulch tackifier.

D. An asphalt tackifier shall only be used when temperatures are too low to allow the use of a latex acrylic copolymer and only with prior written approval from the Engineer.

PART 3 EXECUTION

3.01 INSTALLATION

A. Silt Fence Installation

1. Sediment fences shall be positioned as indicated on the Drawings and as necessary to prevent off site movement of sediment produced by construction activities as directed by the Engineer.

2. Dig trench approximately six in. wide and six in. deep along proposed fence lines.

3. Drive stakes, eight ft on center (maximum) at back edge of trenches. Stakes shall be driven two ft (minimum) into ground.

4. Hang filter fabric on posts carrying to bottom of trench with about four in. of fabric laid across bottom of trench. Stretch fabric fairly taut along fence length and maintain secure both ways.

5. Backfill trench with excavated material and tamp.

6. Install pre-fabricated silt fence according to manufacturer's instructions.

B. Staging areas and access ways shall be surfaced with a minimum depth of four in. of crushed stone.

3.02 MAINTENANCE AND INSPECTIONS

A. Inspections:

1. Make a visual inspection of all erosion and sedimentation control devices once per week and promptly after every rainstorm. If such inspection reveals that additional measures are needed to prevent movement of sediment to offsite areas, promptly install additional devices as needed. Sediment controls in need of maintenance shall be repaired promptly.

B. Device Maintenance:

1. Sediment Fences

a. Remove accumulated sediment once it builds up to 1/2 of the height of the fabric.
b. Replace damaged fabric, or patch with a two-ft minimum overlap.
c. Make other repairs as necessary to ensure that the fence is filtering all runoff directed to the fence.

2. Add crushed stone to access ways and staging area as necessary to maintain a firm surface free of ruts and mudholes.

3.03 TEMPORARY MULCHING

A. Apply temporary mulch to areas where rough grading has been completed but final grading is not anticipated to begin within 30 days of the completion of rough grading.

B. Straw mulch shall be applied at rate of 100 lbs/1000 sq ft and tackified with latex acrylic copolymer at a rate and diluted in a ratio per manufacturer's instructions.

3.04 EROSION CONTROL BLANKETS

A. Erosion control blankets shall be installed in all seeded drainage swales and ditches as shown on the Drawings and as directed by the Engineer in accordance with manufacturer's instructions. The area to be covered shall be properly prepared, fertilized and seeded with permanent vegetation before the blanket is applied. When the blanket is unrolled, the netting shall be on top and the fibers in contact with the soil over the entire area. The blankets shall be applied in the direction of water flow and stapled. Blankets shall be placed a minimum of three rows (of four ft) wide (total approx. 12-ft width) within the drainage swale/ditch and stapled together in accordance with manufacturer's instructions. Side overlaps shall be four-in minimum. The staples shall be made of wire, .091-in in diameter or greater, "U" shaped with legs 10-in in length and a 1-1/2-in. crown. Commercial biodegradable stakes may also be used with prior approval by the Engineer. The staples shall be driven vertically into the ground, spaced approximately two linear feet apart, on each side, and one row in the center alternately spaced between each size. Upper and lower ends of the matting shall be buried to a depth of four in. in a trench. Erosion stops shall be created every 25-ft by making a fold in the fabric and carrying the fold into a silt trench across the full width of the blanket. The bottom of the fold shall be four in. below the ground surface. Staple on both sides of fold. Where the matting must be cut or more than one roll length is required in the swale, turn down upper end of downstream roll into a slit trench to a depth of four in. Overlap lower end of upstream roll four-in. past edge of downstream roll and staple.

1. To ensure full contact with soil surface, roll matting with a roller weighing 100 lbs/ft of width perpendicular to flow direction after seeding, placing matting and stapling. Thoroughly inspect channel after completion. Correct any areas where matting does not present a smooth surface in full contact with the soil below.

3.05 REMOVAL AND FINAL CLEANUP

A. Once the site has been fully stabilized against erosion, remove sediment control devices and all accumulated silt. Dispose of silt and waste materials in proper manner. Regrade all areas disturbed during this process and stabilize against erosion with surfacing materials as indicated on the Drawings.

END OF SECTION

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SECTION 02311
EXCAVATION SUPPORT AND PROTECTION

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The work specified in this Section includes requirements for excavation and support of temporary excavations, launch and exit shafts, and trenches. The Contractor shall design, furnish, install, and maintain a system of supports, including all bracing and associated items, to retain excavations in a safe manner and to control ground movements Upon completion of the required construction, the system of support shall be removed or cut and left in place as noted herein and the excavation and staging area sites restored as discussed herein.

B. The work specified in this Section also includes the use of portable trench boxes or sliding shields.

C. The work shall include site grading; fencing and signing; construction staging areas; design and construction of excavation support systems; design and construction of thrust blocks; disposal of excavated material, surface water, and ground water; backfilling; and site restoration. Work shall include all labor, materials, and equipment required to complete excavation support.

D. The Contractor shall retain the services of a Professional Engineer licensed in the State of Florida to prepare excavation support and protection system designs and submittals described herein.

E. All excavations and support systems shall conform to the Florida Trench Safety Act and to applicable OSHA excavation, trenching, and shoring standards which are contained in the U.S. Code of Federal Regulations 29 (C.F.R.) 1926.650-1926.653, other federal, state or local requirements. In the event of a conflict, comply with the more restrictive applicable requirements.

F. The Contractor shall be responsible for choosing and sizing the support of excavation systems. The size of the systems shall, however, be adequate for removal of material as indicated on the Drawings and to provide adequate space to meet the Contractor’s work requirements for his/her selected methods of construction. The excavation support system shall be chosen such that it controls groundwater, limits the amount of ground movements and protects the adjacent structures.

1.02 RELATED WORK

A. Submittals is included in Section 01300,

B. Site Preparation is included in Section 02100.

C. Dewatering and Drainage is included in Section 02140.

D. Jack and Bore is included in Section 02157.

E. Excavation, Bedding and Backfill for Pipe is including in Section 02221.

F. Geotechnical Instrumentation is included in Section 02495.

1.03 DESIGN REQUIREMENTS

A. The design of the temporary excavation support system is the responsibility of the Contractor. The design calculations and drawings shall be prepared, stamped and signed by a Professional Engineer licensed in the State of Florida, who is experienced in designing similar excavation support systems.

B. Design the sheeting excavation support system in accordance with requirements of this Section. These criteria are the minimum acceptable standards. Design shall consider all phases of construction and design of each member or support element to support the maximum loads that can occur during construction with appropriate factors of safety.

C. Design shall consider all phases of construction. Design each member or support element to support the maximum loads that can occur during construction with appropriate factors of safety.

D. All underground utility lines shall be identified, located, and protected from damage or displacement. Utility companies and other responsible authorities shall be contacted to locate and mark the locations and, if they so desire, direct or assist with protecting the underground installation. When required, the Contractor shall obtain an excavation permit from the local authority having jurisdiction prior to the initiation of any excavation work.

E. Design excavation support systems in accordance with all OSHA requirements and other local and agency requirements.

F. Design the support system to minimize horizontal and vertical movements and to protect adjacent structures and utilities from damage.

G. Excavations below the level of the base of any adjacent foundation or retaining wall shall not be permitted unless the design of the excavation and bracing includes an analysis of the stability of the structure supported by the foundation and as necessary, incorporates required bracing/underpinning of the foundation.

H. For support systems in which bracing is installed between opposite sides of the excavation, design the excavation support of both sides to be nearly the same as feasible.

I. Where necessary to resist point loads, pipe piles used as soldier piles shall be filled with concrete with a compressive strength not less than 3,000 psi. The strength of the concrete shall not be considered in design of the pipe pile for bending stress.

J. Design a working slab for each launch shaft bottom to provide stable support for guide rails, thrust block, and other construction operations.

K. Design, install, operate, and maintain ground water control system to control ground water inflows, prevent piping or loss of ground, and maintain stability of the excavation. Refer to the requirements of Section 02140.

L. Thrust blocks shall be designed to resist the maximum jacking load at each launch shaft. The jacking load shall be estimated and thrust block designed based on a minimum friction

resistance on the steel casing of 250 psf. A minimum jacking load of 200 tons shall be used. The thrust block shall be designed using a maximum passive earth pressure coefficient of 3.25, and a minimum factor of safety of 1.2. The maximum jacking load shall be incorporated into the launch shaft design.

M. Design, install, operate, and maintain deformation monitoring points to monitor the performance of the excavation support system in accordance with Section 02495.

N. Provide temporary fencing around all excavations. Provide pedestrian and traffic control around working areas and support systems located within or adjacent to streets, roadways, driveways, walkways or parking lots.

O. Receipt of the Contractor's plans and methods of construction by the Engineer does not relieve the Contractor of his responsibility to provide an adequate support system achieving the specified requirements.

P. Design review and field monitoring activities by the District or by the Engineer shall not relieve the Contractor of his/her responsibilities for the work.

1.04 SUBMITTALS

A. Submit to the Engineer in accordance with Section 01300, Shop Drawings and design calculations for the Contractor-designed excavation support system stamped by a Professional Engineer in the State of Florida. Submittals shall indicate the following, as a minimum:

1. Provide overall plan layout of the system, as shown on contract drawings, indicating clearances, dimensions, material properties, member sizes, locations, spacing and penetration depths of all members, as well as locations of various types of lateral supports. Indicate existing and proposed utilities, structures or other obstruction. Indicate location and type of instrumentation and monitoring points within the area of influence of the excavation.

2. Provide wall elevations and locations of all bracing and anchors.

3. Show methods and overall sequence of installation and removal of bracing, indicating levels to which the work will be carried out before bracing is installed or removed.

4. Method of preloading bracing (if required) and the preload for each member, and the method of locking-off the preload. Include detailed drawings of the connections, jacking supports and method of shimming.

5. Details, layout, arrangement, equipment requirements, and method of construction of the proposed steel sheeting excavation support system.

6. Submit thrust block design calculations and shop drawings for all jack and bore launch shafts.

7. Submit design calculations and shop drawings for the launch and exit shafts detailing material types, equipment, and construction methods to be used for construction of the excavation support systems prepared by a professional engineer registered in the state of

Florida as shown on the Contract Drawings. Shop drawings shall also detail all member connections and tunnel portal openings.

8. Procedures for resolving difficulties arising from misalignment of members exposed during excavation, and criteria for implementing those procedures.

B. Design calculations shall include:

1. Loads on the excavation support system for all stages of excavation, bracing removal, and concrete placement, including material and equipment loads on adjacent ground during construction.

2. Design of wall and all bracing members including all details for all stages of construction. Design shall account for water pressures associated with flood conditions.

3. Theoretical deflections of excavation support system and deformation of structures, pipelines and other utilities located within the area of influence of the excavation.

C. Submit quality control measures as required to ensure that the performance of the excavation support system is consistent with the requirements herein.

D. For portable trench boxes or sliding shields, submittals shall include the following as a minimum:

1. Trench box manufacturer's specifications, recommendations, and limitations.

2. Detailed drawings showing intended use of trench box during excavation, pipe placement, and backfilling activities.

E. Submit welder qualifications and weld procedures in accordance with AWS D1.1.

F. Submit Contractor's and Design Engineer's qualifications as described herein.

G. At least one copy of the design shall be maintained at the job site during excavation that includes a plan indicating the sizes, types, and configurations of the materials to be used in the protective system, and the identity of the registered engineer who approved the design.

H. Do not proceed with any support of excavation or protection activities until the submittal has been reviewed by the Engineer for compliance with the Contract Documents and for general compatibility with the work and with accepted engineering practices.

I. Contractor's Design Engineer's documentation shall include:

1. Periodic on-site inspections of excavation support system as the systems are constructed.

2. Review of quality control measures and performance data.

3. Certification that the excavation support system is constructed per the applicable design following completion of each support system and following any modifications by Contractor during construction.

1.05 REFERENCES

A. American Society for Testing and Materials (ASTM)

1. ASTM A36 - Specification for Structural Steel Standard Specifications

B. American Welding Society (AWS)

1. AWS D1.1 for Public Works Construction

C. Codes

1. U.S. Occupational Safety and Health Administration (OSHA) Regulations, 29 CFR Part 1926 Subpart P – Excavations.

D. Where reference is made to one of the above standards the revision in effect at the time of the bid opening shall apply.

1.06 QUALITY ASSURANCE

A. Regulations: Perform all work in accordance with current applicable regulations and codes of all Federal, State and local agencies.

B. The Contractor shall have at least five years of experience with work comparable to the Work shown and specified, employing labor and supervisory personnel who are similarly experienced in this type of Work.

C. The Contractor's Design Engineer shall be a Licensed Professional Engineer in the State of Florida with at least five years professional experience in the design and construction of support of excavation systems and shall have completed not less than five successful excavation support projects of equal type, size, and complexity to that required for the work.

D. Design of thrust blocks shall be performed by a professional engineer, licensed in the State of Florida, with at least five years' experience in this type of work.

PART 2 PRODUCTS

2.01 MATERIALS

A. All timber, structural steel, and steel sheet piling used for the supporting systems, whether new or used, shall be sound and free from defects that may impair their strength.

B. Soldier piles and structural steel members shall conform to ASTM A572 or ASTM A242 unless approved otherwise. All steel conforming to ASTM A 572 shall be Grade 36 or better. No members with permanent deformations are to be provided. Members shall not be spliced unless approved by the Engineer.

C. Pipe piles used as soldier piles shall conform to ASTM A252, Grade 36, or better.

D. Steel sheet piling shall conform to ASTM A328 or ASTM A572 or ASTM A690. All steel sheet piling conforming to ASTM A 572 shall be Grade 50 or better.

E. Concrete shall conform to ASTM C33 and ASTM C150 unless otherwise approved.

F. All timber shall be structural grade with a minimum allowable flexural strength of 1100 psi. Timber lagging shall be at least three inches thick and free of large or loose knots.

PART 3 EXECUTION

3.01 GENERAL

A. Commence installation of support system and excavations only after shop drawings have been reviewed by the Engineer for conformance with the contract documents and for general compatibility with the work and with accepted engineering practices.

B. All instrumentation required per Section 02495 shall be installed and initialized prior to the start of work.

C. Methods of construction for excavations shall be such as to ensure the safety of the Work, Contractor's employees, Engineer, and District's employees and inspectors, the public and adjacent property and improvements, whether public or private.

D. Before beginning construction at any location of this project, adequately protect existing structures, utilities, trees, shrubs, and other existing facilities. The repair of or compensation for damage to existing facilities shall be at no additional cost to the District.

E. As a minimum, place fencing, gates, lights, and signs as necessary around the excavations and staging areas to provide for public safety.

F. Install excavation support systems in accordance with the approved shop drawings and applicable permits. Upon completion, the installed excavation support system shall be inspected by the Contractor’s Design Engineer with written certification provided to the Engineer.

G. Care shall be taken to prevent voids outside the excavation support system, but if voids are formed, they shall be immediately filled with common fill material. Voids in locations that cannot be properly compacted upon backfilling shall be filled with lean concrete or other material as approved by the Engineer at no additional cost to the District.

H. If unstable material is encountered during excavation, all necessary measures shall be taken immediately to contain it in place and prevent ground displacement.

I. If settlement or deflections of supports indicate that support system requires modification to prevent excessive movements, redesign and resubmit revised shop drawings and calculations to the Engineer at no additional cost to the District.

J. Sufficient quantity of material shall be maintained on site for protection of work and for use in case of accident or emergency.

K. All welding shall conform to the applicable provisions of ANSI/AWS D1.1.

3.02 PORTABLE TRENCH BOXES

A. Portable trench boxes or sliding trench shields may be used for the protection of workers only.

B. Trench boxes shall not be used in launch or exit shafts for trenchless work.

C. Additional excavation, backfilling, and surface restoration required as the result of trench box use shall be at no additional cost to the District.

D. Trench boxes or shields shall be designed, constructed, and maintained to meet acceptable engineering and industry standards.

E. Shields shall be installed in a manner to restrict lateral or other hazardous movement of the shield in the event of the application of sudden lateral loads.

F. A copy of the trench box manufacturer's specifications, recommendations, and limitations shall be in written form and maintained at the job site during all excavation work.

3.03 SOLDIER PILES AND LAGGING

A. Install soldier piles with the minimum embedment depths as shown on approved shop drawings.

B. Soldier piles shall be installed in predrilled holes with casing or other methods of support as necessary to prevent caving of holes and loss of ground.

C. Predrilled holes for soldier piles shall be backfilled with concrete from the pile tip elevation to the elevation of the bottom of the excavation. The remainder of the predrilled hole shall be backfilled with lean concrete or sand. Concrete strength shall be in accordance with the approved shop drawings.

D. The predrilled hole diameter shall be sufficient to allow for proper alignment and concrete backfilling of the pile.

E. Provide timber lagging of sufficient thickness to withstand earth pressures and in accordance with the approved shop drawings.

F. Install lagging such that ground loss does not occur between adjacent or below the lowest board. As excavation proceeds, the maximum height of unlagged face of excavation shall not exceed four feet. The unlagged face shall not exceed two ft if water seeps or flows from the face of the excavation or if the face of the excavation becomes unstable.

G. As installation progresses, backfill the voids between the excavation face and the lagging. Pack with materials such as hay, burlap, or geotextile filter fabric where necessary to allow drainage of ground water without loss of ground.

3.04 STEEL SHEET PILING

A. Drive sheeting in plumb position with each sheet pile interlocked with adjoining piles for its entire length so as to form a continuous diaphragm throughout the length of each run of wall, bearing tightly against original ground. Exercise care in driving so that interlocking members can be extracted without damaging adjacent structures or utilities. The methods of driving, cutting, and splicing shall conform to the shop drawings.

B. Use templates or other temporary alignment facilities to maintain piling line.

C. Prior to installation, the sheet piles shall be thoroughly cleaned and inspected for defects and for proper interlock dimensions. The Contractor shall provide a tool for checking the interlock dimensions.

D. Each sheet pile shall have sufficient clearance in the interlocks to slide, under its own weight, into the interlock of the sheet pile previously placed.

E. Excavation shall not be carried in advance of steel sheet piling installation.

F. Where obstructions are anticipated, pre-excavation or pre-drilling along the sheet pile wall alignment shall be conducted at no additional cost to the District. Pre-excavation and pre-drilling shall not extend below the lowest excavation level or into bearing soils for existing or future structures.

G. Obstructions encountered before the specified embedment for piles shall be removed. Where obstructions cannot be removed, the sheet pile system shall be re-evaluated by the Contractor's Design Engineer for the resulted reduced embedment and additional toe stability measure implemented, as required or for realignment of the sheet pile wall. A submittal of the proposed measures shall be provided.

H. Damaged piling or piling with faulty alignment shall be withdrawn and new piling driven properly in its place. The cost of such additional work shall be considered as part of the pile driving and shall be borne by the Contractor.

3.05 INTERNAL BRACING

A. Provide internal bracing to carry maximum design load without distortion or buckling.

B. Include web stiffeners, plates, or angles as needed to prevent rotation, crippling, or buckling of connections and points of bearing between structural steel members. Allow for eccentricities caused by field fabrication and assembly.

C. Install and maintain all bracing support members in tight contact with each other and with the surface being supported. Wood shims shall not be used.

D. Coordinate excavation work with installation of bracing. Excavation shall extend no more than two feet below any brace level prior to installation of the bracing.

E. Use procedures that produce uniform loading of bracing member without eccentricities or overstressing and distortion of members of system.

3.06 REMOVAL OF EXCAVATION SUPPORT

A. Do not remove internal bracing and transfer loads to the permanent structure without prior acceptance of the Engineer.

B. Removal of excavation support system shall begin at, and progress from, the bottom of the excavation. Members shall be released slowly as to note any indication of possible failure of the remaining members or possible cave-in of the sides of the excavation.

C. Backfilling shall progress together with the removal of support systems from excavations.

D. Do not remove vertical support members that were installed within the zone of influence of new or existing structures or pipelines. The zone of influence is defined as a zone extending down and away from the outer edge of the structure at one horizontal to one vertical or from the centerline of the pipe. Support members installed within this zone shall be cut off at a minimum of five ft below finished grade and abandoned in place.

E. Unless otherwise indicated or directed by the Engineer, remove all portions of excavation support.

F. No wood shall remain as part of the abandoned portion of the work.

G. When removing the exaction support system, do not disturb or damage adjacent buildings, structures or utilities. Fill voids immediately with lean concrete or well-graded cohesionless sand, as indicated or directed by the Engineer.

H. Remove material of the excavation support system from the site immediately.

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SECTION 02495
GEOTECHNICAL INSTRUMENTATION

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Work described under this section pertains to monitoring of excavations, dewatering, excavation support systems, jack and bore, and/or other construction activities that may cause deformation and vibrations.

B. Employ an instrumentation specialist (or specialty firm) to review the Contract Work and prepare an instrumentation installation and monitoring plan.

C. Furnish all materials, equipment, labor, and services required for the complete installation, maintenance, protection, and monitoring of instrumentation and reporting of collected data for all instrumentation on buildings, utilities, and in the ground adjacent to the site or on the site, as specified in this Section and as necessary to monitor construction performance and impacts on adjacent property.

D. Establish response actions to be taken if the maximum allowable instrument readings are exceeded so that existing structures and utilities are protected from damage. Implement response actions if maximum allowable instrument readings are exceeded.

E. Dispose of all instruments at the end of the project as instructed by the Engineer.

1.02 RELATED WORK

A. Dewatering and drainage are included in Section 02140.

B. Jack and Bore is included in Section 02157.

C. Excavation, Bedding and Backfill for Pipe is included in Section 02221.

D. Excavation Support and Protection is included in Section 02311.

1.03 SUBMITTALS

A. Submit in accordance with Section 01300.

B. Submit for review by the Engineer the following information four weeks prior to instrument installation:

1. Installation Plan and Schedule: Full details of the proposed plan and schedule for installing and monitoring instruments, including proposed locations, types, installation methods, and monitoring schedule of the instruments.

2. The names, qualifications, and experience of the personnel or subcontractor(s) who will install the instruments, perform optical level survey and vibration monitoring, read the instruments, and report data to the Engineer demonstrating compliance with “Quality Assurance” Article included in this specification.

3. Layout of monitoring points, observation wells, seismographs and reference points and description of monitoring provisions, including full details of the proposed instruments, proposed plan and schedule for installing the instruments, and schedule for monitoring and data reporting.

4. Description of methods for installing and protecting all instrumentation including but not limited to seismographs, observation wells, crack gages, monitoring points, and reference points.

5. Copies of all instrument calibrations and certifications specified.

6. Groundwater observation well construction details including casing type, filter gradation, screen interval, grout mix, drilling methods, and depth of wells.

7. Field Calibration: Within 5 working days of performing a field calibration, submit results of the calibration to the Engineer.

8. Reports and Records: Provide reports of monitoring data to the Engineer. Include the following minimum information:

    a. Preconstruction survey.
    b. As-installed location plan, installation records and baseline values for all instrumentation.
    c. Monitoring data for all instruments with plots against threshold values.
    d. Weekly records of crack monitors, including photographs with readings.
    e. Event reports and summary from vibration monitoring.
    f. Discussion and associated action related to any result exceeding the threshold values set herein.

9. Certificates: For each seismograph instrument to be furnished submit a certificate issued by the instrument's manufacturer stating that the manufacturer has inspected and tested each instrument before it leaves the factory to confirm that the instrument is working correctly and has no defects or missing parts.

10. Submit three copies of the pre-construction condition surveys as specified herein.

C. Submit proposed remedial measures to the Engineer of action to be taken in the event that the instrument Threshold Values are reached.

1.04 DEFINITIONS

A. Surface Monitoring Points (SMPs): Inscribed marking or approved surveyor's nail installed to measure vertical (elevation) movement.

B. Deformation Monitoring Points (DMPs): Fixed markers placed on existing utilities and structures to measure both vertical and horizontal movement. Initial coordinate locations and vertical controls are determined by optical survey methods.

C. Excavation Support Monitoring Points (ESMPs): Inscribed marking or fixed makers placed on excavation support systems to measure horizontal movement of the excavation support system.

D. Utility Monitoring Points (UMPs): Steel rod inside fully cased hole that is resting on existing utilities or underground structures to measure movement of the existing underground structure or utility.

E. Groundwater Observation Wells: Screened or slotted pipe with solid riser pipe installed in a drilled hole with the annulus around the pipe backfilled with sand. Near surface groundwater levels are measured in the well.

F. Seismographs: Electronic recording device with vibration transducer capable of monitoring and recording ground vibrations induced by construction activity.

1.05 QUALITY ASSURANCE

A. Personnel Qualifications for Instrument Installation.

1. Employ qualified technicians with comparable experience in the installation of geotechnical instrumentation similar to that specified herein.

2. Employ a qualified Geotechnical Instrumentation Engineer who is a professional engineer, with at least 5 years of experience in the installation of instrumentation specified herein, to supervise and direct technicians and be responsible for instrument installation. This person is to be present at the installation site(s) to direct and supervise the installations, oversee the reading of the instrumentation and supervise the interpretations of geotechnical instrumentation data.

B. Installation of instrumentation shall, at all times, be performed in the presence of the Engineer.

C. The Contractor shall be responsible for all aspects pertaining to the installation, maintenance and monitoring of the geotechnical instrumentation specified herein.

D. Provide each instrument or component of instrument specified herein from an approved manufacturer currently engaged in manufacturing geotechnical instrumentation hardware of the specified types.

E. Surveyor Qualifications: The professional Land Surveyors shall be licensed in the State of Florida and with at least three years of experience in surveying of similar instruments. The professional Land Surveyors shall establish the Deformation Monitoring Points, Surface Monitoring Points, Utility Monitoring Points, and Excavation Support Monitoring Points and take baseline readings.

F. Perform optical level surveys, instrument readings, and report data. Personnel responsible for this work shall be qualified by a minimum of three years of experience with similar work.

G. Factory Calibration: A factory calibration shall be conducted on all seismographs prior to shipment. Certification shall be provided to indicate that the test equipment used for this purpose is calibrated and maintained in accordance with the test equipment manufacturer's calibration requirements and that, where applicable, calibrations are traceable to the U.S. National Institute of Standards and Technology.

H. Vibration monitoring shall be conducted by persons trained in the use of a seismograph and records shall be analyzed and results reported by persons familiar with analyzing and reporting the frequency content of a seismograph record.

I. Persons responsible for pre-construction surveys shall be professional engineers, licensed in the State of Florida, and shall have had a minimum of 5 years of professional experience in structural evaluation and conditions surveys.

1.06 TOLERANCES

A. Survey measurements for initial location of each of the instrumentation elements shall consist of determining the elevation and horizontal position with respect to benchmark(s) approved by the Engineer.

B. Monitoring Points (SMPs, DMPs, UMPs and ESMPs)

1. Elevations of all instrumentation shall be determined to an accuracy of plus/minus 0.01 feet.

2. The horizontal position of surface monitoring points shall be determined to an accuracy of plus/minus 0.1 foot.

3. The horizontal position of deformation monitoring points and excavation support monitoring points shall be determined to an accuracy of plus/minus 0.01 foot.

C. Should actual field conditions prohibit installation at the location and elevations specified in this Section, obtain prior acceptance from the Engineer for new instrument location and elevation.

1.07 DESIGN AND PROJECT REQUIREMENTS

A. Project Requirements

1. Install Geotechnical Instrumentation as required herein and as necessary to monitor ground conditions, ground response, and facilities to achieve specified project requirements, and prevent damage to facilities potentially affected.

2. Install the instrumentation in accordance with the approved Instrumentation Schedule.

3. The Engineer's monitoring of the installed instruments does not relieve the Contractor of the obligation to complete the project within the requirements specified herein and the Contractor shall take additional measurements as may be necessary.

B. Pre-Construction Survey

1. Prior to start of excavation work, installation of excavation support and dewatering work, engage the services of an independent professional engineer, licensed in the State of Florida, to conduct a pre-construction survey of existing structures and conditions within 100 feet of the anticipated excavation work and installation of excavation support.

a. Coordinate activities, issue notices, obtain clearances and provide photographic and secretarial assistance necessary to accomplish the survey.

b. Give notice in writing, to the property owner and any representative of local authorities required to be present at such survey. Notify in writing the dates on which surveys are planned so that representatives are present during the examination. Provide copies of notices to the District and Engineer.

2. Record observations of the existing conditions for residences, buildings and other structures, which are affected.

a. Provide the survey consisting of a description of interior and exterior conditions. Locate cracks, damage or other defects existing and include information to make it possible to determine the effect, if any, of the construction operations on the defect. Where significant cracks or damage exists, or for defects too complicated to describe in words, photographs shall be taken and made part of the record.
b. The records of each property examined must be signed by the representatives present and, if practicable, by the property owner, whether or not they are present at the examinations.

3. Record of the pre-construction survey shall consist of written documentation, video and photographs of the conditions identified. At the completion of the survey, submit copies of the documentation to the District.

4. Upon completion of all excavation work and installation of excavation support, complete a similar examination of properties and structures where complaints of damage have been received or damage claims have been filed. Give notice to interested parties so that they may be present during the final examinations. Records of the final examination shall be signed and distributed as the original pre-construction survey.

5. Retain records in the Contractor's file for at least three years after completion of the Contract. In the event of damage claims, a report shall be prepared by the Contractor on the particular structures as requested by the Engineer from those notes and photographs and submitted to the District. Repair damage attributed to the Contractor’s activity promptly and completely to the property owner’s satisfaction to restore the conditions of the property to that existing prior to work.

C. Secure all required permits prior to the installation or removal of observation wells.

D. Provide and facilitate safe access to the instruments at all times. The Engineer may perform additional monitoring in a manner that will minimize unnecessary work delays. Allow and facilitate instrument monitoring as required by the Engineer. No claim for lost production time due to this activity will be allowed.

E. Maintain all instrumentation. Replace all damaged instruments within 24 hours. Report all damaged or non-functional instrumentation to the Engineer within 24 hours.

F. Availability of Data

1. Interpretations developed by the Engineer will be available to Contractor. Contractor may observe readings at any time or take their own supplementary readings.

2. Monitoring data is the property of the District and is not to be disclosed or published to third parties without the District’s written permission.

3. Contractor is expected to make their own interpretations for their own purposes at no additional cost to the District.

PART 2 PRODUCTS

2.01 SURVEYING INSTRUMENTS

A. Elevations of all instrumentation shall be determined to an accuracy of plus/minus 0.01 feet.

B. Horizontal position of all instrumentation shall be determined to an accuracy of plus/minus 0.1 feet.

2.02 MATERIALS

A. General: All instruments and materials, including readout units, remain the property of the Contractor following completion of the Contract.

B. Furnish all installation tools, materials, and miscellaneous instrumentation components.

C. Surface protection for all instruments provided shall be flush with the surface in paved or other ground surface areas, at the time that the work is completed.

D. Locations and number of instruments shall be determined by the Contractor and approved by the Engineer.

GROUNDWATER OBSERVATION WELLS

E. Observation wells will be used to monitor the groundwater levels outside the excavation.

F. Pipe shall consist of one-inch minimum inside diameter Schedule 40 PVC pipe.

G. Maximum screen size shall be 0.020-in unless otherwise approved by the Engineer.

2.03 MONITORING POINTS

A. Establish system of control points and monitor in accordance with the requirements herein.

1. Surface Monitoring Points (SMPs)

a. SMPs will be used to monitor vertical deformation at or near the ground surface. Clearly identify all points with permanent easily readable letters and numbers as approved by the Engineer.
b. Provide SMPs in paved areas consisting of a two-inch-long masonry nail, manufactured from hardened zinc–plated steel. Drive the masonry nail into an asphalt covered surface. Identify each nail individually with an identification tag or surface marking.
c. Provide SMPs in non-paved areas consisting of a three-ft-long, 3/4 inch diameter steel rod. Drive the rod into the ground or set in concrete in the ground such that no more than three inches of the rod is exposed above the ground surface. Round the top of the rod and punch-mark it at its center. Identify each rod with a surface marking.

d. Provide SMPs on utility manholes consisting of an observable cross mark or welded bead on the top horizontal surface of utility manhole rims. Clean the surface within three inches of the point and mark it to permit easy identification of the exact point. Clearly identify the point shall using fluorescent spray paint adjacent to the point.

2. Deformation Monitoring Points (DMPs)

a. DMPs will be used to monitor vertical and horizontal movement of adjacent utilities and structures.
b. DMPs shall consist of nails, screws, reinforcing bars, bolts and similar materials with well-defined measurement points as approved by the Engineer. DMP's shall be firmly attached and shall be protected from damage and vandalism. Remove or cover with a protective box or cap as approved by the Engineer all elements of DMPs protruding more than 0.25-in. Clearly identified all DMPs with permanent easily readable letters and numbers as approved by the Engineer.

3. Utility Monitoring Points (UMPs)

a. Utility monitoring points (UMPs) will be used to monitor vertical and horizontal deformation of selected utilities and underground structures as specified herein.
b. UMP shall include, at a minimum, the following:

1) Three and one-half inch extra strong steel pipe sleeve and one-inch extra strong steel riser pipe, threaded and coupled, ASTM A 53/A 53M Grade B;
2) PVC centralizers, consist of a schedule 40 PVC pipe conforming to ASTM D1785, sized to provide a tight fit on the riser pipe, and spring-formed to a larger diameter to provide a loose fit in the sleeve pipe

c. UMPs shall be installed to top of utility or underground structure by vacuum excavation method. The monitoring rod with centralizers shall set on top of the utility or underground structure and extending to within one foot of the ground surface. The utility monitoring point shall be installed with a flush mount roadbox casing at grade and shall be clearly identified by surface marking

4. Excavation Support Monitoring Points (ESMPs)

a. ESMPs shall be fixed markers on the vertical elements of the excavation support system and shall be used to monitor horizontal deformation of excavation support system designed by the Contractor. Clearly identified all points with permanent easily readable letters and numbers as approved by the Engineer. Surface within three inches of each point shall be cleaned and clearly identified using fluorescent spray paint adjacent to the point.

B. Non-Shrink Cement Grout shall be suitable for intended application.

2.04 SEISMOGRAPHS

A. Provide portable seismographs for monitoring the velocities of ground vibrations resulting from construction activities as specified herein. Provide for full-time use on the project during vibration causing construction activities. Provide two (minimum) seismographs which have been

calibrated within the previous six months to a standard that is traceable to the National Institute of Standards and Technology. Required characteristics of seismographs are listed below:

1. Measure the three mutually perpendicular components of particle velocity in directions vertical, radial, and perpendicular to the vibration source.

2. Measure and display the maximum peak particle velocity continuously during vibration-generating activities.

3. Have a low frequency omnidirectional transducer for measuring air blast overpressure with a flat frequency response within the limits of two Hz to 250 Hz with a tolerance equal to or better than plus or minus 10 percent.

4. Seismic range: 0.01 to four inches per second with an accuracy of plus or minus five percent of the measured peak particle velocity or better at frequencies between 10 Hertz and 100 Hertz, and with a resolution of 0.01 inches per second or less.

5. Acoustic range: 110 to 140 dB (referenced to 20 micro-Pascals) with an accuracy and resolution of plus or minus one dB.

6. Frequency response (plus or minus three dB points): two to 200 Hertz.

7. Two power sources: internal rechargeable battery and charger and 115 volts AC. Battery must be capable of supplying power to monitor vibrations continuously for up to 24 hours.

8. Self-triggering wave form capture mode that provides the following information: plot of wave forms, peak particle velocities, peak overpressure, frequencies of peaks.

9. Continuous monitoring mode must be capable of recording single-component peak particle velocities, and frequency of peaks with an interval of one minute or less.

2.05 CRACK MONITORS

A. Provide crack gages for monitoring the width of existing cracks and joints as manufactured by Geokon, Inc., Lebanon, NH Model 4420, or equal.

B. Crack gages shall have threaded anchors with ball joints which can be grouted to each side of the crack in any orientation and a transducer with a range of at least one inch and an accuracy of less than 0.1 percent and a nonlinearity of no more than 0.5 percent. The gage shall be capable of operating in temperatures ranging from minus 20 degrees to 80 degrees (Celsius).

C. Provide a solid steel cover over each gage which does not touch or otherwise interfere with the operation of the gage.

PART 3 EXECUTION

3.01 PREPARATION

A. Prior to commencing any installation of excavation support, excavation for both open trench and trenchless crossings, and pile installation and dewatering work, furnish components of

instrumentation that are to be installed during construction and conduct pre-construction surveys.

B. Install instruments.

C. Protect from damage and maintain instruments installed by the Contractor.

D. Repair or replace damaged instruments furnished by the Contractor.

E. Collect, reduce, process, plot and report monitoring data obtained by survey, seismograph data, groundwater levels, and submit to the Engineer.

F. Coordinate with the Engineer to verify consistency of collected data.

G. Implement remedial measures based on interpretations of monitoring data program.

3.02 GENERAL REQUIREMENTS

A. Perform a pre-construction survey prior to any dewatering, excavation, trenchless crossings, installation of piles or installation of excavation support.

B. Install instruments at locations selected by the Contractor and approved by the Engineer in accordance with the approved installation procedures. The Engineer may modify instrument locations depending on field conditions and monitoring objectives. Install all instrumentation in accordance with the approved installation schedule. Instruments shall be installed and baseline data, acceptable to the Engineer, shall be obtained before construction starts.

C. Provide the Engineer with access to instrument locations and assistance required in obtaining monitoring data.

D. All instruments shall be clearly marked, labeled, and protected to avoid being obstructed or otherwise damaged by construction operations or the general public. Immediately following installation, the location of the top of all instruments shall be surveyed to provide horizontal and vertical coordinates. Resurveying shall be done as required by the Engineer if there is a question regarding the instrumentation location.

E. A unique instrument identification number shall be assigned to each instrument and each point. The instrument identification number shall be clearly marked on each instrument in a non-destructible manner.

F. Initial Reading: Immediately following instrument installation, the Contractor, in the presence of the Engineer, shall take two sets of initial readings to provide baseline readings and to demonstrate the adequacy of the completed installation.

G. Factory Calibration: A factory calibration shall be conducted on all instruments at the manufacturer's facility prior to shipment. Each factory calibration shall include a calibration curve with data points clearly indicated, and a tabulation of the data. Each instrument shall be marked with a unique identification number.

H. The instrumentation and monitoring specified here is considered the minimum required. The Contractor shall obtain additional data from the instrumentation and /or furnish, install, and

monitor additional instrumentation as necessary to adequately monitor construction performance and safety aspects of the work.

3.03 MONITORING POINTS

A. Monitoring Points shall include but not be limited to SMPs, DMPs, UMPs and ESMPs. Monitor these control points using surveying methods.

B. Install SMPs, UMPs and DMPs as described below near excavations, pile installation locations, trenchless crossings, and open trench locations. Additional SMPs, UMPs, and DMPs may be required by the Engineer.

C. SMPs shall also be installed in the pavement or ground surface, within five feet, along each side of trench excavations that is within 50 feet of structures. The SMPs shall be installed at spacing not more than 50 feet. Locations may be modified to meet site constraints with the approval of the Engineer.

D. SMPs shall also be installed on the rim of manhole covers of utilities located within 50 feet of trenchless crossings or within 30 ft of open excavations.

E. Along trenchless crossing alignments, SMPs shall be installed at intervals of not more than 10 feet over the proposed trenchless crossing locations in rows of three; one directly above the alignment and the other two located 10 feet apart on each side oriented perpendicular to the pipe alignment. Locations may be modified to meet site constraints with the approval of the Engineer.

F. DMPs:

1. DMPs shall be installed on the exterior walls of buildings or structures located within 30 ft of open excavations or 50 feet of shafts or trenchless crossing alignments. As much as practical, DMPs shall be installed on supporting walls or columns. Avoid installation in brick unless absolutely necessary.

2. As a minimum, DMPs shall be installed on the exterior wall corners of buildings, structures, or property boundary walls at not more than 50 feet spacing. The Engineer may require additional DMPs be installed to monitor building movement at other locations.

3. Install DMPs in cooperation with property owners so that installations are inconspicuous and acceptable to the property owners. Existing features of building foundations that are permanent and can be repeatedly surveyed may substituted for DMPs, if approved by the Engineer.

G. UMPs shall be installed on existing utility over 36 inch in diameter and located within 15 feet from excavation. UMPs shall be located at a spacing of not more than 50 feet.

H. ESMPs shall be installed on excavation support systems other than trench box along support walls at spacing not more than 25 feet.

I. Install and obtain SMP, UMP, and DMP monitoring point readings prior to installing excavation support, beginning excavation or operation of groundwater control system, start of pile installation, or start of installation of excavation support at the site. Install ESMPs prior to

excavation within the exaction support system. The Contractor shall obtain two sets of measurements for each monitoring point to establish the baseline data within three days of installation. These measurements shall be made at least 24 hours apart but not more than 48 hours apart. Monitoring points with initial surveyed elevations (or offsets as appropriate) differing by more than two mm shall be checked for secure installation and resurveyed.

J. The reading schedule of all SMPs, UMPs and DMPs surveyed shall be daily during excavation, dewatering, filling and backfilling, pile installation, trenchless excavation and excavation support installation by all methods within 50 feet of the work and then at least twice a week until all excavation, dewatering and backfill has been completed.

K. Survey of SMPs, UMPs and DMPs for trenchless crossing operation shall include once per day starting at least two days prior to the start of trenchless excavations and extend at least 30 days after the completion of the crossing.

L. The reading schedule of ESMPs shall be at least daily during associated excavation and twice a week until backfill is completed.

3.04 VIBRATION MONITORING

A. Seismograph readings shall be taken during pile installation and other ground vibrations including excavation support installation or other activities causing ground vibrations within 50 feet of existing structures to document that peak particle velocities do not exceed the limit criteria as described below.

B. Seismographs shall be installed by the Contractor near existing structures when vibratory or impact hammers are used for the installation of shoring within 50 feet of existing structures, and as directed by the Engineer. Seismograph locations shall include points on the ground surface between three and six feet from the faces of the nearest building(s). Seismographs shall be firmly mounted on the surface slab of concrete or asphalt or firmly set in undisturbed soils.

3.05 GROUNDWATER OBSERVATION WELLS

A. At least one monitoring well shall be installed on each side of trenchless crossing to 10 feet below the invert of the casing.

B. Existing wells may be used if appropriate and approved by the Engineer.

C. The screened interval of each well shall be set to monitor groundwater levels.

D. Using approved drilling methods, drill four-in minimum diameter holes for observation wells of the size and depth required, and case with temporary casing. Bentonite drilling mud shall not be used in drilling holes for the observation wells.

E. Flush all cased holes with clean water through an approved bit. Flush until the discharge water is free of soil particles.

F. Construct observation well with 10 feet of slotted PVC well screen, filter sand, bentonite seal, couplings, a pipe cap, and a locking cover.

1. Place two feet of filter sand in the bottom of the drilled hole; then place the well screen and surround it with filter sand, as the temporary casing is carefully withdrawn.

2. Insert solid PVC casing and cap and fill the annular space with bentonite pellets then non-shrink cement grout.

3. Protect the observation wells at ground surface by providing a roadway box or outer protective casing with lockable top and padlock. Design the surface protection to prevent damage by vandalism or construction operations and to prevent surface water from infiltrating.

    a. Provide two keys for each padlock to the Engineer for access to each well.
    b. Observation wells shall be developed so as to provide a reliable indication of groundwater levels. Wells shall be re-developed if well clogging is observed, in the event of apparent erroneous readings, or as directed by the Engineer.
    c. Submit observation well installation logs, top of casing elevation, and well locations to the Engineer within 24 hours of completion of well installation.

G. Observation Well Maintenance

1. The Contractor shall maintain each observation well until adjacent structures, box culverts and pipelines are completed and backfilled. Clean out or replace any observation well which ceases to be operable before adjacent work is completed.

2. It is the Contractor's obligation to maintain observation wells and repair or replace them at no additional cost to the District, whether or not the observation wells are damaged by the Contractor's operations or by third parties.

H. Monitoring and Reporting of Observation Well Data

1. The Contractor shall begin daily monitoring of groundwater levels in work areas prior to initial operation of drainage and dewatering system. Daily monitoring in areas where groundwater control is in operation shall continue until the time that adjacent structures, box culverts and pipelines are completed and backfilled and until the time that groundwater control systems are turned off.

2. The Contractor is responsible for processing and reporting observation well data to the Engineer on a daily basis. Data is to be provided to the Engineer on a form, which should include the following information: observation well number, depth to groundwater, top of casing elevation, groundwater level elevation and date and time of reading.

I. Following construction, abandon new observation wells as directed by the Engineer. Abandon observation wells by removing all material within the original borehole, including the casing, filter, and grout seal in accordance with all applicable permits. Using approved tremie methods completely fill the hole and all voids with non-shrink cement grout prior to removal of the drill casing such that formation materials do not move into the hole prior to grouting. Restore the ground surface to its original condition. Abandon wells within paved areas by removing the vaults and well caps to the pavement subgrade. Remove wells with as discussed above and repair or patch pavement with the same surface type.

3.06 INSTRUMENT PROTECTION, MAINTENANCE AND REPAIR

A. Protect the instruments from damage. The Contractor shall immediately replace, within 72 hours of damage, any instrument that becomes damaged or is destroyed for whatever reason at no additional cost to the District. If necessary, the contractor will suspend work in the areas being monitored by the damaged instrument and take remedial action.

B. Maintain the instruments by draining water and flushing debris from under protective covers and keeping covers locked and sealed at all times.

3.07 MONITORING

A. The Contractor shall collect, tabulate, plot and interpret the survey monitoring data and provide the Engineer with the tabulated and plotted data. Report the status of excavation, bracing, groundwater levels, pile installation operation, stationing of the trenchless casing face/leading edge, and backfilling at the time of data collection with each report.

B. Monitoring frequency may be modified as directed and approved by the Engineer.

C. Provide data from readings of all monitoring points to the Engineer within 24 hours of reading. Communicate verbally with the Engineer immediately after visual observations or data collection if excessive movements or other anomalies are indicated.

D. For seismograph data, a summary report with event summary of peak particle velocity and frequency shall be provided. A strip chart indicates the time and magnitude of maximum single-component peak particle velocity measured during each five-minute interval of the monitoring period shall be submitted. A summary of vibration producing activities for that week shall be listed along with any specific events which caused anomalous readings.

E. The Contractor shall make visual observations of ground conditions and building conditions in the vicinity of the site and communicate immediately with the Engineer if signs of ground or building movements are observed.

F. The Engineer may take independent instrumentation measurements. Cooperate with the Engineer during instrumentation monitoring by providing access to the instrumentation locations in a timely manner and by providing and maintaining safe means of access to all instrumentation locations for data collection. Data acquired by the Engineer will be made available to the Contractor in a timely manner.

G. The Contractor may make his/her own interpretations of monitoring data for his/her own purposes. Data or interpretations shall not be published of disclosed to other parties without advance written permission of the District.

H. If the Contractor collects data from an instrument that has been installed to replace a damaged instrument, the formal initial reading for the damaged instrument shall be used as an initial reading for the replacement instrument so that data are plotted continuously, without an offset at the time of damage. The time of damage and replacement shall be noted on the plot.

3.08 INTERPRETATION AND RESPONSE VALUES

A. The Contractor shall make its own interpretations of the data resulting from monitoring programs.

B. Threshold and Limiting Values for instruments:

Instrument	Threshold Value	Limiting Value
Seismographs	1.0 in/sec over 40 Hz 0.75 in/sec at 30- 40 Hz 0.5 in/sec at 20-30 Hz 0.25 in/sec under 20 Hz	2.0 in/sec over 40 Hz 1.5 in/sec at 30- 40 Hz 1.0 in/sec at 20-30 Hz 0.5 in/sec under 20 Hz
Surface Monitoring Points	0.5 inch	1.0 inch
Deformation Monitoring Points	0.25 inch	0.5 inch
Utility Monitoring Points	0.25 inch	0.5 inch
Excavation Support Monitoring Points	1.0 inch	2 inches
Observation Wells	2 ft below bottom of excavation (including shafts)	at bottom of excavation
Observation Wells	1 ft below bottom of casing for trenchless crossing	at bottom of casing for trenchless crossing

C. These values are subject to adjustment by the Engineer as indicated by prevailing conditions and/or circumstances.

D. If a Threshold Value is reached:

1. Engineer and Contractor shall meet to discuss remedial measures.

2. Contractor shall increase the instrument monitoring frequency as directed by the Engineer.

3. Contractor shall install and monitor additional instruments as directed.

4. Contractor shall implement the remedial measures in the event the Threshold Value is reached, so the Limiting Value is not reached.

E. Contractor to take all necessary steps so that the Limiting Value is not exceeded. Contractor may be directed to suspend activities in the affected area with the exception of those actions necessary to avoid exceeding the Limiting Value.

3.09 DISPOSITION OF INSTRUMENTS

A. Monitoring Points and Crack Gages: All monitoring points and crack gages shall be removed during the cleanup and restoration work, unless directed otherwise by the Engineer.

B. Utility Monitoring Points: When required by the Engineer, abandon and remove protective housings and caps in accordance with the required permits. All surfaces affected by installation of instruments shall be restored to their original condition prior to completion of work.

1. Leave in place any casings located within the plan limits of structures or pipelines or within the zone below 1H:1V planes extending downward and out from the edges of foundation elements or from the downward vertical footprint of the pipe, or where removal would otherwise result in ground movements causing adverse settlement to adjacent ground surface, utilities or existing structures.

2. Where casings are pulled, holes shall be filled with sand. Where left in place, casings should be filled with non-shrink cement grout and cut off a minimum of three ft below finished ground level or one ft below foundation level so as not to interfere with finished structures or pipelines.

3. Remove precast boxes or vaults and reconstruct pavement in paved areas. Restore surface to the conditions existing prior to installation of the instruments.

C. Seismographs: Units shall be returned to the Contractor following completion of the installation of excavation support and excavation.

END OF SECTION

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SECTION 02612
REINFORCED CONCRETE SEWER PIPE

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals necessary and install and test reinforced concrete pipe for sewers complete as shown on the Drawings and as specified herein.

B. All pipe and fittings shall be manufactured for this project and no pipe shall be furnished from stock.

1.02 RELATED WORK

A. Testing and cleaning of sewers are included in Section 01445.

B. Excavation and backfilling are included in Section 02200.

C. Granular materials are included in Section 02200.

1.03 SUBMITTALS

A. Submit, in accordance with Section 01300, shop drawings showing layout and details of reinforcement, joint, method of manufacture and installation of pipe, gasket, specials and fittings, the name of the pipe manufacturer and a schedule of pipe lengths (including the length of individual pipes by diameter) for the entire job.

B. Submit with the shop drawings documentation that the fine and course aggregates to be used in manufacture of the concrete pipe comply with the requirements of Paragraph 2.01C. Documentation shall be less than six months old and shall indicate the source of the aggregates and the date of the analysis. Similar documentation shall be submitted to the Engineer at least yearly while pipe is being manufactured for this project.

C. Prior to each shipment of pipe, submit certified test reports that the pipe was manufactured and tested in accordance with the ASTM Standards specified herein.

D. Submit the results of the compressive strength tests to the Engineer.

1.04 REFERENCE STANDARDS

A. ASTM International

1. ASTM C33 - Standard Specification for Concrete Aggregates.

2. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe.

3. ASTM C150 - Standard Specification for Portland Cement.

4. ASTM C361 - Standard Specification for Reinforced Concrete Low-Head Pressure Pipe.

5. ASTM C443 - Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.

6. ASTM C497 - Standard Test Methods for Concrete Pipe, Manhole Sections or Tile.

7. ASTM 969 - Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines.

B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. The manufacturer shall perform the acceptance tests in accordance with ASTM C76.

B. Reinforced concrete pipe manufactured for this Contract may be inspected at the plant for compliance with this Section by an independent testing laboratory provided by the District. The manufacturer's cooperation in these inspections shall be required. The cost of this inspection of all pipe approved for this Contract, plus the cost of inspection of a reasonable amount of disapproved pipe will be borne by the District.

C. Inspection of the pipe will be made by the Engineer or other representatives of the District after delivery. The pipe shall be subject to rejection at any time on account of failure to meet any of the requirements specified herein, even though pipes may have been accepted as satisfactory at the place of manufacture. Pipe rejected after delivery shall be marked for identification and shall immediately be removed from the job.

PART 2 PRODUCTS

2.01 REINFORCED CONCRETE PIPE

A. Except as otherwise specified herein, pipe shall conform to ASTM C76, Class IV, per FDOT Section 449. The pipe interior shall be smooth and even, free from roughness, projections, indentation-s, offsets, or irregularities of any kind. The concrete mass shall be dense and uniform. Minimum reinforcement and wall thickness for sizes not tabulated in ASTM C76 shall be designed by the manufacturer in accordance with Section 7.2 of ASTM C76.

B. Cement shall be non-air-entraining portland cement conforming to ASTM C150, Type II. The use of any admixture shall be subject to the specific approval of the Engineer.

C. Fine aggregate shall consist of washed inert sand conforming to the requirements of ASTM C33, except for gradation, with a maximum loss of eight percent when subjected to five cycles of the soundness test using magnesium sulfate. Coarse aggregate shall consist of well-graded crushed stone or washed gravel conforming to the requirements of ASTM C33, except for gradation, with a maximum loss of eight percent when subjected to five cycles of the soundness test using magnesium sulfate. Documentation that the aggregates to be used in the manufacture of reinforced concrete pipe meet these requirements shall be submitted to the Engineer as stated in Paragraph 1.03 above.

D. The 28-day compressive strength of the concrete as indicated by cores cut from the pipe or from representative test cylinders taken from the same batch shall be equal to or greater than the

design strength of the concrete. The concrete mass shall be dense and uniform. Reinforcement shall be circular for all concrete pipes. Quadrant steel shall not be used. Reinforcement shall be installed in both the bell and the spigot. At least one circumferential reinforcement wire shall be in both the bell and spigot area and reinforcement in the bell and spigot shall be adequate to prevent damage to concrete during shipping, handling and after installation. The pipe shall be subjected to a three-edge bearing test and hydrostatic testing to 13 psi for 10 minutes in accordance with ASTM C443 to verify strength and water tightness. The District reserves the right to witness the testing.

E. Pipe may be rejected for any of the following reasons:

1. Exposure of any wires, positioning spacers or chairs used to hold the reinforcement in place, or steel reinforcement in any surface of the pipe, except for the ends of the longitudinals, stirrups or spacers specifically permitted by Section 8.2 of ASTM C76.

2. If cores taken show that the transverse reinforcing steel is found to be in excess of 1/4-in out of specified position after the pipe is molded.

3. Any shattering or flaking of concrete at a crack.

4. Voids, with the exception of minor bug holes, on the interior and exterior surfaces of the pipe exceeding 1/4-in in depth unless properly and soundly pointed with mortar or other approved material.

5. Unauthorized application of any wash coat of cement or grout. Pipe dressing procedures shall be subject to approval of the Engineer.

6. A deficiency greater than 1/4-in from the specified wall thickness of pipe 30-in or smaller in internal diameter.

7. A hollow spot (identified by tapping the internal surface of the pipe) which is greater than 30-in in length or wider than three times the specified wall thickness. Repair of such defective areas not exceeding these limitations may be made as specified in Paragraph 2.01M.

8. Defects that indicate imperfect molding of concrete; or any surface defect indicating honeycomb or open texture (rock pockets) greater in size than area equal to a square with a side dimension of two and one-half times the wall thickness or deeper than two times the maximum graded aggregate size; or local deficiency of cement resulting in loosely bonded concrete, the area of which is greater than 30-in in length or wider than three times the specified wall thickness when the defective concrete is removed. Repair of such defects not exceeding these limits may be made as specified in Paragraph 2.01M.

9. Any of the following:

    a. A crack having a width of 0.005 to 0.01-in throughout a continuous length of 36-in or more.
    b. A crack having a width of 0.0 to 0.03-in or more throughout a continuous length of one ft or more.
    c. A crack greater than 0.005-in extending through the wall of the pipe and having a length in excess of the wall thickness.

d. A crack showing two visible lines of separation for a continuous length of two ft or more, or an interrupted length of three ft or more anywhere in evidence, both inside and outside.
e. Cracks anywhere greater than 0.03-in in width.

F. The pipe shall be clearly marked as required by ASTM C76 in a manner acceptable to the Engineer. The markings may be at either end of the pipe for the convenience of the manufacturer, but for any one size shall always be at the same end of each pipe length. Pipe shall not be shipped until the compressive strength of the concrete has attained as percent of the design strength and not before seven days after manufacture and/or repair, whichever is the longer.

G. Pipe shall have a minimum laying length of approximately eight ft, except for closure and other special pieces as approved by the Engineer. Have available at the site sufficient pipe of various lengths to affect closure at manholes or structures that cannot be located to accommodate standard lengths. Short lengths of pipe made for closure, etc., may be used in the pipeline at the end of construction if properly spaced. The length of the incoming and outgoing concrete pipe at each structure shall not exceed four ft, except where the joint is cast flush with the exterior wall of the structure or where otherwise noted on the Drawings. Maximum laying length shall not exceed 16-ft, but the installation of 16-ft lengths will depend upon the ability to handle such lengths of pipe in sheeted trenches, comply with trench width requirements, maintain the integrity of the sheeting and avoid disturbance to adjacent ground. If in the opinion of the Engineer the use of 16-ft lengths is impractical, shorter lengths shall be used.

H. Each length of pipe shall be checked against the length noted on the shop drawings. Pipe more than 1-1/2-in longer than that shown on the shop drawings shall not be used on this project. Variations in length of the same pipe shall not exceed ASTM C76 requirements.

I. The Engineer shall have the right to cut cores from such pieces of the finished pipe as he/she selects for inspection and for such tests as he/she may wish to apply. Holes left by the removal of cores shall be filled in an approved manner by and at the expense of the manufacturer. Core drilling shall be carried out by the pipe manufacturer at his/her expense. The number of cores shall not exceed the requirements of ASTM C76.

J. The pipe will be carefully examined for compliance with the appropriate ASTM standard, as specified herein, and shop drawings by the manufacturer prior to shipment. All pipes shall be inspected for general appearance, dimension, "scratch-strength," blisters, cracks, roughness, soundness, etc. All pipes will be checked for soundness by being tapped and scratched at least once on every 50 sq in of pipe surface. The surface shall be dense and close-textured. Cores also shall serve as a basis for rejection of pipe, particularly if lamination or poor bond of reinforcement is apparent.

K. The manufacturer shall use measuring devices to assure joint assembly is within tolerances of ASTM C76 and as specified herein. If, during construction, the pipes cannot be satisfactorily joined, the manufacturer shall pre-join the pipe at the plant.

L. Only pipe actually conforming the requirements of ASTM C76 and these specifications shall be shipped. Approved pipe will be so stamped or stenciled on the inside before it is shipped. All pipe which has been damaged after delivery will be rejected and if such pipe already has been laid in the trench, it shall be removed and replaced, entirely at the Contractor's expense.

M. Pits, blisters, rough spots and other imperfections may be repaired, subject to the approval of the Engineer, after demonstration by the manufacturer that strong and permanent repairs result. Repairs shall be carefully inspected before final approval. Non-shrink cement mortar used for repairs shall have a minimum compressive strength of 6,000 psi at the end of seven days and 8,000 psi at the end of 28 days, when tested in three-in cylinders stored in the standard manner. Epoxy mortar may be utilized for repairs subject to the approval of the Engineer.

N. Supply a length of concrete pipe with three holes of proper diameter cut at the quarter points for each of the Y-saddles required. The holes shall be cut halfway through in the pipe by the manufacturer while the concrete is still "green" leaving the reinforcement intact. These pipes shall be reserved for use with Y-saddles only and the remaining concrete and reinforcement shall be cut in the field only from the hole to be used.

O. Pipe for use on curved sections shall be fabricated by beveling one or both ends up to five degrees to produce the radius of curvature required. Joint deflection shall not be utilized to produce the radius of curvature required. Reinforced concrete bends shall be cast to the degree of curvature required or fabricated by cutting the pipe at the required angle and rejoining the sections. Bends may be smooth or mitered providing mitered angles do not exceed 22-1/2 degrees and bends have a radius divided by the pipe diameter greater or equal to one.

2.02 JOINTS FOR CONCRETE PIPE

A. Joints shall be bell and spigot type joint conforming to ASTM C361 or C443 with provisions for using a round rubber O-Ring gasket in a recess in the spigot end of the pipe or profile gasket in a single step joint.

B. The gaskets shall conform to ASTM C361 or ASTM C443 except as otherwise specified herein. Two gaskets shall be submitted to the Engineer for tests at least 30 days before joining any the pipe.

C. Specimens shall be heated in a dry oven to 150 degrees F for six-hour duration and five specimens shall be tested by immersion, one each as follows: two-hour immersion in petroleum ether, 72-hour immersion in saturated Hydrogen Sulfide solution, 72-hour immersion in one percent NaOH solution, 72-hour immersion in standard soap solution (80 percent alcohol), 72-hour immersion in 10 percent NaCl solution. The specimens shall show no detrimental change in color, texture, or feeling upon completion of the above tests. Specimens of the gaskets shall be subjected to tensile tests of approximately 100 psi before and after immersion and heating tests and shall show an elongation of at least 25 percent. Upon release from the tensile tests, each specimen shall return to its original length. The manufacturer shall supply test data and affidavits showing compliance with these requirements. Tests shall have been conducted within six months of the start of manufacture of the pipe.

D. The joint and gaskets shall be designed and manufactured so that the completed joint will withstand an internal water pressure in excess of 13 psi for a period of 10 minutes without showing any leakage by the gasket or displacement of it. The pipe manufacturer shall provide facilities for testing the effectiveness of the joints against leakage and one such test may be required for each 800-ft of pipe for each type of joint manufactured. Such tests shall be made by an internal or external pressure against the joint of at least 13 psi for a period of 10 minutes in accordance with ASTM C443. The completed joint, when installed in place in the work, shall be capable of withstanding a groundwater pressure of 13 psi without exceeding the allowable leakage specified for the pipe testing.

E. The pipe manufacturer shall furnish information and be on hand during the installation of the first five joints installed under this Contract.

F. The ends of the pipe shall be made true to form and dimension and the bell shall be made by casting against steel forms. The manufacturer shall inspect all pipe joint surfaces for out-of-roundness and pipe ends for squareness.

PART 3 EXECUTION

3.01 LAYING CONCRETE PIPE

A. Care shall be taken in loading, transporting and unloading to prevent injury to the pipe or fittings and the joint surfaces. Pipe or fittings shall not be dropped. All pipe or fittings shall be examined before laying and no piece shall be installed which is found to be defective.

B. As soon as the excavation is completed to the normal grade of the bottom of the trench, place screened gravel bedding in the trench and firmly bed the pipe in this gravel to conform accurately to the lines and grades indicated on the Drawings. Blocking under the pipe will not be permitted.

C. Prior to the installation of any pipe, review the proposed method of installation with the Engineer. Jacks or come-alongs shall be used to force the pipes home. The use of other methods, including the use of motor driven equipment, shall be reviewed by the Engineer. The Engineer reserves the right to direct the Contractor to revise his operation at any time within this Contract.

D. A depression shall be left in the supporting gravel at the joint to prevent contamination of the rubber gasket. Before the pipe is lowered into the trench, the spigot and bell shall be cleaned and free from dirt. Gasket and bell shall be lubricated by a vegetable lubricant which is not soluble in water, furnished by the pipe manufacturer and harmless to the rubber gasket. The pipe shall be properly aligned in the trench to avoid any possibility of contact with the side of the trench and fouling the gasket. As soon as the spigot is centered in the bell of the previously laid pipe, it shall be engaged by approved methods.

E. After the gasket is compressed, but before the pipe is brought home, each gasket shall be checked for proper position around the full circumference of the joint. Steel inserts shall be used to prevent the pipe from going home until the feeler gauge is used to check the final position of the gasket.

F. As soon as the pipe is in place and before the come-along is released, backfill shall be placed as indicated on the Drawings and compacted for at least one-half the length of pipe. Not until this backfill is placed shall the come-along be released. If any motion at joints can be detected, a greater amount of backfill shall be placed before pressure is released. When pipe laying is not in progress, including lunchtime, the open ends of the pipe shall be closed by a watertight plug or other approved means.

G. For each of the pieces to be supplied and used for saddles, plug the remaining two holes not used for the service with non-shrink cement mortar.

H. Regulate the equipment and construction operations such that the loading of the pipe does not exceed the loads for which the pipe is designed and manufactured. Any pipe damaged during construction operations shall promptly and satisfactorily be repaired or replaced at the Contractor's expense.

3.02 TESTING AND CLEANING

A. Testing and cleaning shall be as specified in ASTM C969 and Section 01445.

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SECTION 02616
DUCTILE IRON PIPE AND FITTINGS BELOW GRADE

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, material, equipment and incidentals required, install, and test below-grade ductile iron pipe (direct-buried or installed in casings) and fittings as shown on the drawings and as specified herein.

B. Piping shall be located substantially as shown on the Drawings. The Engineer reserves the right to make such modifications in locations as may be found desirable to avoid interference between pipes, conduits, utilities or for other reasons. Pipe fitting notation is for the Contractor's convenience and does not relieve him/her from installing and jointing different or additional items where required to achieve a complete piping system.

C. Where the word "pipe" is used it shall refer to pipe, fittings, or appurtenances unless otherwise noted.

1.02 RELATED WORK

A. Excavation, Bedding and Backfilling for Pipe is included in Section 02221.

B. Valves and Appurtenances (for above-grade and below-grade service) are included in Section 15100.

C. Ductile Iron Pipe and Fitting Above Grade are included in Section 15072.

1.03 SUBMITTALS

A. Submit to the Engineer, in accordance with Section 01300, shop drawings and product data for all ductile iron pipe, fittings, and accessories.

B. Submit anticipated production and delivery schedule

1.04 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1. ASTM A193 - Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.

2. ASTM A194 - Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service.

3. ASTM C150 - Standard Specification for Portland Cement.

B. American Water Works Association (AWWA)

1. AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.

2. AWWA C110 - Ductile-Iron and Gray-Iron Fittings, 3-In Through 48-In for Water and Other Liquids.

3. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

4. AWWA C150 - Thickness Design of Ductile-Iron Pipe.

5. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids.

6. AWWA C153 - Ductile- Iron Compact Fittings, 3-In Through 16-In for Water and Other Liquids.

7. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.

C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. Each length of ductile iron pipe supplied for the project shall be hydrostatically tested at the point of manufacture to 500 psi for a duration of 10 seconds per AWWA C151. Testing may be performed prior to machining bell and spigot. Failure of ductile iron pipe shall be defined as any rupture of the pipe wall. Certified test results shall be furnished in duplicate to the Engineer prior to time of shipment.

B. All ductile-iron pipe and fittings to be installed under this project shall be inspected and tested at the foundry as required by the standard specifications to which the material is manufactured. Furnish in duplicate to the Engineer sworn certificates of such tests and their results prior to the shipment of the pipe.

C. All pipe and fittings to be installed under this Contract may be inspected at the plant for compliance with this Section by an independent testing laboratory selected by the District at the District's expense.

D. Inspection of the pipe and fittings will also be made by the Engineer or representative of the District after delivery. The pipe shall be subject to rejection at any time on account of failure to meet any of the requirements specified herein, even though sample pipes may have been accepted as satisfactory at the place of manufacture. Pipe rejected after delivery shall be marked for identification and shall be removed from the job.

E. All pipe and fittings shall be permanently marked with the following information:

1. Manufacturer, date.

2. Size, type, class, or wall thickness.

3. Standard produced to (AWWA, ASTM, etc).

1.06 DELIVERY, STORAGE AND HANDLING

A. Care shall be taken in loading, transporting, and unloading to prevent injury to the pipe. Under no circumstances shall the pipe be dropped or skidded against each other. Slings, hooks, or pipe tongs shall be used in pipe handling.

B. Materials, if stored, shall be kept safe from damage. The interior of all piping, fittings and other appurtenances shall be kept free from dirt or foreign matter at all times.

C. Pipe shall not be stacked higher than the limits recommended by its manufacturer. The bottom tier shall be kept off the ground on timbers, rails, or concrete. Stacking shall conform to manufacturer's recommendations.

D. Gaskets for mechanical and push-on joints to be stored shall be placed in a cool location out of direct sunlight. Gaskets shall not come in contact with petroleum products. Gaskets shall be used on a first-in, first-out basis.

PART 2 PRODUCTS

2.01 DUCTILE IRON PIPE, FITTINGS AND ACCESSORIES

A. Pipe

1. Ductile iron pipe shall conform to AWWA C151 and ANSI A21.51. Pipe shall be supplied in standard lengths as much as possible.

2. Thickness design shall be per AWWA C150, except provide minimum Class 350 for piping 12-in and smaller and pipe shall be minimum Class 250 for larger than 12-in. Where welded-on outlets on ductile iron pipe are shown on the Drawings, ductile iron pipe shall be Special Thickness Class 53 minimum. Where threaded taps in ductile iron pipe are shown on the Drawings, ductile iron pipe shall be Special Thickness Class 55 minimum.

3. Ductile iron pipe shall be by U.S. Pipe and Foundry Company, Inc.; American Cast Iron Pipe Company or equal. All pipe shall be made in the United States and supplied by a single manufacturer.

B. Joints

1. Buried ductile iron pipe shall have rubber-gasket push-on joint, rubber-gasket mechanical joint, or flanged joints as shown on the Drawings. All ductile iron pipe and fittings joints shall be restrained.

2. Ductile iron pipe installed in casings shall have restrained push-on joints. Rubber-gasket joints shall conform to AWWA C111.

3. Joint restraint devices for ductile iron mechanical joint pipe and fittings shall be EBAA Iron Sales Series 1100 Megalug®, or equal.

4. Joint restraint for push-on joint ductile pipe shall be independent of the joint gasket. Restrained push-on joint pipe shall be US Pipe and Foundry TR Flex, American Cast Iron Pipe Company, Flex Ring, or equal.

5. Gaskets shall conform to AWWA C111 and ANSI A21.1 and shall be Styrene Butadiene Copolymer (SBR), Buna N, or EPDM.

6. Bolts and nuts on mechanical joint fittings or restraint devices shall be standard Cor-Ten steel or 304 stainless steel conforming to ANSI B16.1.

C. Fittings

1. Except where flanged joins are shown, buried ductile iron pipe fittings shall have restrained mechanical joints. Fittings shall have a pressure rating of 350 psi for 24-in and smaller piping and 250 psi for 30-in and larger piping. Fittings shall meet the requirements of AWWA C110 or AWWA C153 as applicable. Fittings shall have the same pressure rating, as a minimum, of the connecting pipe. Fittings may be made outside the United States, but shall be supplied by one of the named pipe manufacturers or Engineer approved equal.

2. Closures shall be made with mechanical joint ductile iron solid sleeves and shall be located in straight runs of pipe. Location of closures shall be subject to approval of the Engineer.

D. Interior Lining

1. Interior surfaces of all ductile iron pipe shall be cleaned and lined in the shop with cement-mortar lining applied centrifugally in conformity with ANSI/AWWA C104. Ductile iron fittings shall be double cement lined. Ductile iron pipe fittings need not have the cement-mortar lining applied centrifugally. The lining machines shall be of the type that has been used successfully for similar work. At the option of the supplier, fittings may be lined in accordance with AWWA C550. Every precaution shall be taken to prevent damage to the lining. If the lining is damaged or found faulty at the delivery site, the damaged or unsatisfactory portion shall be repaired in the field in accordance the ANSI/AWWA C104.

E. Exterior Coating

1. Buried pipe shall be coated on the exterior with a one mils thick bituminous coat in accordance with ANSI A21-51. All buried ductile iron pipe shall have a polyethylene wrap with a minimum eight mils thickness and shall conform to ASTM specification D-1248. Wrap for raw water transmission main shall be olive green and imprinted “RAW WATER FORCE MAIN”. When imprinted color coated polyethylene wrap is not available, color-coded polyethylene wrap can be used in conjunction with pipe ID tape.

2.02 DUCTILE IRON PIPE DESIGN

A. Ductile iron pipe shall have a minimum tensile strength of 60,000 psi with a minimum yield strength of 42,000 psi. Design shall be done for external and internal pressures separately using the larger of the two for the net design thickness. Additional allowances shall be made for service allowance and casting tolerance per AWWA C150. The pipe classes determined for various sizes and conditions shall provide the total calculated thickness at a minimum or conform to minimum pipe class specified in Paragraph 2.01.A.2 above, whichever is greater.

B. Design for the net thickness for external loading shall be taken as the greater of the following conditions:

1. 2-1/2-ft of cover with AASHTO H-20 wheel loads, with an impact factor of 1.5.

2. Depth from existing ground level of future proposed grade (whichever is greater) to top of pipe as shown on the Drawings, with truck load.

3. Soil Density: 120 lbs/cu ft.

4. Laying Conditions; AWWA C150, Type 2.

C. Design for the net thickness shall be based upon the following design internal pressure conditions:

1. Total internal Pressure design:	500 psi (includes 100 psi surge allowance and 2.0 safety factor)
2. Soil Modulus E.:	300 psi

D. Copies of design calculations showing that the pipe meets all requirements specified herein shall be furnished to the Engineer for approval during shop drawing review in accordance with Section 01300. A yield strength of 42,000 psi shall be used during design calculations

PART 3 EXECUTION

3.01 GENERAL

A. Care shall be taken in loading, transporting and unloading to prevent injury to the pipe or coatings. Pipe and fittings shall not be dropped. All pipe and fittings shall be examined before laying and no piece shall be installed which is found to be defective. Damage to the pipe coatings shall be repaired per Manufacturer's recommendations.

B. If any defective pipe is discovered after it has been laid, it shall be removed and replaced with a sound pipe in a satisfactory manner. All pipe and fittings shall be thoroughly cleaned before laying, shall be kept clean until they are used in the work and when installed or laid, shall conform to the lines and grades required.

3.02 INSTALLING DUCTILE IRON PIPE AND FITTINGS

A. Ductile iron pipe and fittings shall be installed in accordance with requirements of AWWA C600, Section 02221, and as specified herein. A firm, even bearing throughout the length of the pipe shall be provided by digging bell holes at each joint and by tamping backfill materials at the side of the pipe to the springline per details shown on the Drawings. Blocking will not be permitted.

B. All pipe shall be sound and clean before laying. When laying is not in progress, open ends of the pipe shall be closed by a watertight plug or other approved means. Sufficient backfill shall be placed to prevent flotation. The deflection at joints shall not exceed 75 percent of allowable deflection recommended by Manufacturer.

C. All ductile iron pipe laid underground shall have a minimum of three ft of cover unless otherwise shown on the Drawings or as specified herein.

D. Fittings, in addition to those shown on the Drawings shall be provided, where required, in crossing utilities which may be encountered upon opening the trench. Solid sleeve closures shall be installed at locations approved by the Engineer.

E. The pipe interior shall be maintained dry and broom clean throughout the construction period.

F. When cutting pipe is required, the cutting shall be done by machine, leaving a smooth cut at right angles to the axis of the pipe. Cut ends of pipe to be used with a bell shall be beveled to conform to the manufactured spigot end. Cement lining shall be undamaged. Field cut ends shall be sealed with approved epoxy in accordance with Manufacturer's instructions.

G. Jointing Ductile-Iron Pipe

1. All pipe joints shall be made in strict accordance with Manufacturer's instructions and AWWA C600.

2. Mechanical joints shall be assembled with bell ends looking ahead. To assemble the joints in the field, thoroughly clean and lubricate the joint surfaces and rubber gasket. Bolts shall be tightened to the specified torques. Under no condition shall extension wrenches or pipe over handle of ordinary ratchet wrench be used to secure greater leverage.

3. Bolts shall be tightened alternately and evenly.

4. Joint restraints shall be installed according to pipe Manufacturer's instructions.

H. All blow-offs, outlets, valves, fittings, and other appurtenances required shall be set and jointed as indicated on the Drawings in accordance with the Manufacturer's instructions.

I. All polyethylene encasement shall be installed per AWWA C105.

3.03 TESTING

A. After installation, the pipe shall be tested for compliance as specified herein. Furnish all necessary equipment and labor for the pressure test and leakage test on the pipelines.

B. Submit detailed test procedures and method for Engineer's review. In general, testing shall be conducted in accordance with AWWA C600. Test pressure shall be 150 psi.

C. New piping shall be subjected to a hydrostatic pressure of testing as specified in Section 01445. This test pressure shall be maintained for a minimum of two hours. The leakage rate shall not exceed those indicated in AWWA C600. Provide suitable restrained bulkheads or blind flanges as required to complete the hydrostatic testing specified.

D. All valves and valve boxes shall be properly located and installed and operable prior to testing. Bulkheads shall be provided with a sufficient number of outlets for filling and draining the line and for venting air.

E. Hydrostatic pressure and leakage tests shall conform with Section 4 of AWWA C600. Furnish gauges, meters, pressure pumps and other equipment needed to fill the line slowly and perform the required hydrostatic pressure leakage tests.

F. Water required for testing will be provided by the District through pumping facilities and raw water transmission mains constructed by others under separate contracts.

G. The line shall be slowly filled with water and the specified test pressure shall be maintained in the pipe for the entire test period by means of a pump furnished by the Contractor. Provide accurate means for measuring the quantity of water required to maintain this pressure. The amount of water required is a measure of the leakage.

H. Submit plan for testing to the Engineer for review at least 10 days before starting the test.

3.04 CLEANING

A. During the course of the work, keep the pipeline clean from dirt, stones, pieces of wood, or other material. All debris shall be removed from the pipeline. At the conclusion of the work the Contractor shall thoroughly clean all of the new pipelines by pigging to remove all dirt, stones, pieces of wood, or other material which may have entered during the construction period. Debris cleaned from the lines shall be removed from the job site. If, after this cleaning, any obstructions remain, they shall be removed. Provide hoses, temporary pipes, ditches, etc., as required to dispose of flushing water without damage to adjacent properties.

3.05 THREADED TAPS

A. Contractor shall be responsible for installing the threaded taps where shown on the drawing or required for testing and disinfection. The threaded taps shall conform to ANSI/ASME B1.20.1.

END OF SECTION

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SECTION 02622
POLYVINYL CHLORIDE (PVC) PIPE

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required to install and test polyvinyl chloride (PVC) pipe and fittings, complete as shown on the Drawings and as specified herein.

B. Pipe or piping refers to all pipe, fittings, material and appurtenances required to construct PVC pipe complete, in place.

1.02 RELATED WORK

A. Dewatering and drainage is included in section 02140.

B. Excavation, backfilling and compacting is included in Section 02221.

C. Valves and Appurtenances are included in Section 15100.

1.03 SUBMITTALS

A. Submit, in accordance with Division 1 Specifications the name of the pipe and fitting manufacturers and a list of materials to be furnished by each manufacturer. Also, include information on local representative for each manufacturer, if product is sold through a distributor.

B. Shop Drawings including piping layouts and schedules shall include dimensioning, fittings, types and locations of valves and appurtenances, joint details, methods and location of supports, anchorage, gasket material, grade of material and all other pertinent technical information for all items to be furnished.

C. Prior to each shipment of pipe, certified test reports that the pipe for this Contract was manufactured and tested in accordance with the ASTM Standards specified herein shall be submitted.

D. Submit anticipated production and delivery schedule.

1.04 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

2. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

3. ASTM F1760 – Standard Specification for Co-extruded Poly (Vinyl Chloride) (PVC) Non-Pressure Plastic Pipe Having Reprocessed-Recycled Content.

4. ASTM D2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).

B. National Sanitation Foundation (NSF)

1. Standard No. 14 - Plastic Piping Components and Related Materials.

C. American Water Works Association (AWWA)

1. AWWA C110 - Ductile-Iron and Gray-Iron Fittings, 3-in Through 48-in (75mm Through 1219mm) for Water.

2. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

3. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.

4. AWWA C-605 -– Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water.

5. AWWA C651 - Disinfecting Water Mains.

6. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4-in through 60-in (100 mm Through 1,500 mm).

7. AWWA M-23 -– Manual of Water Supply Practices PVC Pipe, Design and Installation.

D. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. All PVC pipe and fittings of a similar type (e.g. solid wall or profile wall) shall be from a single manufacturer. The supplier shall be responsible for the provisions of all test requirements specified in ASTM D3034 as applicable.

B. Inspections of the pipe may also be made by the Engineer or other representatives of the District after delivery. The pipe shall be subject to rejection at any time on account of failure to meet any of the requirements specified herein, even though sample pipes may have been accepted as satisfactory at the place of manufacture. Pipe rejected after delivery shall be marked for identification and shall be removed from the job at once.

1.06 SYSTEM DESCRIPTION

A. Contractor is responsible for compatibility between pipe materials, fittings and appurtenances.

1.07 DELIVERY, STORAGE AND HANDLING

A. All items shall be bundled or packaged in such a manner as to provide adequate protection of the ends during transportation to the site. Any pipe damaged in shipment shall be replaced as directed by the Engineer.

B. PVC items deteriorate in sunlight and are slightly brittle, especially at lower temperatures, so care shall be taken in loading, transporting and unloading items to prevent injury to the items. All items shall be examined before installation and no piece shall be installed which is found to be defective. Handling and installation of pipe and fittings shall be in accordance with the manufacturer's instructions, referenced standards and as specified herein.

C. Any pipe or fitting showing a crack or which has received a blow that may have caused an incident fracture, even though no such fracture can be seen, shall be marked as rejected and removed at once from the work.

D. While stored, pipe shall be adequately supported from below at not more than three foot intervals to prevent deformation. Pipe shall not be stacked higher than six feet. Pipe and fittings shall be stored in a manner which will keep them at ambient outdoor temperatures. Temporary shading as required to meet this requirement shall be provided. Simple covering of the pipe and fittings which allows temperature buildup when exposed to direct sunlight will not be permitted. Pipe covering shall be in conformance with the Manufacturer's recommendations.

E. Pipe and fittings shall be stored in a manner which will keep them at ambient outdoor temperatures and out of the sunlight or delivered to the site so that no pipe is exposed to sunlight for more than 60 days. Temporary shading as required to meet this requirement shall be provided. Simple covering of the pipe and fittings which allows temperature buildup or direct or indirect sunlight will not be permitted.

F. If any defective item is discovered after it has been installed, it shall be removed and replaced with an exact replacement item in a satisfactory manner by the Contractor, at the Contractor's own expense. All pipe and fittings shall be thoroughly cleaned before installation and the interior shall be kept clean until testing.

G. In handling the items, use special devices and methods as required to achieve the results specified herein. No uncushioned devices shall be used in handling the item.

1.08 PROJECT/SITE REQUIREMENTS

A. PVC pipe shall be stored in the right of way as to not disturb the flow of traffic or to block driveway or sidewalk access.

PART 2 PRODUCTS

2.01 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

A. Polyvinyl Chloride (PVC) Pipe:

1. Except where otherwise shown on the Drawings, PVC pipe and accessories four to 30 inches in diameter, where shown on the Drawings or as specified, shall meet the requirements of AWWA Specification C-900 "Polyvinyl Chloride (PVC) Pressure Pipe". Four to 24-inch diameter pipe shall be Class 150, meeting requirements of Dimension Ratio (DR) 18 and 30-inch pipe shall meet the requirements of DR 25. Pipe shall have ductile iron pipe outside diameters. Each length of pipe shall be hydrotested to four times its class pressure by the Manufacturer in accordance with AWWA C 900. Pipe shall be listed by Underwriters Laboratories. Provisions shall be made for expansion and contraction at each joint with an elastomeric ring and shall have an integral thickened bell

as part of each joint. PVC Class pipe shall be installed in accordance with the Uni-Bell Plastic Pipe Association Guide Specification UNI-B-3-76, and as recommended by the Manufacturer. Pipe shall be furnished in nominal lengths of approximately 20 feet, unless otherwise approved by the Engineer. Pipe and accessories shall bear the NSF mark indicating pipe size, Manufacturer's name, AWWA and/or ASTM Specification number, working pressure, and production code. Pipe shall be made from Class 12454-A or Class 12454-B virgin compound, as designed in ASTM D 1784.

2. PVC pipe three inches in diameter or less, shall have threaded or solvent welded joints unless otherwise approved by the Engineer.

B. Joints:

1. Except where otherwise indicated on the Drawings, the PVC line joints for below ground piping four to 30 inches in diameter shall be of the push-on type approved by the Engineer so that the pipe and fittings may be connected on the job without the use of solvent cement or any special equipment. The push-on joint shall be a single rubber gasket joint designed to be assembled by the positioning of a continuous, molded rubber ring gasket in annular recess in the pipe and the forcing of the plain end of the entering pipe into the socket, thereby compressing the gasket radially to the pipe to form a positive seal. The gasket and annular recess shall be designed and shaped so that the gasket is locked in place against displacement as the joint is assembled. The rubber ring joint shall be designed for thermal expansion or contraction with a total temperature change of at least 75^{o}F in each joint per length of pipe. The bell shall consist of an integral wall section with a solid cross section elastomeric ring which shall meet requirements of ASTM D 1869. The thickened bell section shall be designed to be at least as strong as the pipe wall. Lubricant furnished for lubricating joints shall be nontoxic, shall not support the growth of bacteria, shall have no deteriorating effects on the gasket or pipe material, and shall not impart color, taste, or odor to the water and shall be approved by the Manufacturer.

C. Fittings:

1. Except where otherwise shown on the Drawings, all fittings for below ground PVC distribution and drain piping of four to 30 inches in diameter shall be ductile iron with restrained mechanical joints and shall conform to AWWA/ANSI specifications C110/A21.10 or AWWA C153 for ductile iron fittings and Section 02616, unless otherwise shown on the drawings or approved by the Engineer. Bolts and nuts on mechanical joint fittings or restraint devices shall be standard Cor-Ten steel or 304 stainless steel conforming to ANSI B16.1. Bolts and nuts on flange joint pipe and fittings shall be 304 stainless steel conforming to ANSI B16.1. Fittings may be made outside the United States and must be compatible with the named manufacturers pipe or Engineer approved equal.

2. Fittings for PVC pipe three inches in diameter or less, shall be threaded or solvent weld and be PVC as shown on the Drawings, or as approved by the Engineer. Threaded PVC fittings shall conform to ASTM Specification D 2464.

3. The Manufacturer of the pipe shall supply all polyvinyl chloride accessories as well as any adaptors and/or specials required to perform the work as shown on the drawings and specified herein. Standard double bell couplings will not be accepted where the pipe will slip completely through the coupling.

D. Restrained Joints:

1. Restraint shall be required at all PVC pipe to ductile iron mechanical joint fittings and PVC pipe to buried mechanical joint valves (distribution piping and drain piping). Restraint mechanism shall be EBAA Iron, Inc. Series 2000PV Megalug, or equal.

2. Restraint of PVC push-on joint piping shall be required as follows:
   a. For 30-inch PVC distribution piping between the ground storage tank and the upstream side of the "Distribution Control Valve Assemblies" (one per cell as shown on the Drawings), provide restraint of all push-on joints located within 30 feet each side of a mechanical joint fitting. Restraint mechanism for four to 12-inch push-on joint pipe shall be EBAA Iron Inc. Series 1600 Restraint Harness, or equal. Restraint mechanism for 14-inch to 30-inch push-on joint pipe shall be Series 2800 Restraint Harness, or equal.
   b. For PVC distribution piping located downstream of "Distribution Control Valve Assemblies" and all PVC drain piping, restraint of PVC push-on joints shall not be required.

E. All buried ductile iron fittings and restrained joints shall have a polyethylene wrap with a minimum 8 mils thickness and shall conform to ASTM specifications D-1248. Wrap for raw water main shall be olive green and imprinted "RAW WATER MAIN".

2.02 IDENTIFICATION

A. Each length of pipe and each fitting shall be marked with the name of the Manufacturer, size, and class. All gaskets shall be marked with the name of the Manufacturer, size, and proper insertion directions. A color sample of the PVC pipe and fittings shall be submitted to the Engineer for approval prior to fabrication of any pipe and accessories.

B. All buried PVC pipe shall be color-coded green.

C. Marking Tape shall be as specified and installed per Section 02221.

PART 3 EXECUTION

3.01 INSTALLING POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

A. All PVC pipe shall be installed in accordance with recommendations of the pipe Manufacturer and as specified herein.

B. Care shall be taken in the handling, storage, and installation of pipe and fittings to prevent injury to the pipe or coatings. All pipe and fittings shall be examined before installing, and no pipe shall be installed which is found to be defective. Pipe or fittings shall not be dropped. All damage to the pipe coatings shall be repaired according to the Manufacturer's recommendations.

C. All pipe and fittings shall be kept clean and shall be thoroughly cleaned before installation.

D. Pipe shall be laid to the lines and grades shown on the Drawings with bedding and backfill as shown on the Drawings and as specified in Section 02221. Blocking under the pipe will not be permitted.

E. All pipe and fittings shall be thoroughly cleaned before laying, shall be kept clean until they are used in the work, and when laid, shall conform to the lines and grades required. Polyvinyl chloride pipe and fittings shall be installed in accordance with requirements of AWWA Standard Specification C600. If any defective pipe is discovered after it has been laid, it shall be removed and replaced with a sound pipe in a satisfactory manner by Contractor, at his own expense.

F. When installation is not in progress, including lunchtime, or the potential exists for dirt of debris to enter the pipe, the open ends of the pipe shall be closed with watertight plugs or other approved means.

G. Under no circumstances shall the pipe or accessories be dropped into the trench.

H. All plugs, caps, bends and other locations where unbalanced forces exist shall be anchored by restrained joints.

I. In all cases where PVC pipe is installed, a detectable marking tape shall be located between 12 and 18 inches above the top of the pipe as specified in Section 02221.

J. When cutting pipe is required, the cutting shall be done by machine, leaving a smooth cut at right angles to the axis of the pipe. Cut ends of pipe to be jointed with a bell shall be beveled to conform to the manufactured spigot end.

K. Maintain a minimum finish grade cover of 36-inches, unless otherwise approved by the Engineer or shown on the Drawings.

L. L. All polyethylene encasement shall be installed per AWWA C105.

3.02 JOINTING PVC PIPE

A. Push on joints shall be made in strict accordance with the manufacturer's instructions. Pipe shall be laid with bell ends looking ahead. A rubber gasket shall be inserted in the groove of the bell end of the pipe and the joint surfaces cleaned and lubricated. The plain end of the pipe to be entered shall then be inserted in alignment with the bell of the pipe to which it is to be joined and pushed home with a come-along or by other means. Check that the reference mark on the spigot end is flush with the end of the bell.

B. Mechanical joints shall be made in accordance with Appendix A of ANSI/AWWA C111 and the Manufacturer's instructions. Thoroughly clean and lubricate the joint surfaces and rubber gasket with soapy water before assembly. Bolts shall be tightened to the specified torques using a calibrated torque wrench. Under no conditions shall extension wrenches or pipe over handle of ordinary ratchet wrench be used to secure greater leverage.

3.03 RESTRAINED JOINTS

A. The restrained joint assemblies shall be made in accordance with the Manufacturer's recommendations. After installation, apply a heavy bitumastic coating to all bolts, nuts and accessories.

3.04 TESTING FOR PRESSURE MAINS

A. All PVC distribution and drain piping (with exception of distribution and drain laterals located within cells) shall be field tested. Hydrostatic pressure and leakage tests shall conform with Section 4 of AWWA C600 Specification with the exception that the Contractor shall furnish all gauges, meters, pressure pumps and other equipment needed to test the line.

B. The pressure required for the field hydrostatic pressure test shall be 20 psi. The Contractor shall provide temporary plugs and blocking necessary to maintain the required test pressure. Fill line slowly with water. Maintain flow velocity of less than 2.0 feet per second. Corporation cocks at least 2-inches in diameter, pipe riser and angle globe valves shall be provided at each pipe dead-end in order to bleed air from the line. Duration of pressure test shall be at least two hours. The cost of these items shall be included as a part of testing.

C. The amount of leakage which will be permitted shall be in accordance with AWWA C600 Standards for all pressure. No pipe installation shall be accepted if the leakage is greater than that determined by the following formula:

$$L = \frac{SD(P)^{1/2}}{133{,}200}$$

In which L is the allowable leakage in gallons per hour; S is the length of pipe tested, in feet; D is the nominal diameter of the pipe, in inches; and P is the average test pressure during the leakage test, in pounds per square inch gauge.

D. The Contractor must submit his plan for testing to the Engineer for review at least 10 days before starting the test. The Contractor shall remove and adequately dispose of all blocking material and equipment after completion and acceptance of the field hydrostatic test, unless otherwise approved by the Engineer. Any damage to the pipe coating shall be repaired by the Contractor. Lines shall be totally free and clean prior to final acceptance.

E. Water required for testing will be provided by the District through pumping facilities and raw water transmission mains constructed by others under separate contracts.

3.05 CLEANING

A. At the conclusion of the work the Contractor shall thoroughly clean all of the new pipelines by pigging to remove all dirt, stones, pieces of wood, or other material which may have entered during the construction period. Debris cleaned from the lines shall be removed from the job site. If, after this cleaning, any obstructions remain, they shall be removed. Provide hoses, temporary pipes, ditches, etc., as required to dispose of flushing water without damage to adjacent properties.

B. After the pipelines are cleaned and if the groundwater level is above the pipe, or following a heavy rain, the Engineer will examine the pipe for leaks. If defective pipes or joints are discovered at this time, they shall be repaired or replaced by the Contractor.

END OF SECTION

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SECTION 02662 – TEXTURED HDPE GEOMEMBRANE LINERS

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. Textured High-Density Polyethylene (HDPE) Geomembrane Liner.

2. Liner shall be installed on inside face of all cell berms to overlap Scrim Reinforced Tarp cell liner as shown on the Drawings.

B. Related Requirements:

1. Section 02100 - Site Preparation.
2. Section 02200 - Earthwork.
3. Section 02264 - Scrim Reinforced Tarp.

1.3 DEFINITIONS:

A. GRI: Geosynthetics Research Institute.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at project site. Attendees include the Owner, Engineer, Contractor, and Installer.

1.5 ACTION SUBMITTALS

A. Submit items in this Article at least 30 days prior to installation.

B. Product Data:

1. Liner:

a. Stress Crack Resistance (ASTM D5397, App A).
b. High Pressure OIT (ASTM D5885).
c. Oven Aging @ 85 degrees C (ASTM D5721) with High Pressure OIT (ASTM D5885) percent retained after 90 days.

d. UV Resistance (ASTM D7238) with High Pressure OIT (ASTM D5885) percent retained after 1,600 hours.

2. Resin:

a. Brand Name
b. Brand Number
c. Supplier Name.
d. Supplier Source.
e. Certification showing no recycled polymer used.
f. Certification showing no more than 10 percent rework of the material to obtain liner.

C. Shop Drawings:

1. Plans, elevations, sections, and attachment details.
2. Details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Work plan showing the construction sequence including existing liner cut/folding back, excavation, backfill, and existing liner reinstallation.
4. Proposed panel layout showing the cut and reinstallation layout identifying field seams as well as any variance or additional details which deviate from the Drawings or specifications.
5. Details of seaming the geomembrane, anchoring, connections, penetrations, and other construction details.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Package and ship to prevent damage of the geomembrane rolls.

B. Store rolls in accordance with manufacturer's requirements and to prevent puncture, dirt, grease, water, moisture, mud, mechanical abrasions, and excessive heat that may damage the geomembrane material.

1.7 FIELD CONDITIONS

A. Weather:

1. Ambient temperature below 32 degrees F or above 104 degrees F unless otherwise authorized by the Engineer.
2. Dry, free of standing or ponding water in the subgrade.
3. No excessive winds which could interfere with geomembrane placement.

1.8 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace Textured HDPE Geomembrane Liner that fail(s) in materials or workmanship within specified warranty period.

1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. High Density Polyethylene (HDPE) Geomembrane – Textured shall have the following material properties and testing shall be performed in accordance with GRI-GM, Table 2(a):

1. Specified Thickness: 60 Mils.

a. Minimum Average: 57 Mils per roll.
b. Lowest Individual: 51 Mils.
c. Asperity Height: 18 Mils per roll (minimum average).

2. Density: 0.940 g/ml (minimum).
3. Tensile Properties (Type IV):

a. Yield Stress: 126 lb/in (minimum average).
b. Break Stress: 90 lb/in (minimum average).
c. Yield Elongation: 12 percent (minimum average).
d. Break Elongation: 100 percent (minimum average).

4. Shear strength of seams:

a. Fusion: 120 lb/in (minimum).
b. Extrusion: 120 lb/in (minimum).

5. Peel strength of seams:

a. Fusion: 91 lb/in (minimum).
b. Extrusion: 78 lb/in (minimum).

6. Tear Resistance: 42 lb (minimum average).
7. Puncture Resistance: 90 lb (minimum average).
8. Stress Crack Resistance: 300 hours (minimum).
9. Carbon Black Content: 2-3 percent.
10. Carbon Black Dispersion Level: 9 in 1 or 2, <1 in 3.
11. Oxidative Induction Time (OIT):

a. Standard OIT: 100 minutes (minimum average).
b. High Pressure OIT: 400 minutes (minimum average).

12. Oven Aging @85C:

    a. Standard OIT: 55 percent retained after 90 days (minimum average).
    b. High Pressure OIT: 80 percent retained after 90 days (minimum average).

13. UV Resistance per ASTM D7238:

    a. High Pressure OIT: 50 percent retained after 1600 hours (minimum average).

B. Resin:

1. Minimum Density: 0.932 g/ml.
2. Melt Index Value: less than 1.0 g/10 minutes (ASTM D1238).
3. Minimum Formulated sheet Density: 0.940 g/ml.
4. Two to three percent carbon black, anti-oxidants, and heat stabilizer, but no fillers or extenders.
5. Virgin material, with no more than two percent rework.

    a. If rework is used, use the same formulation as the parent material.
    b. Post-consumer resin not permitted.

C. General Requirements:

1. The sheets shall be manufactured in a minimum 20-foot seamless width.
2. Labels on the roll shall identify the thickness, length, width, and manufacturer's roll and lot number.
3. The geomembrane material shall be so produced as to be free of holes, blisters, undispersed raw materials, or any sign of contamination by foreign matter.
4. Manufacturer shall provide certification that continuous spark testing was performed, and that liner has no defects.
5. The geomembrane material color shall be as specified or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION AND PREPARATION

A. Subgrade:

1. Surface:

    a. Smooth, uniform.
    b. Free from sudden changes in grade caused by ruts, stones, debris or other deleterious material.
    c. Free of standing water during installation and seaming of liner.
    d. During actual placing and seaming of the geomembrane, keep the subgrade free of all standing water.

        1) If the subgrade below the geomembrane becomes wet and unstable, dewater.

B. Prevent stormwater runoff on the prepared subgrade and protect the subgrade from erosion.

1. Construct diversion berms and other structures as required to direct stormwater runoff away from the work area.

3.2 INSTALLATION

A. Geomembrane:

1. Roll out and place the geomembrane in accordance with the approved Shop Drawings.
2. Install with surfaces oriented in the up position indicated by manufacturer's instructions.
3. Place geomembrane panel number on the ends of each panel.
4. Place panels such that there is a 2-feet overlap between panels.
5. Weight geomembrane at corners to prevent uplift prior to anchoring.
6. Engineer to inspect each panel, after placement for damage and/or defects.

    a. Replace defective or damaged panels as required. Costs of repair or replacement at the Contractor's expense.

7. Anchor as shown on the Drawings and consistent with Manufacturer's requirements.
8. Modify placement and overlap, in accordance with Manufacturer requirements, to address installation of geomembrane on steep slopes.

B. Construction Equipment:

1. Vehicular traffic across the geomembrane shall not be allowed, except as specified herein. Rubber-tired ATV's and trucks are acceptable if wheel contract is less than 6 psi. Any vehicle used prior to or after liner placement shall be first approved by the Engineer. All vehicles are restricted from traveling on the liner material unless a temporary access is constructed. Vehicles, machinery, and equipment shall be operated to avoid abrupt stops, starts, or turns.
2. Construction equipment or vehicles with steel tracks shall not be permitted on the geomembrane.
3. Other equipment such as portable generators and power centers shall be permitted if the support apparatus is protected from damaging the liner, and if care is taken to prevent leaking lubricants from damaging the geomembrane.

3.3 REPAIR

A. Any portion of the geomembrane exhibiting signs of defect shall be repaired.

B. Repair procedures:

1. Patching: for large holes, tears, undispersed raw materials, and contamination by foreign matter.
2. Spot welding or seaming for small tears, pinholes, or other minor, localized defects.
3. Capping for large lengths of failed seam.

C. For any repair method, the following provisions shall be satisfied:

1. Surfaces of the geomembrane which are to be repaired using extrusion methods shall be abraded no more than one hour prior to the repair.
2. All surfaces shall be clean and dry at the time of the repair.
3. All seaming equipment used in repairing procedures shall be qualified.
4. All patches and caps shall extend at least 4 inches beyond the edge of the defect.
5. All patches shall have rounder corners.

3.4 FIELD QUALITY CONTROL

A. Quality Control Plan:

1. Engineer will provide forms to be used for field installation documentation. Alternative forms may be used for documentation as approved by Engineer.

3.5 DISPOSAL OF WASTE MATERIAL

A. Upon completion of installation, dispose of all trash, waste material and equipment used.

END OF SECTION 02662

SECTION 02830
FENCING AND GATES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals necessary and install the chain link fencing, timber post fencing, and cantilevered slide gates complete as shown on the Drawings and as specified herein.

1.02 RELATED WORK

A. Earth excavation and backfill is included in Section 02200.

1.03 SUBMITTALS

A. Submit, in accordance with Section 01300, shop drawings showing layout and details of construction and erection of fence and accessories required.

1.04 REFERENCE STANDARDS

A. FDOT

1. FY 2023-24 Standard Plans for Road Construction.

2. Standard Specifications for Road and Bridge Construction (latest edition).

PART 2 PRODUCTS

2.01 CHAIN LINK FENCE MATERIALS

A. General: Chain link fence shall be nominal six-foot height. Details and materials of construction shall be per FDOT Indexes 550-002 (Fence Type B) and as specified herein. Fence shall include barb wire attachment per FDOT Index 550-002.

B. Line posts shall be 2.0-inch nominal diameter aluminum alloy pipe in accordance with FDOT Index 550-002 – Line post option (3).

C. Corner, end, and pull posts shall be 2.5-inch nominal diameter aluminum alloy pipe in accordance with FDOT Index 550-002 – Corner, end, and pull posts option (3).

D. Rails shall be 1.25-inch nominal diameter aluminum alloy pipe in accordance with FDOT Index 550-002 – Rail option (3).

E. Chain link fabric shall be aluminum-coated steel, No. 9 gage in accordance with FDOT Index 550-002 – Chain link fabric option (2).

F. Tension wire shall be aluminum alloy wire in accordance with FDOT Index 550-002 – Tension wire option (2).

G. Tie wire shall be aluminum alloy wire in accordance with FDOT Index 550-002 – Tie wire and hog ring option (2).

H. Barb wire shall be aluminum in accordance with FDOT Index 550-001.

2.02 TIMBER POST FENCE MATERIALS

A. General: Timber post fence shall be nominal four-foot height. Details and materials of construction shall be per FDOT Index 550-001 (Fence Type A) and as specified herein. Fence shall include barb wire per FDOT Index 550-001.

B. Timber posts shall be in accordance with FDOT Index 550-001.

C. Fence fabric shall be woven wire, galvanized steel, meeting the requirements of ASTM A116, No. 9, Grade 60, Design Number 1047-6-9, with Class 3 zinc coating and in accordance with FDOT Index 550-001.

D. Barb wire shall be aluminum in accordance with FDOT Index 550-001.

2.03 CANTILEVERED SLIDE GATE MATERIALS

A. Cantilevered slide gate frame, support posts, latch posts, and truss rods shall conform to FDOT Index 550-003.

B. Fence fabric, barb wire, stretcher bars, tension bars, tension wire, and tie wire shall meet the requirements of Paragraph 2.01.

C. Cantilevered slide gate shall have a 20-foot opening width, a 10-foot back frame, a height of six feet, and barb wire extension.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, and other conditions affecting performance of the Work.

1. Do not begin installation before final grading is completed unless otherwise permitted by Engineer.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

3.03 CHAIN-LINK FENCE INSTALLATION

A. Install fencing at location shown on the Drawings.

B. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed soil.

C. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.

1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.

2. Concrete Fill: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.

D. New posts for all fences shall be anchored directly into new concrete footings as shown on the Drawings.

E. Post Bracing and Intermediate Rails: Install according to ASTM F 567, maintaining plumb position and alignment of fence posts. Diagonally brace terminal posts to adjacent line posts with truss rods and turnbuckles. Install braces at end and gate posts and at both sides of corner and pull posts.

1. Locate horizontal braces at midheight of fabric 72 inches or higher, on fences with top rail, and at two-third fabric height on fences without top rail. Install so posts are plumb when diagonal rod is under proper tension.

F. Tension Wire: Install according to ASTM F 567, maintaining plumb position and alignment of fence posts. Pull wire taut, without sags. Fasten fabric to tension wire with 0.120-inch- diameter hog rings of same material and finish as fabric wire, spaced a maximum of 24 inches o.c. Install tension wire in locations indicated before stretching fabric. Provide horizontal tension wire at along top and bottom of fence fabric. Install top tension wire through post cap loops. Install bottom tension wire within six inches of bottom of fabric and tie to each post with not less than same diameter and type of wire.

G. Chain-Link Fabric: Apply fabric to outside of enclosing framework. Leave one-inch bottom clearance between finish grade or surface and bottom selvage unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.

H. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts, with tension bands spaced not more than 15 inches o.c.

I. Tie Wires: Use wire of proper length to firmly secure fabric to line posts and rails. Attach wire at one end to chain-link fabric, wrap wire around post a minimum of 180 degrees, and attach other end to chain-link fabric according to ASTM F 626. Bend ends of wire to minimize hazard to individuals and clothing.

J. Fasteners: Install nuts for tension bands and carriage bolts on the side of fence opposite the fabric side.

3.04 TIMBER POST FENCE INSTALLATION

A. Install timber post fence according to FDOT Standard Specifications for Road and Bridge Construction Section 550-4.

3.05 GATE INSTALLATION

A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation.

3.06 GROUNDING AND BONDING

A. Fence and Gate Grounding:

1. Ground for fence and fence posts shall be a separate system from ground for gate and gate posts.

2. Install ground rods and connections at maximum intervals of 1500 feet.

3. Fences within 100 Feet (30 m) of Buildings, Structures, Walkways, and Roadways: Ground at maximum intervals of 750 feet.

4. Ground fence on each side of gates and other fence openings.

   a. Bond metal gates to gate posts.
   b. Bond across openings, with and without gates, except openings indicated as intentional fence discontinuities. Use No. 2 AWG wire and bury it at least 18 inches below finished grade.

B. Protection at Crossings of Overhead Electrical Power Lines: Ground fence at location of crossing and at a ground rod located a maximum distance of 150 feet on each side of crossing.

C. Fences Enclosing Electrical Power Distribution Equipment: Ground according to IEEE C2 unless otherwise indicated.

D. Grounding Method: At each grounding location, drive a grounding rod vertically until the top is six inches below finished grade. Connect rod to fence with No. 6 AWG conductor. Connect conductor to each fence component at grounding location.

1. Retain one or both subparagraphs below if applicable.

2. Make grounding connections to each barbed tape coil with connectors designed for this purpose.

E. Connections:

1. Make connections with clean, bare metal at points of contact.

2. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.

3. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.

4. Make above-grade ground connections with mechanical fasteners.

5. Make below-grade ground connections with exothermic welds.

6. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

F. Bonding to Lightning Protection System: Ground fence and bond fence grounding conductor to lightning protection down conductor or lightning protection grounding conductor according to NFPA 780.

G. Comply with requirements in Section 16660 "Grounding System".

3.07 ADJUSTING

A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

END OF SECTION

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SECTION 02900
TURF AND GRASSES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. FDOT Standard Specifications for Road and Bridge Construction include additional requirements for seeding and sodding.

1.02 SUMMARY

A. Section Includes:

1. Seeding.

2. Sodding.

1.03 DEFINITIONS

A. Finish Grade: Elevation of finished surface of planting soil.

B. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

C. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), unwanted plants (weeds), fungi, bacteria, and viruses.

D. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See drawing designations for planting soils.

E. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.04 SUBMITTALS

A. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture, stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.

1. Identification of source and name and telephone number of sod supplier.

B. Product Certificates: For fertilizers, from manufacturer.

C. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

1.05 QUALIFICATIONS

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful turf establishment.

1. Professional Membership: Installer shall be a member in good standing of either the National Association of Landscape Professionals or AmericanHort.

2. Experience: Three years' experience in turf installation.

3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.

4. Personnel Certifications: Installer's field supervisor shall have certification in one of the following categories from the National Association of Landscape Professionals:

a. Landscape Industry Certified Technician - Exterior.
b. Landscape Industry Certified Lawn Care Manager.
c. Landscape Industry Certified Lawn Care Technician.

5. Pesticide Applicator: State licensed, commercial.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws, as applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.

2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.

3. Accompany each delivery of bulk materials with appropriate certificates.

1.07 FIELD CONDITIONS

A. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

PART 2 PRODUCTS

2.01 SEED

A. Grass Seed: Fresh, clean, dry, new-crop seed complying with Association of Official Seed Analysts (AOSA's) "Rules for Testing Seeds" for purity and germination tolerances.

B. Seed Species:

1. State-certified Bahia grass seed.

2. Quality: Not less than 85 percent germination, not less than 95 percent pure seed, and not more than 0.5 percent weed seed.

2.02 SOD

A. Sod shall be Bahia and shall comply with requirements of FDOT Standard Technical Specifications for Road and Bridge Construction (latest edition).

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas to be planted for compliance with requirements and other conditions affecting installation and performance of the Work.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.

2. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.

3. Uniformly moisten excessively dry soil that is not workable, or which is dusty.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Engineer and replace with new planting soil.

3.02 PREPARATION

A. Protect structures; utilities; sidewalks; pavements; and other facilities, trees, shrubs, and plantings from damage caused by planting operations.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.03 TURF AREA PREPARATION

A. General: Prepare planting area for soil placement and mix planting soil

B. Placing Planting Soil: Place and mix planting soil in place over exposed subgrade.

1. Reduce elevation of planting soil to allow for soil thickness of sod.

C. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

D. Before planting, obtain Engineer's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.04 PREPARATION FOR EROSION-CONTROL MATERIALS

A. Prepare area as specified in "Turf Area Preparation" Article.

B. For erosion-control blanket or mesh, install from top of slope, working downward, and as recommended by material manufacturer for site conditions. Fasten as recommended by material manufacturer.

C. Moisten prepared area before planting if surface is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

3.05 SEEDING

A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph.

1. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.

2. Do not use wet seed or seed that is moldy or otherwise damaged.

3. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.

B. Sow seed at a total rate of two lb./1000 sq. ft.

C. Rake seed lightly into top 1/8 inch of soil, roll lightly, and water with fine spray.

D. Protect seeded areas with erosion-control mats where indicated on Drawings; install and anchor according to manufacturer's written instructions.

E. Protect seeded areas with slopes not exceeding 1:4 by spreading straw mulch. Spread uniformly at a minimum rate of two tons/acre to form a continuous blanket 1-1/2 inches in loose thickness over seeded areas. Spread by hand, blower, or other suitable equipment.

1. Anchor straw mulch by crimping into soil with suitable mechanical equipment.

2. Bond straw mulch by spraying with asphalt emulsion at a rate of 10 to 13 gal./1000 sq. ft.. Take precautions to prevent damage or staining of structures or other plantings adjacent to mulched areas. Immediately clean damaged or stained areas.

3.06 TURF MAINTENANCE

A. General: Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.

1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.

2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.

3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.

B. Watering: Convey water from offsite sources and to keep turf uniformly moist to a depth of four inches.

1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.

2. Water turf with fine spray at a minimum rate of one inch per week unless rainfall precipitation is adequate.

C. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than one-third of grass height. Remove no more than one-third of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:

1. Mow bahia grass turf-type to a height of two to three inches.

D. Turf Postfertilization: Apply commercial fertilizer after initial mowing and when grass is dry.

1. Use fertilizer that provides actual nitrogen of at least one lb/1000 sq. ft. to turf area.

3.07 SATISFACTORY TURF

A. Turf installations shall meet the following criteria as determined by Engineer:

1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding five by five inches.

2. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.

B. Use specified materials to reestablish turf that does not comply with requirements, and continue maintenance until turf is satisfactory.

3.08 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Engineer's property.

C. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.

D. Remove nondegradable erosion-control measures after grass establishment period.

3.09 MAINTENANCE SERVICE

A. Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in "Turf Maintenance" Article. Begin maintenance immediately after each area is planted and continue until acceptable turf is established, but for not less than the following periods:

1. Seeded Turf and Sodded Turf: 60 days from date of planting completion.

a. When initial maintenance period has not elapsed before end of planting season, or if turf is not fully established, continue maintenance during next planting season.

END OF SECTION

SECTION 03200
CONCRETE REINFORCEMENT

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and install all concrete reinforcement complete as shown on the Drawings and as specified herein.

1.02 RELATED WORK

A. Cast-in-place concrete is included in Section 03300.

B. Grout is included in Section 03600.

1.03 SUBMITTALS

A. Submit, in accordance with Section 01300, shop drawings and product data showing materials of construction and details of installation for:

1. Reinforcing steel. Drawings for fabrication, bending, and placement of concrete reinforcement shall conform to the recommendations of ACI 315 for placement drawings and as specified herein.

    a. Placement drawings. For slabs, show top and bottom reinforcement on separate plan views, as needed for clarity. For beams and columns, show schedules with sections and/or elevations and stirrup/tie spacing. Show additional reinforcement around openings, at corners and at other locations indicated, diagrams of bent bars, arrangements and assemblies, all as required for the fabrication and placement of concrete reinforcement. Reference bars to the same identification marks shown on the bar bending details. Identify bars to have special coatings and/or to be of special steel or special yield strength.
    b. Bar bending details. Reference bars to the same identification marks shown on the placement drawings. Identify bars to have special coatings and/or to be of special steel or special yield strength.

B. Submit, in accordance with Section 01300, Test Reports of each of the following items.

1. Certified copy of mill test on each heat of each steel proposed for use showing the physical properties of the steel and the chemical analysis.

2. Welder's certification in accordance with AWS D1.4 when welding of reinforcement is indicated, specified, or approved.

1.04 REFERENCE STANDARDS

A. ASTM International

1. ASTM A1064 - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.

2. ASTM A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.

3. ASTM A704 - Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement.

B. American Concrete Institute (ACI)

1. ACI 301 - Specifications for Structural Concrete.

2. ACI 315 - Details and Detailing of Concrete Reinforcement.

3. ACI 318 - Building Code Requirements for Structural Concrete.

4. SP-66 (ACI 315) ACI Detailing Manual.

C. Concrete Reinforcing Steel Institute (CRSI)

1. Manual of Standard Practice

D. American Welding Society (AWS)

1. AWS D1.4 Structural Welding Code - Reinforcing Steel

E. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 DELIVERY, HANDLING AND STORAGE

A. Provide reinforcement free from mill scale, rust, mud, dirt, grease, oil, ice, or other foreign matter.

B. Ship and store reinforcement with bars of the same size and shape fastened in bundles with durable tags, marked in a legible manner with waterproof markings showing the same "mark" designations as those shown on the submitted placement drawings. Tags for ASTM A706 reinforcing and for ASTM A615 reinforcing meeting the requirements of Paragraph 2.01C.1 shall indicate that the reinforcing is weldable.

C. Store reinforcement off the ground, protect from moisture and keep free from rust, mud, dirt, grease, oil, ice, or other injurious contaminants.

PART 2 PRODUCTS

2.01 MATERIALS

A. Provide new materials of domestic manufacture complying with the following material specifications.

B. Deformed Concrete Reinforcing Bars: ASTM A615, Grade 60 deformed bars.

C. Welded Steel Wire Fabric: ASTM A1064. Provide in flat sheets.

D. Reinforcing Steel Accessories

1. Plastic Protected Wire Bar Supports: CRSI Bar Supports, Class 1 - Maximum Protection.

2. Stainless Steel Protected Wire Bar Supports: CRSI Bar Supports, Class 2 - Moderate Protection with legs made wholly from stainless steel wire.

3. Precast Concrete Bar Supports: CRSI Bar Supports, Precast Concrete Bar Supports. Precast concrete blocks that have equal or greater strength than the surrounding concrete.

4. Provide galvanized supports for galvanized reinforcement or embedded steel items in contact with galvanized reinforcement.

E. Tie Wire

1. Tie Wires for Reinforcement: 16-gauge or heavier black annealed wire.

2.02 FABRICATION

A. Comply with the CRSI Manual of Standard Practice.

B. Bend bars cold. Do not straighten or rebend bars.

C. Bend bars around a revolving collar having a diameter not less than that recommended by the CRSI or ACI 318.

D. Saw cut bar ends that are to be butt spliced, placed through limited diameter holes in metal, or threaded. Terminate saw cut ends in flat surfaces within 1-1/2 degrees of a right angle to the axis of the bar.

PART 3 EXECUTION

3.01 INSTALLATION

A. Comply with the CRSI Manual of Standard Practice for surface condition, bending, spacing and tolerances of placement for reinforcement. Provide the amount of reinforcing indicated at the spacing and clearances indicated on the Drawings.

B. Determine clear concrete cover based on exposure to the environment. Unless indicated otherwise on the Drawings, provide the following minimum clear concrete cover over reinforcement:

1. Concrete cast against and permanently exposed to earth: three in.

2. Concrete exposed to soil, water and/or weather:

   a. Slabs (top and bottom cover), walls: two in.
   b. Beams and columns (ties, spirals and stirrups): two in.

3. Concrete not exposed to soil, water and/or weather:

   a. Slabs (top and bottom cover), walls, joists, shells and folded plate members: one in.
   b. Beams and columns (ties, spirals and stirrups): 1-1/2-in

C. Coat uncoated reinforcement which will be exposed for more than 60 days after placement with a heavy coat of neat cement slurry.

D. Do not weld reinforcing steel bars either during fabrication or erection unless indicated on the Drawings or as specified herein, or unless prior written approval has been obtained from the Engineer. Remove immediately all bars that have been welded, including tack welds, without such approval. Comply with AWS D1.4 when welding of reinforcement is shown on the Drawings, specified, or approved.

E. Reinforcing steel interfering with the location of other reinforcing steel, piping, conduits or embedded items may be moved within the specified tolerances or one bar diameter, whichever is greater. Obtain the approval of the Engineer if greater displacement of bars to avoid interference is needed. Do not cut reinforcement to install inserts, conduits, mechanical openings or other items without the prior approval of the Engineer.

F. Secure, support and tie reinforcing steel to prevent movement during concrete placement. Secure dowels in place before placing concrete.

G. Do not field bend reinforcing unless indicated or specifically authorized in writing by the Engineer. Cold-bend bars indicated or authorized to be field bent around the standard diameter spool specified in the CRSI. Do not heat bars. Closely inspect the reinforcing steel for breaks. Replace, repair by cutting out damaged bars and splicing new bars using coupling sleeves filled with ferrous material, or otherwise repair damaged reinforcing bars as directed by the Engineer at no additional cost to the District. Do not bend reinforcement after it is embedded in concrete unless indicated on the Drawings.

3.02 REINFORCEMENT AROUND OPENINGS

A. Provide additional reinforcing steel on each side of the opening equivalent to one half of the cross-sectional area of the reinforcing steel interrupted by the opening unless indicated otherwise on the Drawings. Extend each end of each bar beyond the edge of the opening or penetration by the tension development length for that bar size.

3.03 SPLICING OF REINFORCEMENT

A. Provide splices as shown on the Drawings and as specified herein.

B. Splices Indicated as Compression Splices: Provide lap splice of 30 bar diameters, but not less than 12-in unless indicated otherwise on the Drawings. For f'_c less than 3000 psi, lap length

shall be increased by one-third per ACI 318. Base the lap splice length for column vertical bars on the bar size in the column above.

C. All Other Splices: Provide tension lap splices in compliance with ACI 318. Stagger splices in adjacent bars where possible. Provide Class B tension lap splices at all locations unless otherwise indicated.

D. Tension Members: Avoid splicing of reinforcing steel in concrete elements indicated as "tension members." However, if splices are required for constructability, splices in the reinforcement subject to direct tension shall be butted and joined with complete penetration welds to develop, in tension, at least 125 percent of the specified yield strength of the bar. Offset splices in adjacent bars the distance of a Class B splice or 30-in, whichever is greater.

E. Lap splices in welded wire fabric in accordance with the requirements of ACI 318 but not less than 12-in. Tie the spliced fabrics together with wire ties spaced not more than 24-in on center and lace with wire of the same diameter as the welded wire fabric. Offset splices in adjacent widths to prevent continuous splices.

F. Mechanical reinforcing steel coupling system shall be used only where shown on the Drawings. Offset splices in adjacent bars by at least 30 bar diameters. Mechanical reinforcing steel coupling system is only to be used for special splice and dowel conditions approved by the Engineer.

3.04 ACCESSORIES

A. Determine, provide and install accessories such as chairs, chair bars and the like to support the reinforcement providing the spacing and clearances indicated on the Drawings and prevent its displacement during the erection of the reinforcement and the placement of concrete.

B. Use precast concrete blocks where the reinforcing steel is to be supported over soil.

C. Use plastic protected bar supports or steel supports with plastic tips where the reinforcing steel is to be supported on forms for a concrete surface that will be exposed to weather, high humidity, or liquid . Use stainless steel protected bar supports in walls, beams and elevated slabs. Use stainless steel supports or plastic tipped metal supports in all other locations unless otherwise noted on the Drawings or specified herein.

D. Provide #5 minimum size support bars. Do not reposition upper bars in a bar mat for use as support bars.

E. Alternate methods of supporting top steel in slabs, such as steel channels supported on the bottom steel or vertical reinforcing steel fastened to the bottom and top mats, may be used if approved by the Engineer.

3.05 INSPECTION

A. Notify the Engineer when the reinforcing is complete and ready for inspection, at least six working hours prior to the proposed concrete placement. Do not cover reinforcing steel with concrete until the installation of the reinforcement, including the size, spacing and position of the reinforcement has been inspected by the Engineer and the Engineer's release to proceed

with the concreting has been obtained. Keep forms open until the Engineer has completed inspection of the reinforcement.

END OF SECTION

SECTION 03300
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals required and install cast-in-place concrete complete as shown on the Drawings and as specified herein.

B. Furnish, as required to establish concrete mixes, all sampling and laboratory testing of products and materials performed by an independent testing laboratory engaged by and at the expense of the Contractor. Provide field sampling, testing, inspection and related laboratory tests.

1.02 RELATED WORK

A. Concrete reinforcement is included in Section 03200.

B. Grout is included in Section 03600.

C. Concrete electrical raceway encasement is included in Section 03800.

D. Miscellaneous metals are included in Section 05500.

1.03 SUBMITTALS

A. Submit, in accordance with Section 01300, product data for:

1. Sources of cement, fly ash, aggregates, and batched concrete. Indicate name and address of mill or quarry, as applicable.

2. Air-entraining admixture. Product data including catalogue cut, technical data, storage requirements, product life, recommended dosage, temperature considerations and conformity to ASTM standards.

3. Water reducing admixture. Product data including catalogue cut, technical data, storage requirements, product life, recommended dosage, temperature considerations and conformity to ASTM standards.

4. Sheet curing material. Product data including catalogue cut, technical data and conformity to ASTM standard.

5. Safety Data Sheets (SDS) for all concrete components and admixtures.

6. Cold weather and hot weather concreting plans demonstrating how concrete will meet the requirements of this Section including but not limited to concrete mixes, placement, curing and protection.

7. High-range water-reducing admixture (plasticizer). Product data including catalogue cut, technical data, storage requirements, product life, recommended dosage, temperature considerations, retarding effect, slump range and conformity to ASTM standards. Identify proposed locations of use.

8. Liquid membrane forming curing compound. Product data including catalogue cut, technical data, storage requirements, product life, application rate and conformity to ASTM standards. Identify proposed locations of use.

B. Test Reports

1. Aggregates: Conformance to ASTM standards, including sieve analysis, mechanical properties, deleterious substance content, and mortar bar expansion test results.

2. Cement and fly ash: Conformance to ASTM standards, including chemical analysis and physical tests.

3. Concrete mixes: For each formulation of concrete proposed for use, submit constituent quantities per cubic yard, water cementitious ratio, air content, concrete slump, type and manufacturer of cement and type and manufacturer of fly ash. Provide either Paragraph a. or b., below, for each mix proposed.

   a. Standard deviation data for each proposed concrete mix based on statistical records.
   b. Provide the following for each strength data point used in the calculation of the standard deviation for determination of the minimum required average strength:

      1) Date of sampling and name of testing laboratory.
      2) Name of concrete batch plant.
      3) Water cementitious ratio.
      4) Slump of batch.
      5) Air content of batch.
      6) Compressive strengths of all cylinders tested at that age in that batch.
      7) If available, temperature and unit weight of batch.
      8) Provide data from projects not more strictly controlled than outlined in these specifications. Provide summary sheet showing all pertinent data and the computation of the standard deviation.

   c. Water cementitious ratio curve for concrete mixes based on laboratory tests. Provide average cylinder strength test results at seven, 14, and 28 days for laboratory concrete mix designs.

C. Certifications

1. Certify that admixtures used in the same concrete mix are compatible with each other and the aggregates.

2. Certify that cement is produced by a manufacturer that does not use hazardous waste derived fuel as an energy source for its kilns.

3. Certificate of conformance for concrete production facilities from the NRMCA.

4. Certify that the Contractor is not associated with the independent testing laboratory, nor does the Contractor or its officers have a beneficial interest in the laboratory.

1.04 REFERENCE STANDARDS

A. 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 C138 - Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete.

7. ASTM C143 - Standard Test Method for Slump of Hydraulic-Cement Concrete

8. ASTM C150 - Standard Specification for Portland Cement

9. ASTM C156 - Standard Test Method for Water Retention by Liquid Membrane-Forming Curing Compound for Concrete

10. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete

11. ASTM C173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.

12. ASTM C192 - Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory.

13. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.

14. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.

15. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.

16. ASTM C311 - Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for use in Portland Cement Concrete.

17. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete.

18. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.

19. ASTM C1017 - Standard Specification for Chemical Admixtures for use in Producing Flowing Concrete.

20. ASTM C1077 - Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.

21. ASTM C1260 - Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method).

22. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection and/or Testing.

B. American Concrete Institute (ACI).

1. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete.

2. ACI 232.2R - Use of Fly Ash in Concrete.

3. ACI 304R - Guide for Measuring, Mixing, Transporting and Placing Concrete.

4. ACI 304.2R - Placing Concrete by Pumping Methods.

5. ACI 305R - Hot Weather Concreting.

6. ACI 306R - Cold Weather Concreting.

7. ACI 318 - Building Code Requirements for Structural Concrete and Commentary.

8. ACI 350 - Code Requirements for Environmental Engineering Concrete Structures and Commentary.

C. National Ready Mixed Concrete Association (NRMCA)

1. Quality Control Manual, Section 3 - Certification of Ready Mixed Concrete Production Facilities.

D. Truck Mixer Manufacturers Bureau (TMMB)

1. TMMB 100 - Truck Mixer, Agitator and Front Discharge Concrete Carrier Standards.

E. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. Comply with ACI 318 and other stated specifications, codes and standards. Apply the most stringent requirements of other stated specifications, codes, standards, and this Section when conflicts exist.

B. Use only one source of cement and aggregates for the project. Provide concrete uniform in color and appearance.

C. At least 10 working days before the first concrete placement hold a preconstruction meeting to review the requirements for concrete placement, waterstop placement, jointing, concrete curing, hot weather concreting, cold weather concreting and finishing. Review, with the attendance of the plasticizer manufacturer, the properties and techniques of batching and placing concrete containing high-range water-reducing admixture. Notify all parties involved, including the Engineer, of the meeting at least 10 working days prior to its scheduled date. Prepare an agenda for the meeting. Take meeting minutes and distribute to all attendees.

D. If, during the progress of the work, it is impossible to secure concrete of the specified workability and strength with the materials being furnished, the Engineer may order such changes in proportions or materials, or both, as may be necessary to secure the specified properties. Make all changes so ordered at no additional cost to the District.

E. If, during the progress of the work, the materials from the sources originally accepted change in characteristics, make, at no additional cost to the District, new acceptance tests of materials and establish new concrete mixes with the assistance of an independent testing laboratory.

F. Provide all field testing and inspection services and related laboratory tests. Methods of testing shall comply with the latest applicable ASTM methods. The following items shall be tested to verify conformity with this Section.

1. Concrete placements - compressive strength (cylinders), compressive strength (cores), temperature, slump, and air content.

2. Other materials that may require field testing.

G. Provide laboratory tests of samples of constituents and of concrete as-placed. All materials incorporated in the work shall conform to accepted samples.

1.06 DELIVERY, STORAGE AND HANDLING

A. Cement: Store in weathertight buildings, bins or silos to provide protection from dampness and contamination and to prevent warehouse set.

B. Aggregate: Arrange and use stockpiles to prevent segregation or contamination with other materials or with other sizes of like aggregates. Build stockpiles in successive horizontal layers not exceeding three feet in thickness. Complete each layer before the next is started. Do not use frozen or partially frozen aggregate.

C. Sand: Arrange and use stockpiles to prevent contamination. Allow sand to drain to a uniform moisture content before using. Do not use frozen or partially frozen sand.

D. Admixtures: Store in closed containers to prevent contamination, evaporation or damage. Provide agitating equipment to uniformly disperse ingredients in admixture solutions which tend to separate. Protect liquid admixtures from freezing and other temperature changes which could adversely affect their characteristics.

E. Fly Ash: Store in weathertight buildings, bins or silos to provide protection from dampness and contamination.

F. Sheet Curing Materials: Store in weathertight buildings or off the ground and under cover.

G. Liquid Membrane Forming Curing Compounds: Store in closed containers.

PART 2 PRODUCTS

2.01 GENERAL

A. The use of manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.

B. Like items of materials shall be the end products of one manufacturer in order to provide standardization for appearance, maintenance and manufacturer's service.

2.02 MATERIALS

A. Materials shall comply with this Section and any applicable State or local requirements.

B. Cement: Domestic portland cement conforming to ASTM C150 or ASTM C595. Do not use air entraining cements. Do not use cement produced by a manufacturer that uses hazardous waste derived fuel as an energy source for its kilns. Cement brand must be approved by the Engineer and one brand shall be used throughout the work. Provide the following type(s) of cement:

1. All Concrete - Type II or Type IL (MS).

C. Aggregates:

1. Fine Aggregate: Washed inert natural sand conforming to ASTM C33.

2. Coarse Aggregate: Well-graded crushed stone or washed gravel conforming to ASTM C33. Grading requirements as listed in ASTM C33, Table 2 for the specified coarse aggregate size number listed in Table 1 herein. Limits of deleterious substances and physical property requirements as listed in ASTM C33, Table 3 for severe weathering regions. Do not use coarse aggregates known to be deleteriously reactive with alkalis in cement.

D. Water: Potable water free of oil, acid, alkali, salts, chlorides (except those attributable to drinking water), organic matter, or other deleterious substances.

E. Admixtures: Use admixtures free of chlorides and alkalis (except for those attributable to drinking water). The admixtures shall be from the same manufacturer when it is required to use more than one admixture in the same concrete mix.

1. Air Entraining Admixture: Conforming to ASTM C260. Proportion and mix in accordance with manufacturer's recommendations.

2. Water Reducing Admixture: Conforming to ASTM C494, Type A. Proportion and mix in accordance with manufacturer's recommendations.

3. High-Range Water-Reducing Admixtures (Plasticizer): Conforming to ASTM C494, Type F resulting in non-segregating plasticized concrete with little bleeding and with the physical properties of low water/cementitious ratio concrete. The treated concrete shall be

capable of maintaining its plastic state in excess of two hours. Proportion and mix in accordance with manufacturer's recommendations.

4. Do not use admixtures causing retarded or accelerated setting of concrete without written approval from the Engineer. Use retarding or accelerating water reducing admixtures when so approved.

F. Fly Ash: Class F fly ash complying with ASTM C618, including the requirements of Table 1 but with the Loss on Ignition (LOI) limited to three percent maximum and the optional physical requirements of Table 3. Test in compliance with ASTM C311 with a minimum of one sample weighing four pounds taken from each 200 tons of fly ash supplied for the project.

G. Sheet Curing Materials: Waterproof paper, polyethylene film or white burlap-polyethylene sheeting, all conforming to ASTM C171.

H. Liquid Membrane-Forming Curing Compound. Compound conforming to ASTM C309, Type 1-D (clear or translucent with fugitive dye) and containing no wax, paraffin, or oil. Curing compounds shall be non-yellowing and have a unit moisture loss no greater than 0.039 gm/cm2 at 72 hours as measured by ASTM C156. Curing compound shall comply with Federal, State and local VOC limits.

2.03 MIXES

A. Select proportions of ingredients to meet the design strength and materials limits specified in Table 1 and to produce placeable, durable concrete conforming to these specifications. Proportion ingredients to produce a homogenous mixture which will readily work into corners and angles of forms and around reinforcement without permitting materials to segregate or allowing free water to collect on the surface.

B. Base concrete mixes on standard deviation data of prior mixes with essentially the same proportions of the same constituents or, if not available, develop concrete mixes by laboratory tests using the materials proposed for the work.

1. For concrete mixes based on standard deviation data of prior mixes, submit standard deviation data of prior mixes with essentially the same proportions of the same constituents in accordance with ACI 318 and based on the modification factors for standard deviation tests contained in ACI 318.

2. For concrete mixes developed by laboratory testing, base cementitious content of the concrete on curves showing the relation between water cementitious ratio and seven, 14 and 28 day compressive strengths of concrete made using the proposed materials. Determine curves by four or more points, each representing an average value of at least three test specimens and one water-cementitious ratio at each age. Provide curves with a range of values sufficient to yield the desired data, including the compressive strengths specified, without extrapolation. The cementitious content of the concrete mixes to be used, as determined from the curve, shall correspond to the required average compressive strength in Table 5.3.2.2 of ACI 318. The resulting mix shall not conflict with the limiting values for maximum water cementitious ratio and net minimum cementitious content specified in Table 1.

C. Test the fly ash and concrete mixture to provide test data confirming that the fly ash in combination with the cement to be used meets all strength requirements and is compatible with the other concrete additives.

D. Test aggregates for potential alkali reactivity in accordance with ASTM C1260. If initial testing indicates aggregates are not potentially reactive repeat test at three-month intervals.

E. Compression Tests: Provide testing of the proposed concrete mixes to demonstrate compliance with the compression strength requirements in conformity with the provisions of ACI 318.

F. Entrained air, as measured by ASTM C231, shall be as shown in Table 1.

1. If the air entraining agent proposed for use in the mix requires testing methods other than ASTM C231 to accurately determine air content, make special note of this requirement in the admixture submittal specified under Paragraph 1.03.

G. Slump of the concrete as measured by ASTM C143, shall be as shown in Table 1. If a high-range water-reducing admixture (plasticizer) is used, the slump indicated shall be that measured before plasticizer is added. Plasticized concrete shall have a slump ranging from seven to 10-in.

H. Proportion admixtures according to the manufacturer's recommendations. Two or more admixtures specified may be used in the same mix provided that the admixtures in combination retain full efficiency and have no deleterious effect on the concrete or on the properties of the other admixture(s).

TABLE 1

Class	Design Strength	Cement	Fine Aggregate	Coarse Aggregate	Cementitious Content
	1	2	3	3	4
A	2500	Type II	Sand	57 (9)	440
B	3000	Type II	Sand	57	480
E3	4500	Type II	Sand	67	600

Class	W/C Ratio	Fly Ash	AE Range	WR	HRWR	Slump Range
	5	6	7	8	10	Inches
A	0.62 max.	Yes	3.5 to 5	Yes	No	1-4
B	0.54 max.	Yes	3.5 to 5	Yes	No	1-3
E3	0.42 max.	Yes	3.5 to 5	Yes	No	3-5

TABLE NOTES:

a. Minimum compressive strength in psi at 28 days
b. ASTM designation in ASTM C150
c. Size Number in ASTM C33
d. Minimum cementitious content in lbs per cubic yard (where fly ash is used cementitious content is defined as cement content plus fly ash content)

e. W/C is Maximum Water Cementitious ratio by weight
f. Fly ash content in the range of 20-25 percent of the total cement content plus fly ash content, by weight
g. AE is percent air entrainment
h. WR is water reducing admixture
i. Except as specified in Section 03800 for concrete electrical raceway encasement
j. HRWR is high-range water-reducing admixture

PART 3 EXECUTION

3.01 MEASURING MATERIALS

A. Provide concrete composed of portland cement, fly ash, fine aggregate, coarse aggregate, water and admixtures as specified and produced by a plant complying with ACI 318 and ASTM C94. Batch all constituents, including admixtures, at the plant. High-range water reducing admixtures may be added in the field.

B. Measure materials for batching concrete by weighing in conformity with and within the tolerances given in ASTM C94 except as otherwise specified. Use scales last certified by the local Sealer of Weights and Measures within one year of use.

C. Weigh cement and fly ash in individual weigh batchers that are separate and distinct from the weigh batchers used for other materials. When cement and fly ash are weighed in a cumulative weigh batcher, the cement shall be weighed first.

D. Measure the amount of free water in fine aggregates within 0.5 percent with a moisture meter. Compensate for varying moisture contents of fine aggregates. Record the number of gallons of water as-batched on printed batch tickets.

E. Dispense admixtures either manually using calibrated containers or measuring tanks, or by means of an automatic dispenser approved by the manufacturer of the specific admixture.

1. Charge air-entraining and chemical admixtures into the mixer as a solution using an automatic dispenser or similar metering device.

2. Inject multiple admixtures separately during the batching sequence.

3.02 MIXING AND TRANSPORTING

A. Provide ready-mixed concrete produced by equipment complying with ACI 318 and ASTM C94 and produced by a plant certified by the NRMCA. Do not hand-mix. All truck mixers shall carry a rating plate conforming to TMMB 100. Clean each transit mix truck drum and reverse drum rotation before the truck proceeds under the batching plant. Equip each transit-mix truck with a continuous, nonreversible, revolution counter showing the number of revolutions at mixing speeds.

B. Transport ready-mix concrete to the site in watertight agitator or mixer trucks loaded not in excess of their rated capacities as stated on the name plate.

C. Keep the water tank valve on each transit truck locked at all times. Any addition of water must be directed by the Engineer. Incorporate water directed to be added by additional mixing of at

least 50 revolutions at mixing speed after the addition of all water. Meter all added water and show the amount of water added on each delivery ticket.

D. Comply with ACI 318 and ASTM C94 for all central plant and rolling stock equipment and methods.

E. Select equipment of size and design to provide continuous flow of concrete at the delivery end. Use metal or metal-lined non-aluminum discharge chutes with slopes not exceeding one vertical to two horizontal and not less than one vertical to three horizontal. Chutes more than 20-ft long and chutes not meeting slope requirements may be used if concrete is discharged into a hopper before distribution.

F. Do not retemper (mix with or without additional cement, aggregate, or water) concrete or mortar which has partially hardened.

G. Handle concrete from mixer to placement providing concrete of specified quality in the placement area and not exceeding the maximum time interval specified in Paragraph 3.02 I.4. Dispatch trucks from the batching plant so they arrive at the work site just before the concrete is required to avoid excessive mixing of concrete while waiting or delays in placing successive layers of concrete in the forms. Remix for a minimum of five minutes prior to discharge or testing.

H. Furnish a delivery ticket for ready mixed concrete to the Engineer as each truck arrives. Provide a printed record of the weight of cement and each aggregate as batched individually on each ticket. Use the type of indicator that returns for zero punch or returns to zero after a batch is discharged. Indicate for each batch the weight of fine and coarse aggregate, cement, fly ash, and water, moisture content of fine and coarse aggregate at time of batching, and types, brand and quantity of each admixture, the quantity of concrete delivered, the time any water is added and the amount, and the numerical sequence of the delivery. Show the time of day batched and time of discharge from the truck. Indicate the number of revolutions of transit mix truck.

I. Temperature and Mixing Time Control

1. In cold weather (see Paragraph 3.07D) maintain the as-mixed temperature of the concrete and concrete temperatures at the time of placement in the forms as indicated in Table 3.

2. If water or aggregate has been heated, combine water with aggregate in the mixer before cement is added. Do not add cement to mixtures of water and aggregate when the temperature of the mixture is greater than 90 degrees F.

3. In hot weather (see Paragraph 3.07E), cool ingredients before mixing to maintain temperature of the concrete below the maximum placing temperature of 90 degrees F. Well-crushed ice may be substituted for all or part of the mixing water.

4. The maximum time interval between the addition of mixing water and/or cement to the batch and the final placing of concrete in the forms shall not exceed the values shown in the following TABLE 2:

TABLE 2

AIR OR CONCRETE TEMPERATURE (WHICHEVER IS HIGHER)		MAXIMUM TIME
(27 Degree C)	80 Degree F to 90 Degree F (32 Degree C)	45 minutes
(21 Degree C)	70 Degree F to 79 Degree F (26 Degree C)	60 minutes
(5 Degree C)	40 Degree F to 69 Degree F (20 Degree C)	90 minutes

5. If an approved high-range water-reducing admixture (plasticizer) is used to produce plasticized concrete, the maximum time interval between the addition of mixing water and/or cement to the batch and the final placing of concrete in the forms shall not exceed 90 minutes.

3.03 INSPECTION AND COORDINATION

A. Batching, mixing, transporting, placing and curing of concrete shall be subject to the inspection of the Engineer at all times. Advise the Engineer of readiness to proceed at least six working hours prior to each concrete placement. The Engineer will inspect the preparations for concreting including the preparation of previously placed concrete, the reinforcing and the alignment, cleanliness and tightness of formwork. Do not place concrete without the inspection and acceptance of the Engineer.

3.04 EMBEDDED ITEMS

A. Secure to forms as required or set for embedment as required, all miscellaneous metal items, sleeves, reglets, anchor bolts, anchors, inserts and other items furnished under other Sections and required to be embedded into concrete. Set and secure such items in the locations and alignments needed so they are not displaced by concrete placement.

B. Clean embedded items free of rust, mud, dirt, grease, oil, ice, or other contaminants which would reduce or prevent bonding with concrete.

C. Coat or isolate all aluminum embedments to prevent aluminum-concrete reaction or electrolytic action between aluminum and steel.

D. Do not embed piping in concrete unless shown on the Drawings.

E. Do not embed electrical conduits in concrete unless shown on the Drawings.

F. Fabricate piping and conduit such that the cutting, bending, or relocation of reinforcing steel is not required. Pipes and conduits embedded within a slab or wall (other than those merely passing through) shall satisfy the following, unless otherwise shown on the Drawings or approved:

1. Maximum outside dimension of pipe or conduit shall not be greater than one third the overall thickness of the slab or wall.

2. Spacing of pipes or conduits shall be greater than or equal to three diameters or widths on center.

G. Close open ends of piping, conduits, and sleeves embedded in concrete with caps or plugs prior to placing concrete.

H. Ensure all specified tests and inspections on embedded piping are completed and satisfactory before starting concrete placement. Ensure all mechanical or electrical tests and inspections are completed and satisfactory prior to starting concrete placement. Do not place concrete until unsatisfactory items and conditions have been corrected.

I. Position embedded anchor bolts using templates.

J. Check location, alignment, and support of anchor bolts, piping, electrical conduits, and other items which will be fully or partially embedded in concrete before depositing concrete. Correct mislocated and misaligned items and secure items which have become loose before depositing concrete.

K. Correct all embedded items not installed in the location or alignment needed or displaced by concrete placement at no additional cost to the District.

3.05 CONCRETE APPEARANCE

A. Remix concrete showing either poor cohesion or poor coating of the coarse aggregate with paste. Reject remixed concrete showing either poor cohesion or poor coating of the coarse aggregate with paste. Make, at no additional cost to the District, changes in the concrete mix design for future deliveries only by adjusting one or more of the following if the slump is within the allowable limit, but excessive bleeding, poor workability, or poor finishability are observed:

1. The gradation of aggregate.

2. The proportion of fine and coarse aggregate.

3. The percentage of entrained air, within the allowable limits.

B. Provide concrete having a homogeneous structure which, when hardened, will have the specified strength, durability and appearance. Provide mixtures and workmanship such that concrete surfaces, when exposed, will require no finishing except as specified in Section 03350.

3.06 PLACING AND COMPACTING

A. Placing

1. Verify that all formwork completely encloses concrete to be placed and is securely braced prior to concrete placement. Remove ice, standing water, dirt, debris, and other foreign materials from forms and exposed joint surfaces. Confirm that reinforcement and other embedded items are securely in place. Have a worker at the location of the placement who can check that reinforcement and embedded items remain in designated locations and alignments while concrete is being placed. Sprinkle semi-porous subgrades or forms to eliminate suction of water from the mix. Do not place concrete on frozen subgrade, snow, or ice.

2. Deposit concrete as near its final position as possible to prevent segregation due to rehandling or flowing. Place concrete continuously at a rate that allows the concrete

previously placed to be integrated with fresh plastic concrete. Do not deposit concrete which has partially hardened or has been contaminated by foreign materials or on concrete which has hardened sufficiently to cause formation of seams or planes of weakness within the section. If the section cannot be placed continuously, place construction joints as specified or as approved.

3. Pumping of concrete will be permitted. Use a mix design and aggregate sizes chosen for pumping and submit for approval. Do not use pipelines made of aluminum or aluminum alloy. When concrete is pumped, slump will be determined at point of truck discharge and air content will be determined at point of placement.

4. Remove temporary spreaders from forms when the spreader is no longer needed. Temporary spreaders may remain embedded in concrete only when made of galvanized steel or concrete and if prior approval has been obtained.

5. Do not place concrete for supported elements until concrete previously placed in the supporting element has attained design strength.

6. Where surface mortar is to form the base of a finish, especially surfaces designated to be painted, work coarse aggregate back from forms to bring the full surface of the mortar against the form. Prevent the formation of surface voids.

7. Slabs

    a. After bulkheads, screeds and jointing materials have been positioned, place concrete continuously between joints beginning at a bulkhead, edgeform, or corner. Place each batch into the edge of the previously placed concrete to avoid stone pockets and segregation.
    b. Avoid delays in placement. If there is a delay in placement, spade and consolidate the concrete placed after the delay at the edge of the previously placed concrete to avoid cold joints. Bring concrete to correct level and strike off with a straightedge. Use bullfloats or darbies to smooth the surface, leaving it free of humps or hollows.
    c. Where slabs are to be placed integrally with the walls below them, place the walls and compact as specified. Allow one hour to pass between placement of the wall and the overlying slab to permit consolidation of the wall concrete. Keep the top surface of the wall moist to prevent cold joints.

8. Formed Concrete

    a. Place concrete in forms using tremie tubes taking care to prevent segregation. Maintain bottom of tremie tubes in contact with the concrete already placed. Do not permit concrete to drop freely more than four ft. Place concrete for walls in 12-in to 24-in lifts, keeping the surface horizontal. If a high-range water-reducing admixture is used do not permit concrete to drop freely more than 15-ft; maximum lift thickness not to exceed seven ft.

9. Bollards

    a. Conform to requirements specified above for formed concrete and completely fill pipe with concrete as indicated.

B. Compacting

1. Consolidate concrete by vibration and puddling, spading, rodding or forking so that concrete is completely worked around reinforcement, embedded items and openings and into corners of forms. Continuously perform puddling, spading, rodding and forking along with vibration of the placement to eliminate air or stone pockets which may cause honeycombing, pitting or planes of weakness.

2. Compact all concrete with mechanical vibrators. Do not order concrete until vibrators (including standby units in working order) are on the job.

3. Use mechanical vibrators having a minimum frequency of 8000 vibrations per minute. Insert vibrators and withdraw at points from 18-in to 30-in apart. Vibrate sufficiently at each insertion to consolidate concrete, generally from five to 15 seconds. Do not over vibrate so as to segregate. Keep standby vibrators on the site during concrete placing operations.

4. Concrete Slabs: Vibration for concrete slabs less than eight in. thick shall be by vibrating screeds. Vibration for concrete slabs eight in. and thicker shall be by internal vibrators and (optionally) with vibrating screeds. Place vibrators into concrete vertically. Do not lay vibrators horizontally or lay over.

5. Amount of Vibration: Use vibrators to consolidate properly placed concrete. Do not use vibrators to move or transport concrete in the forms. Continue vibration until:

   a. Frequency of vibrator returns to normal.
   b. Surface appears liquefied, flattened and glistening.
   c. Trapped air ceases to rise.
   d. Coarse aggregate has blended into surface, but has not disappeared.

3.07 CURING AND PROTECTION

A. Protect all concrete work against injury from the elements and defacements of any nature during construction operations.

B. Curing Methods

1. Curing Methods for Concrete Surfaces: Cure concrete to retain moisture and maintain a temperature of at least 50 Degrees F at the concrete surface for a minimum of seven days after placement. Use the following curing methods as specified:

   a. Water Curing: Keep entire concrete surface wet by ponding, continuous sprinkling or covered with saturated burlap. Begin water curing as soon as concrete attains an initial set and maintain water curing 24 hours a day. Do not permit the surface of the concrete to dry out at any time during the curing period. Temperature of curing water shall be within 20 Degrees F of the concrete temperature.
   b. Sheet Material Curing: Cover entire surface with sheet material. Anchor sheeting to prevent wind and air from lifting the sheeting or entrapping air under the sheet. Place and secure sheet as soon as initial concrete set occurs.
   c. Liquid Membrane Curing: Apply over the entire concrete surface except as follows. Curing compound shall NOT be placed on any concrete surface where additional

concrete or grout is to be placed, where concrete sealers or surface coatings are to be used, or where the concrete finish requires an integral floor product. Apply curing compound as soon as the free water on the surface has disappeared and no water sheen is visible, but not after the concrete is dry or when the curing compound can be absorbed into the concrete. Apply in compliance with the manufacturer's recommendations.

2. Specified applications of curing methods:.

   a. Slabs on Grade and Footings (not used to retain liquids): Water curing or sheet material curing or liquid membrane curing.
   b. Structural Slabs (other than Liquid Retaining Structures): Water curing or liquid membrane curing.
   c. Horizontal Surfaces which will Receive Additional Concrete, Coatings, Grout or Other Material that Requires Bond to the substrate: Water curing.
   d. Formed Surfaces: None if nonabsorbent forms are left in place seven days. Water curing if absorbent forms are used. Water curing if forms are removed prior to seven days. Sheet cure or liquid membrane cure if forms are removed prior to seven days. Exposed horizontal surfaces of formed walls or columns shall be water cured for seven days or until next placement of concrete is made.
   e. Surfaces of Concrete Joints: Water curing or sheet material curing.

C. Protect finished surfaces and slabs from the direct rays of the sun to prevent checking and crazing.

D. Cold Weather Concreting

1. For this Specification, "cold weather" is defined as a period when for more than three successive days, the average daily outdoor temperature drops below 40 degrees F. Calculate average daily temperature as the average of the highest and the lowest temperature during the period from midnight to midnight.

2. Batch, deliver, place, cure and protect concrete during cold weather in compliance with the recommendations of ACI 306R and the additional requirements of this Section.

3. Review the cold weather concreting plan at the preconstruction meeting. Include the methods and procedures for use during cold weather including the production, transportation, placement, protection, curing and temperature monitoring of the concrete and the procedures to be implemented upon abrupt changes in weather conditions or equipment failures.

4. The minimum temperature of concrete immediately after placement and during the protection period shall be as indicated in Table 3. The temperature of the concrete in place and during the protection period shall not exceed these values by more than 20 degrees F. Prevent overheating and non-uniform heating of the concrete.

TABLE 3 Concrete Temperatures Minimum Dimension of Section

	< 12-in	12 to 36-in
Min. conc temp:	55 Degree F	50 Degree F

5. Protect concrete during periods of cold weather to provide continuous warm, moist curing (with supplementary heat when required by weather conditions) for a total of at least 350 degree-days of curing.

    a. Degree-days are defined as the total number of 24 hour periods multiplied by the weighted average daily air temperature at the surface of the concrete (e.g., seven days at an average 50 degrees F = 350 degree-days).
    b. To calculate the weighted average daily air temperature, sum hourly measurements of the air temperature in the shade at the surface of the concrete taking any measurement less than 50 degrees F as 0 degrees F. Divide the sum thus calculated by 24 to obtain the weighted average temperature for that day.

6. Do not use salt, manure or other chemicals for protection.

7. At the end of the protection period, allow the concrete to cool gradually to the ambient temperature. If water curing has been used, do not expose concrete to temperatures below those shown in Table 3 until at least 24 hours after water curing has been terminated and air dry concrete for at least 3 days prior to first exposure to freezing temperatures.

8. During periods not defined as cold weather, but when freezing temperatures are expected or occur, protect concrete surfaces from freezing for the first 24 hours after placing.

E. Hot Weather Concreting

1. For this Specification, "hot weather" is defined as any combination of high air temperatures, low relative humidity and wind velocity which produces a rate of evaporation as estimated in ACI 305R, approaching or exceeding 0.2 pounds per square foot per hour (lb/sq ft/hr).

2. Batch, deliver, place, cure and protect concrete during hot weather in compliance with the recommendations of ACI 305R and the additional requirements of this Section.

    a. Temperature of concrete being placed shall not exceed 90 degrees F. Maintain a uniform concrete mix temperature below this level. The temperature of the concrete shall not cause loss of slump, flash set or cold joints.
    b. Promptly deliver concrete to the site and promptly place the concrete upon its arrival at the site, not exceeding the maximum time interval specified in Paragraph 3.02I.4. Provide vibration immediately after placement.
    c. The Engineer may direct the Contractor to immediately cover concrete with sheet curing material.

3. Review the hot weather concreting plan at the preconstruction meeting. Include the methods and procedures for use during hot weather including production, placement, and curing.

3.08 REMOVAL OF FORMS

A. Do not remove forms before the concrete has attained a strength of at least 70 percent of its specified design strength for beams and slabs and at least 30 percent of its specified design strength for walls and vertical surfaces, nor before reaching the following number of day-degrees of curing (whichever is the longer):

TABLE 4

Forms for	Degree Days
Beams and slabs	500
Walls and vertical surfaces	100

(See definition of degree-days in Paragraph 3.07D).

B. Do not remove shores until the concrete has attained at least 70 percent of its specified design strength and also sufficient strength to support safely its own weight and the construction live loads upon it.

C. In cold weather, when temperature of concrete exceeds ambient air temperature by 20 Degrees F at the end of the protection period, loosen forms and leave in place for at least 24 hours to allow concrete to cool gradually to ambient air temperature.

3.09 FIELD AND LABORATORY TESTS

A. Take field control cylinder specimens during the progress of the work, in compliance with ASTM C31. The number of sets of concrete test cylinders taken of each class of concrete placed each day shall not be less than one set per day, nor less than one set for each 100 cu yds of concrete nor less than one set for each 5,000 sq ft of surface area for slabs or walls. Specimens shall be formed in six-in. diameter by 12-in. long non-absorbent cylindrical molds.

1. A "set" of test cylinders shall consist of five cylinders: one to be tested at seven days, one to be tested at 14 days, and two to be tested and their strengths averaged at 28 days. The fifth may be used for a special test at three days or to verify strength after 28 days if 28 day test results are low.

2. When the average 28 day compressive strength of the cylinders in any set falls below the required compressive strength or below proportional minimum seven-day or 14-day strengths (where proper relation between seven, 14 and 28 day strengths have been established by tests), change proportions, cementitious content, or temperature conditions to achieve the required strengths at no additional cost to the District.

B. Provide four firmly braced, insulated, heated, closed wooden curing boxes, each sized to hold ten specimens, complete with cold weather temperature and hot weather temperature control thermostat for initial curing and storage from time of fabrication until shipment to the testing lab. Protect the specimens against injury or loss through construction operations.

C. Test slump immediately prior to placing the concrete. Test shall be made in accordance with ASTM C143. When concrete is pumped, slump will be determined at point of truck discharge. If the slump is outside the specified range, the concrete will be rejected.

D. Test for air content shall be conducted on a fresh concrete sample. Air content for concrete made of ordinary aggregates having low absorption shall be made in compliance with either the pressure method complying with ASTM C231 or by the volumetric method complying with ASTM C173. If aggregates with high absorptions are used, the latter test method shall be used. When concrete is pumped, air content will be determined at point of placement.

3.10 FIELD CONTROL

A. The Engineer may have cores taken from any questionable area in the concrete work such as construction joints and other locations as required for determination of concrete quality. The results of tests on such cores shall be the basis for acceptance, rejection or determining the continuation of concrete work. The right of the Engineer to take such cores shall not be construed as creating any obligation to take such cores, and not exercising this right to do so shall not relieve the Contractor from meeting the requirements of these Specifications.

B. Cooperate in obtaining cores by allowing free access to the work and permitting the use of ladders, scaffolding and such incidental equipment as may be required. Repair all core holes with non-shrink grout as specified in Section 03600. The work of cutting, testing and repairing the cores will be at the expense of the Contractor if defective work is uncovered. If no defective work is found, such cost will be at the expense of the District.

3.11 FAILURE TO MEET REQUIREMENTS

A. Should the strengths shown by the test specimens made and tested in compliance with the previous provisions fall below the values given in Table 1, the Engineer may require changes in proportions or materials, or both, to apply to the remainder of the work in accordance with Paragraph 1.05E. Furthermore, the Engineer may require additional curing on those portions of the structure represented by the test specimens which fall below the values given in Table 1. The cost of such additional curing shall be at no additional cost to the District. In the event that such additional curing does not give the strength required, as evidenced by core and/or load tests, the Engineer may require strengthening or replacement of those portions of the structure which fail to develop the required strength. Coring and testing and/or load tests and any strengthening or concrete replacement required because strengths of test specimens are below that specified, shall be at no additional cost to the District. In such cases of failure to meet strength requirements the Contractor and District shall confer to determine what adjustment, if any, can be made in compliance with Sections titled "Strength" and "Failure to Meet Strength Requirements" of ASTM C94. The "purchaser" referred to in C94 is the Contractor.

B. When the tests on control specimens of concrete fall below the required strength, the Engineer will permit check tests for strengths to be made by means of typical cores drilled from the structure in compliance with ASTM C42 and C39. In cases where tests of cores fall below the values given in Table 1, the Engineer, in addition to other recourses, may require load tests on any one of the slabs, walls, beams, and columns piles, pile caps in which such concrete was used. Test need not be made until concrete has aged 60 days. The Engineer may require strengthening or replacement of those portions of the structure which fail to develop the required strength. All coring and testing and/or load tests and any strengthening or concrete replacement required because strengths of test specimens are below that specified, shall be at no additional cost to the District.

C. Should the strength of test cylinders fall below 60 percent of the required minimum 28 day strength, the concrete shall be rejected and shall be removed and replaced at no additional cost to the District.

3.12 PATCHING AND REPAIRS

A. It is the intent of these Specifications to require quality work including forming, mixture and placement of concrete and curing so completed concrete surfaces will require no patching or repairs.

B. As soon as the forms have been stripped and the concrete surfaces exposed: remove fins and other projections; fill recesses left by the removal of form ties; and repair surface defects which do not impair structural strength. Clean all exposed concrete surfaces and adjoining work stained by leakage of concrete.

C. Immediately after removal of forms remove tie cones and metal portions of ties as specified in Section 03100. Fill holes promptly upon stripping as follows: Moisten the hole with water, followed by a 1/16-in brush coat of neat cement slurry mixed to the consistency of a heavy paste. Immediately plug the hole with a one to 1.5 mixture of cement and concrete sand mixed slightly damp to the touch (just short of "balling"). Hammer the grout into the hole until dense, and an excess of paste appears on the surface in the form of a spider web. Trowel smooth with heavy pressure. Avoid burnishing.

D. When filling tie cone holes and patching or repairing exposed surfaces use the same source of cement and sand as used in the parent concrete. Adjust color to match by addition of white cement. Rub lightly with a fine carborundum stone at an age of one to five days if necessary to bring the surface down with the parent concrete. Do not damage or stain the virgin skin of the surrounding parent concrete. Wash thoroughly to remove all rubbed matter.

E. Defective concrete and honeycombed areas: Chip down square and at least one in. deep to sound concrete with hand chisels or pneumatic chipping hammers. Irregular voids or surface stones need not be removed if they are sound, free of laitance, and firmly embedded in the parent concrete. If honeycomb exists around reinforcement, chip to provide a clear space at least 3/8-in wide all around the steel. For areas less than 1-1/2-in deep, the patch may be made in the same manner as described above for filling form tie holes, care being exercised to use adequately dry (non-trowelable) mixtures and to avoid sagging. Thicker repairs will require build-up in successive 1-1/2-in layers on successive days, each layer being applied (with slurry, etc.) as described above.

F. For very heavy (generally formed) patches, the Engineer may order the addition of pea gravel to the mixture and the proportions modified as follows:

Material	Volumes	Weights
Cement	1.0	1.0
Sand	1.0	1.0
Pea Gravel	1.5	1.5

G. The Contractor may use a pre-packaged patching compound, such as: Poly-Patch by Euclid Chemical Company; Sikatop 122 Plus by Sika Chemical Corporation or equal only if approved by the Engineer for use and for color match.

3.13 SCHEDULE

A. The following (Table 5) are the general applications for the various concrete classes and design strengths:

TABLE 5

Class	Design Strength (psi)	Description
A	2,500	Concrete fill, concrete fill for bollards, electrical raceway encasement and pipe encasement.
B	3,000	Miscellaneous site civil, and where specified or noted.
E3	4,500	Structural concrete including slabs on grade, .

END OF SECTION

SECTION 03600
GROUT

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and install grout complete as shown on the Drawings and as specified herein.

1.02 RELATED WORK

A. Concrete reinforcement is included in Section 03200.

B. Cast-in-place concrete is included in Section 03300.

C. Miscellaneous metals are included in Section 05500.

1.03 SUBMITTALS

A. Submit, in accordance with Section 01300, shop drawings and product data showing materials of construction and details of surface preparation, mixing and installation for:

1. Commercially manufactured non-shrink cementitious grout. Include catalog cuts, technical data, storage requirements, product life, working time after mixing, temperature considerations, conformity to the specified ASTM standards, and Safety Data Sheet.

2. Cement grout. Include the type and brand of cement, the gradation of fine aggregate, product data on any proposed admixtures and the proposed grout mix.

B. Certifications

1. Certify that commercially manufactured grout products and admixtures for cement grout are made for use in contact with potable water 30 days after installation (non-toxic and free of taste and odor).

C. Qualifications

1. Submit documentation that grout manufacturers have a minimum of at least 10 years experience in the production and use of the grouts proposed.

1.04 REFERENCE STANDARDS

A. ASTM International

1. ASTM C33 - Standard Specification for Concrete Aggregates

2. ASTM C150 - Standard Specification for Portland Cement

3. ASTM C579 - Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings and Polymer Concretes

4. ASTM C827 - Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures

5. ASTM C1077 - Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation

6. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink)

7. ASTM E329 - Standard specification for agencies engaged in the testing and/or inspection of materials used in construction

B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. Qualifications

1. Grout manufacturers shall have a minimum of 10 years experience in the production and use of the type of grout proposed.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the jobsite in original, unopened packages, clearly labeled with the manufacturer's name, product identification, batch numbers and printed instructions.

B. Store materials in full compliance with the manufacturer's recommendations. Limit total storage time from date of manufacture to date of installation to six months or the manufacturer's recommended storage time, whichever is less.

C. Remove immediately from the site material which becomes damp, contains lumps, or is hardened and replace with acceptable material at no additional cost to the District.

D. Deliver non-shrink cementitious grout as a pre-portioned blend in prepackaged mixes requiring only the addition of water.

E. Deliver non-shrink epoxy grout as a pre-proportioned, prepackaged, three component system requiring only mixing as directed by the manufacturer.

1.07 DEFINITIONS

A. Non-shrink Grout: A commercially manufactured product that does not shrink in either the plastic or hardened state, is dimensionally stable in the hardened state and bonds to a clean base plate.

PART 2 PRODUCTS

2.01 GENERAL

A. The use of a manufacturer's name and product or catalog number is for the purpose of establishing the standard of quality desired.

B. Like materials shall be the products of one manufacturer or supplier in order to provide standardization of appearance.

2.02 MATERIALS

A. Non-shrink Cementitious Grout

1. Non-shrink cementitious grouts: Conform to ASTM C1107. Grouts shall be portland cement based, contain a pre-proportioned blend of selected aggregates and shrinkage compensating agents and require only the addition of water. Non-shrink cementitious grouts shall not contain expansive cement or metallic particles. The grouts shall exhibit no shrinkage when tested in conformity with ASTM C827.

    a. General purpose non-shrink cementitious grout: Conform to the standards stated above. SikaGrout 212 by Sika Corp.; Set Grout by BASF Building Systems; NS Grout by The Euclid Chemical Co.; Five Star Grout by Five Star Products, Inc., or approved equal.
    b. Flowable (Precision) non-shrink cementitious grout: Conform to the standards stated above. Masterflow 928 by BASF Building Systems; Hi-Flow Grout by The Euclid Chemical Co.; SikaGrout 212 by Sika Corp.; Five Star Grout by Five Star Products, Inc., or approved equal.

B. Cement Grout

1. A mixture of one part portland cement conforming to ASTM C150, Type I, II, or III and one to two parts sand conforming to ASTM C33 with sufficient water to place the grout. The water content shall be sufficient to impart workability to the grout but not to the degree that it will allow the grout to flow.

C. Water

1. Potable water free of oil, acid, alkali, salts, chlorides (except those attributable to drinking water), organic matter, or other deleterious substances.

PART 3 EXECUTION

3.01 PREPARATION

A. Place grout where indicated or specified over existing concrete and cured concrete which has attained its specified design strength unless otherwise approved by the Engineer.

B. Concrete surfaces to receive grout shall be clean and sound; free of ice, frost, dirt, dust, grease, oil, form release agent, laitance and paints and free of all loose material or foreign matter which may affect the bond or performance of the grout.

C. Roughen concrete surfaces by chipping, sandblasting, or other dry mechanical means to bond the grout to the concrete. Remove loose or broken concrete. Irregular voids or projecting coarse aggregate need not be removed if they are sound, free of laitance and firmly embedded into the parent concrete.

1. Air compressors used to clean surfaces in contact with grout shall be the oilless type or equipped with an oil trap in the airline to prevent oil from being blown onto the surface.

D. Remove all loose rust, oil or other deleterious substances which may affect the bond or performance of the grout from metal embedments or bottom of baseplates prior to the installation of the grout.

E. Wash concrete surfaces clean and then keep moist for at least 24 hours prior to the placement of non-shrink cementitious or cement grout. Saturation may be achieved by covering the concrete with saturated burlap bags, use of a soaker hose, or flooding the surface. Upon completion of the 24 hour period, remove visible water from the surface prior to grouting.

F. Provide forms for grout. Line or coat forms with release agents recommended by the grout manufacturer. Provide forms anchored in place and shored to resist the forces imposed by the grout and its placement.

1. Forms for all grout other than concrete grout shall be designed to allow the formation of a hydraulic head and shall have chamfer strips built into forms.

G. Level and align the structural or equipment bearing plates in accordance with the structural requirements or the recommendations of the equipment manufacturer, as applicable.

H. Support equipment during alignment and installation of grout by shims, wedges, blocks or other approved means. The shims, wedges and blocking devices shall be prevented from bonding to the grout by bond breaking coatings and removed after grouting unless otherwise approved by the Engineer. Grout voids created by the removal of shims, wedges and blocks.

3.02 INSTALLATION - GENERAL

A. Mix, apply and cure products in strict compliance with the manufacturer's recommendations and these specifications.

B. Provide staffing and equipment available for rapid and continuous mixing and placing. Keep all necessary tools and materials ready and close at hand.

C. Maintain temperatures of the base plate, supporting concrete, and grout between 40 and 90 degrees F during grouting and for at least 24 hours after placement, until grout compressive strength reaches 1000 psi or as recommended by the grout manufacturer, whichever is longer. Do not allow differential heating or cooling of baseplates and grout during the curing period.

D. Take special precautions for hot weather or cold weather grouting as recommended by the manufacturer when ambient temperatures and/or the temperature of the materials in contact with the grout are outside of the 40 to 90 degrees F range.

E. Install grout to preserve the isolation between the elements on either side of the joint where grout is placed in the vicinity of an expansion or control joint.

F. Reflect all existing underlying expansion, control and construction joints through the grout.

3.03 INSTALLATION - NON-SHRINK CEMENTITIOUS GROUTS AND CEMENT GROUTS

A. Mix in accordance with manufacturer's recommendations. Do not add cement, sand, pea gravel or admixtures without prior approval by the Engineer.

B. Do not mix by hand. Mix in a mortar mixer with moving blades. Pre-wet the mixer and empty excess water. Add pre-measured amount of water for mixing, followed by the grout. Begin with the minimum amount of water recommended by the manufacturer and then add the minimum additional water required to obtain workability. Do not exceed the manufacturer's maximum recommended water content.

C. Placements greater than 3-in in depth shall include the addition of clean, washed pea gravel to the grout mix when approved by the manufacturer. Comply with the manufacturer's recommendations for the size and amount of aggregate to be added.

D. Provide forms as specified in Paragraph 3.01G. Place grout into the designated areas and prevent segregation and entrapment of air. Do not vibrate grout to release air or to consolidate the material. Fill all spaces and provide full contact between the grout and adjoining surfaces. Provide grout holes and vent holes as necessary.

E. Place grout rapidly and continuously to avoid cold joints. Do not place grout in layers. Do not add additional water to the mix (retemper) after initial stiffening.

F. Just before the grout reaches its final set, cut back the grout to the substrate at a 45 degree angle from the lower edge of bearing plate unless otherwise ordered and approved by the Engineer. Finish this surface with a wood float or brush finish.

G. Begin curing immediately after form removal, cutback, and finishing. Keep grout moist and within its recommended placement temperature range for at least 24 hours after placement, until grout compressive strength reaches 1000 psi or as recommended by the manufacturer, whichever is longer. Saturate the grout surface by use of saturated burlap bags, soaker hoses or ponding. Provide sunshades. If drying winds inhibit the ability of a given curing method to keep grout moist, erect wind breaks until wind is no longer a problem or curing is finished.

3.04 SCHEDULE

A. The following list indicates where the particular types of grout are to be used:

1. General purpose non-shrink cementitious grout: Use at all locations where non-shrink grout is indicated on the Drawings, except for base plates greater in area than three-ft wide by three-ft long.

2. Flowable (precision) non-shrink cementitious grout: Use under all base plates greater in area than three-ft wide by three-ft long. Use at all locations indicated on the Drawings to receive flowable non-shrink grout. Flowable (precision), non-shrink, cementitious grout may be substituted for general purpose non-shrink cementitious grout.

3. Cement grout: Use where indicated on the Drawings.

END OF SECTION

SECTION 03800
CONCRETE ELECTRICAL RACEWAY ENCASEMENT

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and install concrete encasement around underground electrical raceways as shown on the Drawings and as specified herein.

1.02 RELATED WORK

A. Excavation, backfilling, fill and grading are included in Division 2.

B. Cast in place concrete is included in Section 03300.

C. Furnishing and installing electrical conduit is included in Division 16.

D. Furnishing and placing polyethylene warning tape in the backfill above encasement is included in Division 16.

PART 2 PRODUCTS

2.01 MATERIALS

A. Cement, lime, aggregate and all other concrete components shall be as specified in Section 03300 except that aggregate size shall not exceed 3/8-in. Concrete shall have a minimum compressive strength at 28 days of 2500 psi.

PART 3 EXECUTION

3.01 GENERAL

A. Concrete shall conform to the requirements Section 03300 and as specified herein.

B. Provide not less than four in. of concrete between the outside of a raceway and the earth. Provide not less than two in. of concrete between adjacent raceways. Form as specified in Section 03100 for buried concrete.

C. All raceway concrete placements shall be continuous between manholes or handholes and between manholes or handholes and structures.

D. Where raceways pass through concrete walls, concrete encasement shall be extended through the finished structure flush with inside surfaces.

E. Encasements shall be reinforced as and where indicated on the Drawings.

F. Encasements shall be laid in trenches on mats of screened gravel not less than six in. thick.

G. The minimum cover for raceway banks shall be 24-in.

END OF SECTION

SECTION 05500
MISCELLANEOUS METAL

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and install all miscellaneous metal complete as shown on the Drawings and as specified herein.

1.02 RELATED WORK

A. Equipment anchor bolts are included in the respective Sections of Divisions 15 and 16.

1.03 SUBMITTALS

A. Submit, in accordance with Section 01300, shop drawings and product data showing materials of construction and details of installation for:

1. Shop drawings, showing sizes of members, method of assembly, anchorage and connection to other members.

B. Design Data

1. Submit manufacturer's specifications and data including recommended design values and physical characteristics for expansion anchors and adhesive anchor system.

C. Test Reports

1. Certified copy of mill test reports on each steel, stainless steel, aluminum proposed for use showing the physical properties and chemical analysis.

1.04 REFERENCE STANDARDS

A. Aluminum Association (AA)

1. AA M31C22A41

a. M31: Mechanical Finish, Fine Satin
b. C22: Finish, Medium Matte
c. A41: Clear Anodic Coating, Class I

B. American Concrete Institute (ACI):

1. ACI 318 - Building Code Requirements for Structural Concrete.

2. ACI-CRSI Adhesive Anchor Installer Certification.

C. ASTM International

1. ASTM A36 - Standard Specification for Carbon Structural Steel.

2. ASTM A48 - Standard Specification for Gray Iron Castings.

3. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

4. ASTM A108 - Standard Specification for Steel Bars, Carbon, Cold Finished, Standard Quality.

5. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

6. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

7. ASTM A276 - Standard Specification for Stainless Steel Bars and Shapes.

8. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.

9. ASTM F3125 - Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel Heat Treated, 120 ksi and 105 ksi Minimum Tensile Strength.

10. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

11. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.

12. ASTM A536 - Standard Specification for Ductile Iron Castings.

13. ASTM A570 - Standard Specification for Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality.

14. ASTM A1008 - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.

15. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

16. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes.

17. ASTM B429 - Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.

18. ASTM F1554 -Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength

19. ASTM F2329 - Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon Screws, Washers, Nuts, and Special Threaded Fasteners

D. American Institute of Steel Construction (AISC)

1. Specification for Structural Steel Buildings – Allowable Stress Design and Plastic Design.

E. American Welding Society (AWS)

1. AWS D1.1 - Structural Welding Code - Steel.

2. AWS D1.2 - Structural Welding Code - Aluminum.

3. AWS D1.6 - Structural Welding Code - Stainless Steel

F. Federal Specifications

1. FS-FF-B-575C - Bolts, Hexagonal and Square

G. Occupational Safety and Health Administration (OSHA)

H. Florida Building Code, 7th Edition (2020)

I. International Code Council Evaluation Services (ICC ES):

1. AC01 - Expansion Anchors in Masonry Elements.

2. AC58 - Adhesive Anchors in Masonry Elements.

3. AC193 - Mechanical Anchors in Concrete Elements.

4. AC308 - Post-Installed Adhesive Anchors in Concrete Elements.

J. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. The work of this Section shall be completely coordinated with the work of other Sections. Verify, at the site, both the dimensions and work of other trades adjoining items of work in this Section before fabrication and installation of items herein specified.

B. Furnish to the pertinent trades all items included under this Section that are to be built into the work of other Sections.

C. All welding shall be performed by qualified welders and shall conform to the applicable AWS welding code. Welding of steel shall conform to AWS D1.1 and welding of aluminum shall conform to AWS D1.2 and welding of stainless steel shall conform to AWS D1.6.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver items to be incorporated into the work of other trades in sufficient time to be checked prior to installation.

B. Store materials on skids and not on the ground and block up so that they will not become bent or otherwise damaged. Handle materials with cranes or derricks. Do not dump material off cars or trucks nor handle in any other way that will cause damage.

C. Repair items that have become damage or corroded to the satisfaction of the Engineer prior to incorporating them into the work.

1.07 PROJECT/SITE REQUIREMENTS

A. Field measurements shall be taken at the site, prior to fabrication of items, to verify or supplement indicated dimensions and to ensure proper fitting of all items.

PART 2 PRODUCTS

2.01 GENERAL

A. The use of manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.

B. Like items of materials shall be the end products of one manufacturer in order to provide standardization for appearance, maintenance and manufacturer's service.

2.02 MATERIALS

A. Unless otherwise noted, materials for miscellaneous metals shall conform to the following standards:

1. Structural Steel	Wide flange shapes:	ASTM A992
2. Other shapes; plates; rods and bars:		ASTM A36
3. Structural Steel Tubing		ASTM A500, Grade B
4. Welded and Seamless Steel Pipe		ASTM A501 or ASTM A53, Type E or S, Grade B Schedule 40. Use standard malleable iron fittings, galvanized for exterior work
5. Steel Sheets		ASTM A1008
6. Gray Iron Castings		ASTM A48, Class 35
7. Ductile Iron Castings		ASTM A536, Grade 65-45-12
8. Aluminum Extruded Pipe		ASTM B429, Alloy 6063 T6 and Alloy 6061 T6 as indicated

9.	Aluminum Extruded Shapes	ASTM B221, Alloy 6061 T6
10.	Aluminum Sheet and Plate	ASTM B209, Alloy 6061 T6
11.	Stainless Steel Plates, Sheets, and Structural Shapes	
	a. Exterior, Submerged or Industrial Use	ASTM A240, Type 316 (Type 316L for welded)
	b. Interior and Architectural Use	ASTM A240, Type 304
12.	Stainless Steel Bolts, Nuts, and Washers	ASTM A276, Type 316
13.	Carbon Steel Bolts and Studs nuts and washers where noted)	ASTM A307, Grade A (hot dip galvanized
14.	High Strength Steel Bolts, Nuts and washers	ASTM F3125 (mechanically galvanized per ASTM B695, Class 50, where noted)
	a. Elevated Temperature Exposure	Type I
	b. General Application	Type I or Type II
15.	Galvanizing minimum Ni	ASTM A123, Zn w/0.05 percent
16.	Galvanizing, hardware minimum Ni	ASTM A153, Zn w/0.05 percent
17.	Galvanizing, anchor bolts minimum Ni	ASTM F2329, Zn w/0.05 percent
18.	Welding electrodes, steel	AWS A5.1 E70xx

2.03 ANCHORS, BOLTS AND FASTENING DEVICES

A. Unless otherwise noted, anchor bolts shall be ASTM F1554, Grade 36. Provide standard headed bolts with heavy hex nuts and Grade A washers. Where galvanized anchor bolts are shown or specified, provide standard headed bolts with heavy hex nuts and Grade A washers, all galvanized in accordance with ASTM F2329.

B. Unless otherwise noted, bolts for the connection of carbon steel or iron shall be steel machine bolts; bolts for the connection of galvanized steel or iron shall be galvanized steel or stainless steel machine bolts; and bolts for the connection of aluminum or stainless steel shall be stainless steel machine bolts.

C. Unless otherwise noted, expansion anchors shall be zinc plated carbon steel wedge type anchors complete with nuts and washers. Type 316 stainless steel wedge type anchors shall be used where they will be submerged or exposed to the weather or where stainless steel expansion anchors are shown or specified. When the length or embedment of the bolt is not noted on the Drawings, provide length sufficient to place the wedge and expansion cone portion of the bolt at least one in. behind the concrete reinforcing steel. Anchors shall meet ICC ES AC01 or ICC ES AC193. Expansion anchors shall be Hilti, Kwik-Bolt TZ; Simpson Strong-Tie Strong Bolt Wedge-All; Powers Power-Stud+ SD1 (Powers Power-Stud+ SD6 for

stainless steel) or approved equal. Unless otherwise noted, anchorage designs shown on the Drawings are based on Hilti Kwik-Bolt TZ.

D. Adhesive anchor system, for fastening to solid concrete substrate, shall be a system manufactured for the installation of post installed studs including anchoring hardware and chemical dispenser. Injection adhesive shall be a two-component epoxy system including a hardener and a resin, furnished in pre-measured side-by-side cartridges which keep the two components separate. Side-by-side cartridges shall be designed to accept a static mixing nozzle which thoroughly blends the two components and allows injection directly into the drilled hole. Provide zinc plated carbon steel or Type 316 stainless steel stud assemblies as indicated on the Drawings consisting of an all-thread anchor rod with nut and washer. Adhesive anchor system shall meet ICC ES AC308. All holes shall be hammer drilled. Adhesive anchor system shall be Hilti HIT-RE 500 V3; Simpson Strong Tie SET-XP; ITW Ramset Red Head Epcon G5; or approved equal. Unless otherwise noted, anchorage designs shown on the Drawings are based on Hilti HIT- RE 500 V3.

E. Automatic end welded headed anchor studs shall be flux ended studs made from cold drawn steel, ASTM A108 Grades C-1010 through C-1020. Headed anchor studs shall be Nelson, H4L Headed Concrete Anchors or approved equal.

F. Machine bolts and nuts shall conform to Federal Specification FF-B-575C. Bolts and nuts shall be hexagon type. Bolts, nuts, screws, washers and related appurtenances shall be Type 316 stainless steel.

G. Toggle bolts shall be Hilti, Toggler Bolt or approved equal.

2.04 MISCELLANEOUS ALUMINUM

A. All miscellaneous metal work shall be formed true to detail, with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture and free from defects impairing strength or durability. Holes shall be drilled or punched. Edges shall be smooth and without burrs. Fabricate supplementary pieces necessary to complete each item though such pieces are not definitely shown or specified.

B. Connections and accessories shall be of sufficient strength to safely withstand the stresses and strains to which they will be subjected. Exposed joints shall be close fitting and jointed where least conspicuous. Threaded connections shall have the threads concealed where practical. Welded connections shall have continuous welds or intermittent welds as specified or shown. The face of welds shall be dressed flush and smooth. Welding shall be on the unexposed side as much as possible in order to prevent pitting or discoloration of the aluminum exposed surface. Provide holes for temporary field connections and for attachment of the work of other trades.

C. Miscellaneous aluminum items shall include: beams, angles, closure angles, grates, hatches, floor plates, stop plates, stair nosings and any other miscellaneous aluminum called for on the Drawings and not otherwise specified.

D. Angle frames for hatches, beams, grates, etc., shall be complete with welded strap anchors attached.

E. Aluminum diamond plate and floor plate shall have a minimum thickness of 3/8-in. Frames and supports shall be of aluminum construction. Fastening devices and hardware shall be Type 316 stainless steel. Plates shall have a mill finish.

F. Stair treads for aluminum stairs shall be as specified for grating and shall have cast abrasive non-slip nosing as approved.

G. Aluminum nosing at concrete stairs shall be Wooster Products, Inc.; Alumogrit Treads, Type 116; similar by Barry Pattern and Foundry Co.; Andco or equal. Furnish with wing type anchors and flat head stainless steel machine screws, 12-in on center. Nosing shall also be used at concrete ladder openings. Nosing shall a single piece for each step extending to within 3-in at each side of stair or full ladder width. Set nosing flush with stair tread finish at concrete stairs. Furnish treads with heavy duty protective tape cover.

2.05 MISCELLANEOUS STEEL

A. All miscellaneous metal work shall be formed true to detail, with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture and free from defects impairing strength or durability. Holes shall be drilled or punched. Edges shall be smooth and without burrs. Fabricate supplementary pieces necessary to complete each item though such pieces are not definitely shown or specified.

B. Connections and accessories shall be of sufficient strength to safely withstand the stresses and strains to which they will be subjected. Exposed joints shall be close fitting and jointed where least conspicuous. Threaded connections shall have the threads concealed where practical. Welded connections shall have continuous welds or intermittent welds as specified or shown. The face of welds shall be dressed flush and smooth. Provide holes for temporary field connections and for attachment of the work of other trades.

C. Miscellaneous steel items shall include: beams, angles, lintels, metal stairs, support brackets, base plates for other than structural steel or equipment, closure angles, bridge crane rails, monorail hoist beams, hold-down straps and lugs, door frames, splice plates, subframing at roof openings and any other miscellaneous steel called for on the Drawings and not otherwise specified.

D. Structural steel angle and channel door frames shall be shop coated with primer. Frames shall be fabricated with not less than three anchors on each jamb.

E. Steel pipe pieces for sleeves, lifting attachments and other functions shall be Schedule 40 pipe unless otherwise shown on the Drawings. Wall and floor sleeves, of steel pipe, shall have welded circumferential steel waterstops at mid-length.

F. Lintels, relief angles or other steel supporting masonry or embedded in masonry shall be shop coated with primer.

G. All steel finish work shall be thoroughly cleaned, by effective means, of all loose mill scale, rust and foreign matter and shall be given one shop coat of primer compatible with the finish coat after fabrication but before shipment. Paint shall be omitted within three in. of proposed field welds. Paint shall be applied to dry surfaces and shall be thoroughly and evenly spread and well worked into joints and other open spaces.

H. Galvanizing, where required, shall be the hot-dip zinc process after fabrication. Coating shall be not less than two oz/sq ft of surface.

2.06 MISCELLANEOUS STAINLESS STEEL

A. All miscellaneous metal work shall be formed true to detail, with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture and free from defects impairing strength or durability. Holes shall be drilled or punched. Edges shall be smooth and without burrs. Fabricate supplementary pieces necessary to complete each item though such pieces are not definitely shown or specified.

B. Connections and accessories shall be of sufficient strength to safely withstand the stresses and strains to which they will be subjected. Exposed joints shall be close fitting and jointed where least conspicuous. Threaded connections shall have the threads concealed where practical. Welded connections shall have continuous welds or intermittent welds as specified or shown. The face of welds shall be dressed flush and smooth. Provide holes for temporary field connections and for attachment of the work of other trades.

C. Miscellaneous stainless steel items shall include: beams, angles, bar racks and any other miscellaneous stainless steel called for on the Drawings and not otherwise specified.

2.07 CASTINGS

A. Casting shall be of good quality, strong, tough, even-grained, smooth, free from scale, lumps, blisters, sand holes and defects of any kind which render them unfit for the service for which they are intended. Castings shall be thoroughly cleaned and will be subjected to a hammer inspection in the field by the Engineer. All matching surfaces shall be machined to a true plane surface to allow contact surfaces to seat at all points without rocking. Allowances shall be made in the patterns so that the thickness specified shall not be reduced in obtaining finished surfaces. Castings will not be acceptable if the actual weight is less than 95 percent of the theoretical weight computed from dimensions. The Contractor shall provide facilities for weighing castings in the presence of the Engineer.

B. Frames, covers, cast grates and trench drains for structures shall be gray iron castings except as otherwise specified or indicated on the Drawings. Sizes shall be as shown on the Drawings. Covers shall have letters "WATER," "SANITARY SEWER," or DRAIN," as applicable, embossed on top.

C. Frames and covers for installation in slabs shall be heavy duty, R-6013-R-6099 Series as manufactured by Neenah Foundry Co., or equal.

D. Electrical and telephone manhole and handhole frames and covers shall be ductile iron castings. The covers shall be watertight. Covers shall have the word "ELECTRIC," "HIGH VOLTAGE," "LOW VOLTAGE," "SIGNAL," "TELEPHONE," as applicable, embossed on or cast into the top in letters two-in. high. The clear opening shall be 36-in unless otherwise indicated on the Drawings.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install all items except those to be embedded in concrete or other masonry which shall be installed under Division 3. Items to be attached to concrete or masonry after such work is completed shall be installed in accordance with the details shown. Fastening to wood plugs in masonry will not be permitted.

B. Abrasions in the shop primer shall be touched up immediately after erection. Areas left unprimed for welding shall be painted with primer after welding.

C. Zinc coating which has been burned by welding, abraded, or otherwise damaged shall be cleaned and repaired after installation. The damage area shall be thoroughly cleaned by wire brushing and all traces of welding flux and loose or cracked zinc coating removed prior to painting. The cleaned area shall be painted with two coats of zinc oxide-zinc dust paint conforming to the requirements of Military Specifications MIL-P-15145. The paint shall be properly compounded with a suitable vehicle in the ratio of one part zinc oxide to four parts zinc dust by weight.

D. Specialty products shall be installed in accordance with the manufacturer's recommendations.

E. Expansion anchors shall be checked for tightness a minimum of 24 hours after initial installation.

F. Install adhesive anchor system in strict compliance with the manufacturer's recommendations, including drill bit diameter, surface preparation, temperature, moisture conditions, injection and installation of bolts. Use oil free compressed air to blast out loose particles and dust from the drilled holes. Studs must be clean and free of dirt, oil, grease, ice or other material which would reduce bond.

G. Headed anchor studs shall be welded in accordance with manufacturer's recommendations.

H. All steel surfaces that come into contact with exposed concrete or masonry shall receive a protective coating of an approved heavy bitumastic troweling mastic applied in accordance with the manufacturer's instructions prior to installation.

I. Where aluminum contacts a dissimilar metal, apply a heavy brush coat of zinc-chromate primer followed by two coats of aluminum metal and masonry paint to the dissimilar metal.

J. Where aluminum contacts masonry or concrete, apply a heavy coat of approved alkali resistant paint to the masonry or concrete.

K. Where aluminum contacts wood, apply two coats of aluminum metal and masonry paint to the wood.

L. Between aluminum gratings, aluminum stair treads, or aluminum handrail brackets and steel supports, insert 1/4-in thick neoprene isolator pads, 85 plus or minus 5 Shore A durometer, sized for full width and length of bracket or support.

END OF SECTION

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SECTION 09901
SURFACE PREPARATION AND SHOP PRIME PAINTING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required for the surface preparation and application of shop primers on ferrous metals, excluding stainless steels, as specified herein.

1.02 RELATED WORK

A. Finish painting is included in Section 09902.

1.03 SUBMITTALS

A. Submit, in accordance with Section 01300, shop drawings, manufacturer's specifications and data on the proposed primers and detailed surface preparation, application procedures and dry mil thicknesses.

B. Submit representative physical samples of the proposed primers, if required by the Engineer.

1.04 REFERENCE STANDARDS

A. The Society for Protective Coatings (SSPC)

1. SSPC-SP 6/NACE No. 3 - Joint Surface Preparation Standard SSPC-SP 6/NACE No. 3: Commercial Blast Cleaning

2. SSPC-SP 10/NACE No. 2 - Joint Surface Preparation Standard SSPC-SP 10/NACE No. 2: Near-White Blast Cleaning.

B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

PART 2 PRODUCTS

2.01 MATERIALS

A. Submerged Surfaces - Shop primer for ferrous metals which will be in contact with water being treated, either submerged or which are subject to splash action or which are specified to be considered submerged service shall be shop primed with the following:

1. Shop Prime Coat for Ferrous Metal Surfaces: (Zinc Micaceous Iron Oxide Polyurethane Aromatic Shop Primer)

a. TNEMEC: Series 1 Omnithane
b. Carboline: Carboguard 561
c. Sherwin-Williams Company (The): Corothane I Zinc Primer 1K Mio-Zinc.
d. PPG PMC Durathane MCZ 97-679 Series or PPG PMC Amerlock 400.
e. Or equal.

2. Shop Prime Coat for Ductile Iron Pipe: (Epoxy, Polyamidoamine Shop Primer)

    a. TNEMEC: Series N140 Pota-Pox-Plus
    b. Carboline: Carboguard 561
    c. Sherwin-Williams Company (The): Macropoxy 846 NSF Winter Grade Epoxy Mill White
    d. PPG PMC Aquapon HB Potable Water Epoxy Coating 95-132 Series or PPG PMC Amerlock 2 Epoxy.
    e. Or equal.

B. Non-Submerged Surfaces: Shop primer for ferrous metals which will not be in contact with water being treated, not submerged and not subject to splash action shall be shop primed with the following:

1. Shop Prime Coat: (Zinc Micaceous Iron Oxide Polyurethane Aromatic Shop Primer)

    a. TNEMEC: Series 1 Omnithane
    b. Carboline: Carboguard 561
    c. Sherwin-Williams Company (The): Corothane I Zinc Primer 1K Mio-Zinc.
    d. PPG PMC Durathane MCZ 97-679 Series or PPG PMC Amercoat 68HS
    e. Or equal.

C. Non-Primed Surfaces - Gears, bearings surfaces and other similar surfaces obviously not to be painted shall be given a heavy shop coat of grease or other suitable rust-resistant coating. This coating shall be maintained as necessary to prevent corrosion during all periods of storage and erection and shall be satisfactory to the Engineer up to the time of the final acceptance test.

D. Compatibility of Coating Systems - Shop priming shall be done with primers that are guaranteed by the manufacturer to be compatible with their corresponding primers and finish coats specified in Section 09902 for use in the field and which are recommended for use together.

PART 3 EXECUTION

3.01 APPLICATION

A. Surface Preparation and Priming

1. Non-submerged components scheduled for priming, as defined above, shall be blast cleaned in accordance with SSPC-SP 6/NACE No. 3, immediately prior to priming. Submerged components scheduled for priming, as defined above, shall be blast cleaned in accordance with SSPC-SP 10/NACE No. 2, immediately prior to priming. Consult manufacturer regarding required surface profiles.

2. Surfaces shall be dry and free of dust, oil, grease and other foreign material before priming.

3. Shop prime in accordance with approved manufacturer's recommendations.

B. Non-Primed Surfaces

1. Apply approved coating per manufacturer's recommendations.

3.02 FABRICATED ITEMS

A. All items to be shop primed shall be blast cleaned as specified for applicable service prior to priming. If, in the opinion of the Engineer, any prime coating that has been improperly applied or if material contrary to this Section has been used, that coating shall be removed by abrasive blasting to white metal and reprimed in accordance with this Section.

B. All shop prime coats shall be of the correct materials and applied in accordance with this Section. Remove prime coats not in accordance with this Section by blast cleaning and apply the specified prime coat at no additional cost to the District.

C. Shop primed surfaces shall be cleaned thoroughly and damaged or bare spots prepared as approved and retouched with the specified primer before the application of successive paint coats in the field.

D. Shop finish coats, if proposed and allowed, shall be equal in appearance and protection quality to a field applied finish coat. If, in the opinion of the Engineer, a shop finish coat system does not give the appearance and protection quality of other work of similar nature, prepare the surfaces and apply the coat or coats of paint as directed by the Engineer to accomplish the desired appearance and protection quality. Submit to the Engineer substantial evidence that the standard finish is compatible with the specified finish coat.

E. Properly protect the shop prime and finish coats against damage from weather or any other cause.

F. Wherever fabricated equipment is required to be blast cleaned, protect all motors, drives, bearings, gears, etc., from the entry of grit. Equipment found to contain grit shall be promptly and thoroughly cleaned.

END OF SECTION

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SECTION 09902
PAINTING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and install all painting complete as shown on the Drawings and as specified herein.

B. It is the intent of this Section to paint all exposed structural and miscellaneous steel; chemical tanks and systems; mechanical and electrical equipment; sluice gates, operators and posts; conveying systems, pipe, fittings and valves; electrical conduit and appurtenances; new CMU walls; exposed interior ducts; all as specified in the attached painting schedules and all other work obviously required to be painted unless otherwise specified. Minor items not mentioned in the schedule of work shall be included in the work of this Section where they come within the general intent of this Section as stated herein.

C. Aluminized steel, above roof level, for stacks - Paint with silicone aluminum as specified. Other aluminum-paint only where noted (as is specified). Paint items so noted in Paragraph 1.01B and in accordance with the Painting Schedule. Provide vinyl film letters and numbers for markings as specified. Items noted in other Specification Sections as having factory finish and other factory finished items are obviously not field painted. The Contractor is responsible for having damaged factory finish painted items repaired or, if so ordered, for replacing items. The various Sections are responsible, as stated in each, for preparation and field touch-up of abrasions, welds and damaged primed areas of primed or galvanized components after erection.

D. The following items will not be painted:

1. Concrete except where specified above and scheduled to be painted and seamless flooring.

2. Finish hardware.

3. Non-ferrous metals and stainless steel, unless specifically noted otherwise.

4. Factory pre-finished architectural components.

5. Packing glands and other adjustable parts and name plates of mechanical equipment.

6. Parts of buildings not exposed to sight, unless specifically noted otherwise.

7. Maintenance equipment

8. Plumbing fixtures.

9. Mechanical, HVAC, Plumbing and Electrical equipment which has been finished painted in the factory as specified in Divisions 11, 13, and 15.

1.02 RELATED WORK

A. Valve identification is included in Division 15.

B. Shop priming and surface preparation of equipment and piping (except copper piping) are specified in Section 09901 and included in the respective Section with the item to be primed.

C. Shop primers associated with hollow metal doors and frames are included in Section 08111.

D. Shop primers associated with louvers are included in Section 10200.

E. Shop priming of metal substrates with primers is included in Division 5.

F. Concrete coating on interior wall surfaces, slabs, and overhead slabs exposed to wastewater are specified in 03180.

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01300.

B. Product Data: For each type of product indicated.

C. Samples: Submit the following for each type of coating system and in each color and gloss of finish coat indicated.

1. Color cards for initial color selections.

2. Three sets of eight-in by eight-in samples, on 1/4-in hardboard, of all colors required for all types of paint. Resubmit until approved.

D. Product List: For each product indicated. Cross-reference products to coating system and locations of application areas. Use same designations indicated on Drawings and in schedules.

1.04 REFERENCE STANDARDS

A. Steel Structures Painting Council (SSPC)

1. SSPC SP-1 - Surface Preparation Specification No. 1 Solvent Cleaning.

2. SSPC SP-2 - Surface Preparation Specification No. 2 Hand Tool Cleaning.

B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 DELIVERY, STORAGE AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.

2. Remove rags and waste from storage areas daily.

1.06 PROJECT CONDITIONS

A. Apply coatings only when temperature of surfaces to be coated and surrounding air temperatures are between 50 and 95 deg F.

B. Do not apply coatings in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than five deg F above the dew point; or to damp or wet surfaces.

1.07 EXTRA MATERIALS

A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.

1. Quantity: Furnish an additional five percent, but not less than one gal. of each material and color applied.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Provide products by one of the following:

1. Tnemec, Inc.(TN);

2. The Sherwin Williams Company (SW)

3. PPG Architectural Finishes, Inc. (PPG)

4. PPG Architectural Finishes, Inc. Ameron (AME)

5. Or equal.

2.02 MATERIALS

A. Material Compatibility:

1. Provide materials for use within each coating system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.

2. Provide products of same manufacturer for each coat in a coating system.

B. All painting materials shall be delivered to the work site in unbroken packages, bearing the manufacturer's brand and name. They shall be used without adulteration and mixed, thinned and applied in strict accordance with manufacturer's directions for the applicable materials and surface and with the Engineer's approval before using.

C. Shop priming shall be done with primers that are guaranteed by the manufacturer to be compatible with the finish paints to be used. Refer to Section 09901 for special primers.

D. Work areas will be designated by the Engineer for storage and mixing of all painting materials. Materials shall be in full compliance with the requirements of pertinent codes and fire regulations. Proper containers outside of the buildings shall be provided and used for painting wastes and no plumbing fixture shall be used for this purpose.

E. Colors: As selected by Engineer from manufacturer's full range.

2.03 COLOR CODING FOR PIPES AND EQUIPMENT

A. The color code establishes, defines and assigns a definite color for each process system. All elements which are an integral part of the system, that is originating from the equipment and/or supplying the equipment, shall be painted between and up to but not including the fixed flanges nor the flexible conduit connections on the equipment. Valves and fittings shall be painted in the color of the main body of the pipe.

B. All pipes and equipment shall be painted with final coat color selected by the Engineer and shall be treated as an integral part of the Contract.

C. All hanger saddles and pipe support floor stands shall be painted the same color and with the same paint as the pipe it supports. Hanger rods and hanger rod connections to building structure shall be painted to match the color of the wall or ceiling to which it is attached.

2.04 LETTERING OF TITLES

A. The name of the materials in each pipeline and alongside this an arrow indicating the direction of flow of fluids, shall be indicated on each pipe system. Titles shall not be located more than 26 linear feet apart and shall also appear directly adjacent to each side of any wall the pipeline breaches, adjacent to each side of the valve regulator, flowcheck, strainer cleanout and all pieces of equipment.

B. Titles shall identify the contents by complete name at least once in each space through which it passes and thereafter by generally recognized abbreviations, letters or numerals as approved. Identification title locations shall be determined by the Engineer but in general they shall be placed where the view is unobstructed and on the two lower quarters of pipe or covering where they are overhead. Title should be clearly visible from operating positions especially those adjacent to control valves.

C. Numbers and letters shall be die-cut from 3.5 mil vinyl film and pre-spaced on carrier tape. Adhesive and finish surface shall be protected with one piece removable liners. Color shall be white or black as approved depending on substrate color.

D. Letter size shall be as indicated in the following table:

OUTSIDE DIAMETER OF PIPE OR COVERING	SIZE OF LEGEND LETTERS
3/4-in to 1-1/4-in	1/2-in
1-1/2-in to 2-in	3/4-in
2-1/2-in to 6-in	1-1/2-in
8-in to 10-in	2-1/2-in
Over 10-in	3-in

E. The system for preparation and application of letters shall be Type B a.s.i/2 by ASI Sign Systems; Architectural Graphics Inc. or equal. Letter type shall be Optima Bold, upper case. Grid 2 spacing shall be employed. Arrow shall match as approved, letter type and size. The instructions of the manufacturer shall be followed in respect to storage, surface preparation and applications of letters.

2.05 TITLES FOR EQUIPMENT

A. Titles shall be provided in vinyl film as specified above on all equipment using one-in. high Optima Bold upper case, Grid 2 spacing, white or black in color as approved depending on substrate. Use titles shown on mechanical drawings for bidding purposes. Titles shall be mounted at eye level on machines where possible or at the upper most broad vertical surface of low equipment. Where more than one piece of the equipment item to be titled exists, the items shall be numbered consecutively as indicated on the mechanical drawings or as directed by the Engineer; for example, Pump No. 1, Pump No. 2, etc. Titles shall be composed in more than one line if required and justified on the left-hand side as approved.

2.06 TESTING EQUIPMENT

A. Furnish to the Engineer for use on the Project for paint inspection, wet and dry film thickness gauges and all other equipment required by the Engineer for inspection.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

   a. Concrete: 12 percent.
   b. Masonry (CMU): 12 percent.

2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

3. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

4. Coating application indicates acceptance of surfaces and conditions.

3.02 PREPARATION

A. All surfaces to be painted shall be prepared as specified herein and shall be dry and clean before painting. Special care shall be given to thoroughly clean interior concrete and CMU surfaces to receive polyamide cured epoxy paint of all marks before application of finish.

B. All metal welds, blisters, etc., shall be ground and sanded smooth. All pits and dents shall be filled, and all imperfections shall be corrected so as to provide a smooth surface for painting. All rust, loose scale, oil, tar and asphalt bearing coatings, grease and dirt shall be removed by use of approved solvents, wire brushing, grinding or sanding.

C. Concrete surfaces shall have been finished as specified in Section 03350. Report unsatisfactory surfaces to the Engineer. Concrete shall be left for one month minimum before painting and shall be free of dust, oil, curing compounds and other foreign matter.

D. Concrete masonry unit surfaces shall be smooth and cleaned of all dust, loose mortar and other foreign matter.

E. All PVC pipe and other plastic matrix surfaces to be painted shall be sanded to an approved profile and cleaned of residue before painting.

F. All PVC pipe and other plastic matrix surfaces to be painted shall be lightly sanded and cleaned of residue before painting.

G. Galvanized, aluminum, and copper surfaces shall have all oxidation and foreign material removed before painting by SSPC SP-1, using an approved V.O.C. compliant method. Galvanized and, when ordered, the other metal surfaces specified above shall be hand tool cleaned to SSPC SP-2 standards to provide a uniform 1 mil surface profile.

H. Existing Surfaces to be Repainted

1. Existing masonry, steel and other previously field painted surfaces so noted or as provided in Paragraph 1.01B shall be repainted.

2. Preparation shall be in general as specified above for new surfaces except that all loose paint shall be removed, and all edges of existing paint shall be feathered to ensure a smooth surface.

3. Paint removal, capture of its residue, and its disposal shall be handled in accordance with all laws and regulations concerning disposal of hazardous materials.

4. Primer (spot) and paint used for a particular surface shall, in general, be as scheduled for that type of new surface. Provide a CDM Smith approved organic zinc-rich (min. 83% zinc in dried film) primer as specified. Confirm with the paint manufacturer that the paint proposed for a particular repaint condition will be compatible with the existing painted surface. Perform adhesion and compatibility tests on existing substrates as ordered and required. Repainted areas shall be covered by the same guaranty specified for remainder of Project.

3.03 WORKMANSHIP

A. General

1. At the request of the Engineer, sample areas of the finished work prepared in strict accordance with this Section shall be furnished and all painting shall be equal in quality to the approved sample areas. Finished areas shall be adequate for the purpose of determining the quality of workmanship. Experimentation with factory or paint manufacturer's

warehouse mixed colors shall be furnished to the satisfaction of the Engineer where standard chart colors are not satisfactory.

2. Protection of furniture and other movable objects, equipment, fittings and accessories shall be provided throughout the painting operation. Canopies of lighting fixtures shall be loosened and removed from contact with surface, covered and protected and reset upon completion. Remove all electric plates, surface hardware, etc., before painting, protect and replace when completed. Mask all machinery name plates and all machined parts not receiving a paint finish. Dripped or spattered paint shall be promptly removed. Lay drop cloths in all areas where painting is being done to adequately protect flooring and other work from all damage during the operation and until the finished job is accepted.

3. On metal surfaces apply each coat of paint at the rate specified by the manufacturer to achieve the minimum dry mil thickness required. If material has thickened or must be diluted for application by spray gun, the coating shall be built up to the same film thickness achieved with undiluted material. One gallon of paint as originally furnished by the manufacturer shall not cover a greater area when applied by spray gun than when applied unthinned by brush. Deficiencies in film thickness shall be corrected by the application of an additional coat(s). On masonry, application rates will vary according to surface texture; however, in no case shall the manufacturer's stated coverage rate be exceeded. On porous surfaces, it shall be the painter's responsibility to achieve a protective and decorative finish either by decreasing the coverage rate or by applying additional coats of paint.

B. Field Priming

1. Steel members, metal castings, mechanical and electrical equipment and other metals which are shop primed before delivery at the site will not require a prime coat on the job. All piping and other bare metals to be painted shall receive one coat of primer before exposure to the weather, and this prime coat shall be the first coat as specified in the painting schedule. Surface preparation of bare metal shall be the responsibility of the Contractor.

2. Equipment which is specified to receive a baked-on enamel finish or other factory finish shall not be field painted unless the finish has been damaged in transit or during installation. Surfaces that have been shop painted and have been damaged, or where the shop coat or coats of paint have deteriorated, shall be properly cleaned and retouched before any successive painting is done on them in the field. All such field painting shall match as nearly as possible the original finish. Preparation and painting shall be provided by the Contractor.

3. Equipment shipped with a protective shop painting coat or coats shall be touched up to the satisfaction of the Engineer with primers as recommended by the manufacturer of the finish paint. Preparation and painting shall be provided by the Contractor.

C. Field Painting

1. All painting at the site shall be under the strict inspection of the Engineer. Only skilled painters and, where dictated by special conditions or systems and so ordered, specialist painters shall be used on the work.

2. All paint shall be at room temperature before applying, and no painting shall be done when the temperature is below 60 degrees F, in dust-laden air, when rain or snow is falling, or until all traces of moisture have completely disappeared from the surface to be painted.

3. Successive coats of paint shall be different shades (from paint manufacturer's stock or shop mixed paint) of the required colors so as to make each coat easily distinguishable from each other with the final undercoat the approximate shade of the finished coat to ensure no show-through as approved.

4. Finish surfaces shall not show brush marks or other irregularities. Undercoats shall be thoroughly and uniformly sanded with the type paper appropriate for the undercoats to remove defects and provide a smooth even surface. Top and bottom edges of doors shall be painted.

5. Painting shall be continuous and shall be accomplished in an orderly manner so as to facilitate inspection. Materials subject to weather shall be primed coated as quickly as possible. Surfaces of exposed members that will be inaccessible after erection shall be cleaned and painted before erection.

6. All painting shall be performed by approved methods with number of coats modified as required to obtain the total dry film thickness specified. Spray painting shall be performed specifically by methods submitted and as approved by the Engineer.

7. All surfaces to be painted as well as the atmosphere in which painting is to be done shall be kept warm and dry by heating and ventilation, if necessary, until each coat of paint has hardened. Any defective paint shall be scraped off and repainted in accordance with the Engineer's directions.

8. Before final acceptance of the work, all damaged surfaces of paint shall be cleaned and repainted as directed by the Engineer.

9. Only the aluminum work noted on the Drawings or in the Painting Schedule shall be field painted.

3.04 FIELD QUALITY CONTROL

A. District reserves the right to invoke the following procedure at any time and as often as District deems necessary during the period when coatings are being applied:

1. District will engage the services of a qualified testing agency to sample coating material being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.

2. Testing agency will perform tests for compliance with specified requirements.

3. District may direct Contractor to stop applying coatings if test results show materials being used do not comply with specified requirements. Contractor shall remove noncomplying coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. Contractor will be required to remove rejected materials from previously coated surfaces if, on recoating with complying materials, the two coatings are incompatible.

3.05 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by Engineer, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

3.06 PAINTING SCHEDULE

A. All colors will be selected by the Engineer.

B. The following types of paints by Tnemec Co. (TN), The Sherwin Williams Company (SW), PPG Protective & Marine Coatings, (PPG), and Ameron International (AME) have been used as a basis for the paint schedule; use one of these paints or equal:

1. Epoxy:

   a. TN: Hi-build Epoxoline II, Series N69.
   b. SW: Macropoxy 646, B58 Series.
   c. PPG: Pitt-Guard 97-145 Series Epoxy Mastic.
   d. AME: Amerlock 2/400 Series Epoxy.

2. Waterborne Cementitious Acrylic: Result in pinhole free surface:

   a. TN: Envirofil, Series 130-6602.
   b. SW: Cement-Plex 875, B42 Series.
   c. PPG: Cementitious Waterproofing Block Filler 95-217 Series.
   d. AME: Amerlock 400 BF Epoxy Block Filler.

3. High-Build Acrylic Polyurethane Enamel:

   a. TN: Endura-Shield - semi-gloss, Series V73.
   b. SW: Acrolon 218 HS, B65 Series.
   c. PPG: Pitthane HB Semigloss Urethane 95-8800 Series.
   d. AME: Amercoat 450HSG Polyurethane.

4. High Heat Silicone Aluminum (to 600 degrees F):

   a. TN: No product.
   b. SW: Heat-Flex Hi-Temp 1000 Aluminum, B59-820 Series.
   c. PPG: Speedhide 6-220 Series Silicone Aluminum Coating.
   d. AME: Amercoat 878 Silicone Aluminum Coating.

5. Tie Coat, Low VOC, Epoxy:

    a. TN: FC Typoxy, Series V27.
    b. SW: Macropoxy 646, B58 Series.
    c. PPG: Pitt-Guard Epoxy Mastic 95-245 Series.
    d. AME: Amercoat 385 Multi-Purpose Epoxy.

6. Acrylic Latex Emulsion, Eggshell Finish:

    a. TN: Tneme-Cryl, Series 6.
    b. SW: DTM Primer/Finish, B66 Series.
    c. PPG: Pitt-Tech Plus 90-1110 Series Satin DTM Acrylic.
    d. AME: Amercoat 220 Waterborne Acrylic.

7. Vinyl Acrylic Surface Sealer:

    a. TN: PVA Sealer, Series 51.
    b. SW: Prep-Rite 200 Primer, B28 Series.
    c. PPG: Speedhide 6-2 Vinyl Acrylic Drywall Primer.
    d. AME: Amercoat 148 Acrylic Primer.

C. The following surfaces shall have the types of paint scheduled below applied at the dry film thickness (DFT) in mils per coat as recommended by manufacturer:

1. Exterior non-submerged ferrous metals (except first coat-hollow metal-pressed metal work):

    a. First Coat: On properly prepared unprimed metal or for touch-up:

        1) TN: Hi-build Epoxoline II, Series N69.
        2) SW: Macropoxy 646, B58 Series.
        3) PPG: Pitt-Guard 97-145 Series Epoxy Mastic.
        4) AME: Amerlock 2/400 Series Epoxy.

    b. Second Coat:

        1) TN: Hi-build Epoxoline II, Series N69.
        2) SW: Macropoxy 646, B58 Series.
        3) PPG: Pitt-Guard 97-145 Series Epoxy Mastic.
        4) AME: Amerlock 2/400 Series Epoxy.

    c. Third Coat:

        1) TN: Endura-Shield - semi-gloss, Series V73.
        2) SW: Acrolon 218 HS, B65 Series.
        3) PPG: Pitthane HB Semigloss Urethane 95-8800 Series.
        4) AME: Amercoat 450HSG Polyurethane.

2. Interior non-submerged concrete scheduled for painting:

    a. First and Second Coats:

        1) TN: Hi-build Epoxoline II, Series N69.
        2) SW: Macropoxy 646, B58 Series.
        3) PPG: Pitt-Guard 97-145 Series Epoxy Mastic.
        4) AME: Amerlock 2/400 Series Epoxy.

3. Interior concrete masonry units:

    a. First Coat: Result in pinhole free surface.

        1) TN: No. 130-6602.
        2) SW: Cement-Plex 875, B42 Series.
        3) PPG: Cementitious Waterproofing Block Filler 95-217 Series.
        4) AME: Amerlock 400 BF Epoxy Block Filler.

    b. Second and Third Coats:

        1) TN: Hi-build Epoxoline II, Series N69.
        2) SW: Macropoxy 646, B58 Series.
        3) PPG: Pitt-Guard 97-145 Series Epoxy Mastic.
        4) AME: Amerlock 2/400 Series Epoxy.

4. Interior non-submerged ferrous metals (except first coat of previously painted metal work), on properly prepared unprimed metal or for touch-up:

    a. First Coat:

        1) TN: Hi-build Epoxoline II, Series N69.
        2) SW: Macropoxy 646, B58 Series.
        3) PPG: Pitt-Guard 97-145 Series Epoxy Mastic.
        4) AME: Amerlock 2/400 Series Epoxy.

    b. Second and Third Coats:

        1) TN: Hi-build Epoxoline II, Series N69.
        2) SW: Macropoxy 646, B58 Series.
        3) PPG: Pitt-Guard 97-145 Series Epoxy Mastic.
        4) AME: Amerlock 2/400 Series Epoxy.

5. Submerged ferrous metals and ferrous metals subject to submersion or splashing. Surface shall be lightly sanded or abraded before application of first field coat.

    a. First and Second Coats:

        1) TN: Hi-build Epoxoline II, Series N69.
        2) SW: Macropoxy 646, B58 Series.
        3) PPG: Pitt-Guard 97-145 Series Epoxy Mastic.
        4) AME: Amerlock 2/400 Series Epoxy.

6. Plastic piping and, where scheduled to be painted, plastic components:

    a. First and Second Coats:

        1) TN: Hi-build Epoxoline II, Series N69.
        2) SW: Macropoxy 646, B58 Series.
        3) PPG: Pitt-Guard 97-145 Series Epoxy Mastic.
        4) AME: Amerlock 2/400 Series Epoxy.

7. Pipe insulation: (Plastic or metal sheathed insulation-paint as scheduled for appropriate substrate):

    a. First Coat:

        1) TN: Vinyl-Acrylic Sealer, No. 51-792.
        2) SW: Prep-Rite 200, B28 Series.
        3) PPG: Speedhide 6-2 Vinyl Acrylic Drywall Primer.
        4) AME: Amercoat 148 Acrylic Primer.

    b. Second and Third Coats:

        1) TN: Hi-build Epoxoline II, Series N69.
        2) SW: Macropoxy 646, B58 Series.
        3) PPG: Pitt-Guard 97-145 Series Epoxy Mastic.
        4) AME: Amerlock 2/400 Series Epoxy.

8. Aluminum Designated to be Painted:

    a. Mechanically abrade surfaces to a uniform profile of 1 to 2 mils and clean completely.

    b. First and Second Coats - (Interior):

        1) TN: Hi-build Epoxoline II, Series N69.
        2) SW: Macropoxy 646, B58 Series.
        3) PPG: Pitt-Guard 97-145 Series Epoxy Mastic.
        4) AME: Amerlock 2/400 Series Epoxy.

    c. First Coat - (Exterior):

        1) TN: Hi-build Epoxoline II, Series N69.
        2) SW: Macropoxy 646, B58 Series.
        3) PPG: Pitt-Guard 97-145 Series Epoxy Mastic.
        4) AME: Amerlock 2/400 Series Epoxy.

9. Copper Piping:

    a. First and Second Coats:

        1) TN: Hi-build Epoxoline II, Series N69.
        2) SW: Macropoxy 646, B58 Series.
        3) PPG: Pitt-Guard 97-145 Series Epoxy Mastic.
        4) AME: Amerlock 2/400 Series Epoxy.

10. Hot Ferrous Metal Surfaces:

    a. First and Second Coats:
        1) TN: No product.
        2) SW: Heat-Flex Hi-Temp 1000 Aluminum, B59-820 Series, Aluminum.
        3) PPG: Speedhide 6-220 Series Silicone Aluminum Coating.
        4) AME: Amercoat 878 Silicone Aluminum Coating.

11. Previously Painted Metal Surfaces:

    a. First coat on substrates prepared as approved and replacing first coat of above-specified systems. Complete painting with remainder of specified system for each type of substrate.

    b. First Coat:

        1) TN: FC Typoxy, Series V27.
        2) SW: Macropoxy 646, B58 Series.
        3) PPG: Pitt-Guard 97-145 Series Epoxy Mastic.
        4) AME: Amerlock 2/400 Series Epoxy.

12. Exterior galvanized steel surfaces:

    a. Mechanically abrade surfaces to a uniform profile of 1 to 2 mils and clean completely.

    b. First Coat:

        1) TN: FC Typoxy, Series V27.
        2) SW: Macropoxy 646, B58 Series.
        3) PPG: Pitt-Guard Epoxy Mastic 95-245 Series.
        4) AME: Amercoat 385 Multi-Purpose Epoxy.

    c. Second Coat:

        1) TN: Endura-Shield - semi-gloss, Series V73.
        2) SW: Acrolon 218 HS.
        3) PPG: Pitthane HB Semigloss Urethane 95-8800 Series.
        4) AME: Amercoat 450HSG Polyurethane.

13. Interior concrete surfaces of secondary containment areas

    a. Surface Preparation: SSPC-SP13

    b. Surfacer:

        1) TN: Series 218 applied at 1/16"±
        2) Or Equal

    c. Primer:

        1) TN: Series 201
        2) Or Equal

d. Base Coat:

1) TN: Series 275
2) Or Equal

e. Top Coat:

1) TN: Series 282
2) Or Equal

END OF SECTION

SECTION 13125 - METAL BUILDING 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. Section Includes:

1. Structural-steel framing.
2. Metal roof panels.
3. Accessories.
4. Delegated Design.

B. Related Requirements:

1. Section 05500 “Miscellaneous Metals”

1.3 DEFINITIONS

A. Terminology Standard: See MBMA's "Metal Building Systems Manual" for definitions of terms for metal building system construction not otherwise defined in this Section or in standards referenced by this Section.

1.4 COORDINATION

A. Coordinate sizes and locations of concrete foundations and casting of anchor-rod inserts into foundation walls and footings. Anchor rod installation, concrete, reinforcement, and formwork requirements are specified in Section 033000 "Cast-in-Place Concrete."

B. Coordinate metal panel assemblies with rain drainage work, flashing, trim, and construction of supports and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of metal building system component.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:

a. Metal roof panels.

B. Shop Drawings: Indicate components by others. Include full building plan, elevations, sections, details and the following:

1. Anchor-Rod Plans: Submit anchor-rod plans and templates before foundation work begins. Include location, diameter, and minimum required projection of anchor rods required to attach metal building to foundation. Indicate column reactions at each location in individual load cases and in load combinations. Foundation engineer to provide embedment into concrete after final reactions are received.
2. Structural-Framing Drawings: Show complete fabrication of primary and secondary framing; include provisions for openings. Indicate welds and bolted connections, distinguishing between shop and field applications. Include transverse cross-sections.

3. Metal Roof Panel Layout Drawings: Show layouts of panels including methods of support. Include details of edge conditions, joints, panel profiles, corners, anchorages, clip spacing, trim, flashings, closures, and special details. Distinguish between factory- and field-assembled work; show locations of exposed fasteners.

    a. Show roof-mounted items including roof hatches, equipment supports, pipe supports and penetrations, lighting fixtures, and items mounted on roof curbs.

4. Accessory Drawings: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches:

    a. Flashing and trim.
    b. Gutters.
    c. Downspouts.

1.6 DELEGATED-DESIGN SUBMITTALS

A. For metal building systems.

1. Include analysis data indicating compliance with performance requirements and design data signed and sealed by the qualified professional engineer responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer.

B. Welding certificates.

C. Letter of Design Certification: Signed and sealed by a qualified professional engineer. Include the following:

1. Name and location of Project.
2. Order number.
3. Name of manufacturer.
4. Name of Contractor.
5. Building dimensions including width, length, height, and roof slope.

6. Indicate compliance with AISC standards for hot-rolled steel and AISI standards for cold-rolled steel, including edition dates of each standard.
7. Governing building code and year of edition.
8. Design Loads: Include dead load, roof live load, collateral loads, roof snow load, deflection, wind loads/speeds and exposure.
9. Load Combinations: Indicate that loads were applied acting simultaneously with concentrated loads, according to governing building code.
10. Building-Use Category: Indicate category of building use and its effect on load importance factors.

D. Erector Certificates: For qualified erector, from manufacturer.

E. Material Test Reports: For each of the following products:

1. Structural steel including chemical and physical properties.
2. Bolts, nuts, and washers including mechanical properties and chemical analysis.
3. Tension-control, high-strength, bolt-nut-washer assemblies.
4. Shop primers.
5. Nonshrink grout.

F. Source quality-control reports.

G. Field quality-control reports.

H. Surveys: Show final elevations and locations of major members. Indicate discrepancies between actual installation and the Contract Documents. Have surveyor who performed surveys certify their accuracy.

I. Sample Warranties: For special warranties.

1.8 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal panel finishes to include in maintenance manuals.

1.9 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer.

1. Accreditation: Manufacturer's facility accredited according to the International Accreditation Service's AC472, "Accreditation Criteria for Inspection Programs for Manufacturers of Metal Building Systems."
2. Engineering Responsibility: Preparation of comprehensive engineering analysis and Shop Drawings by a professional engineer who is legally qualified to practice in jurisdiction where Project is located.

B. Erector Qualifications: An experienced erector who specializes in erecting and installing work similar in material, design, and extent to that indicated for this Project and who is acceptable to manufacturer.

C. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3, "Structural Welding Code - Sheet Steel."

D. Land Surveyor Qualifications: A professional land surveyor who practices in jurisdiction where Project is located and who is experienced in providing surveying services of the kind indicated.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, sheets, panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.

B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

1.11 FIELD CONDITIONS

A. Weather Limitations: Proceed with panel installation only when weather conditions permit metal panels to be installed according to manufacturers' written instructions and warranty requirements.

1.12 WARRANTY

A. Special Warranty on Metal Panel Finishes: Manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

B. Special Weathertightness Warranty for Standing-Seam Metal Roof Panels: Manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that leak or otherwise fail to remain weathertight within specified warranty period.

1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE AND DESIGN CRITERIA

A. Delegated Design: Engage a qualified professional engineer, as defined in Sections 01300 “Submittals” and 01400 "Quality Control," to design metal building system.

B. Structural Performance: Metal building systems shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to procedures in MBMA's "Metal Building Systems Manual."

1. Design Loads:

a. Dead Loads: Self weight of structure, roofing, and accessories, and 5psf collateral
b. Roof Live Load: 20 psf
c. Wind Load: Per requirements indicated on S drawings.

2. Design Calculations:

a. Column base reactions shall be vertical and horizontal only. No bending moments shall be allowed at the base of the columns.

3. Deflection and Drift Limits: Design metal building system assemblies to withstand serviceability design loads without exceeding deflections and drift limits recommended in AISC Steel Design Guide No. 3 "Serviceability Design Considerations for Steel Buildings."
4. Deflection and Drift Limits: No greater than the following:

a. Purlins and Rafters: Vertical deflection of 1/240 of the span.
b. Metal Roof Panels: Vertical deflection of 1/240 of the span.
c. Design secondary-framing system to accommodate deflection of primary framing and construction tolerances, and to maintain clearances at openings.
d. Lateral Drift: Maximum of 1/100 of the building height.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change: 120 degrees F, ambient; 180 degrees F (100 degrees C), material surfaces.

D. Structural Performance for Metal Roof Panels: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592:

1. Wind Loads: As indicated on Drawings.

E. Water Penetration for Metal Roof Panels: No water penetration when tested according to ASTM E1646 or ASTM E331 at the following test-pressure difference:

1. Test-Pressure Difference: 2.86 lbf/sq. ft.

F. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.

1. Uplift Rating: UL 90.

2.2 MANUFACTURERS

A. Source Limitations: Obtain metal building system components, including primary and secondary framing and metal panel assemblies, from single source from single manufacturer.

2.3 SYSTEM DESCRIPTION

A. Provide a complete, integrated set of mutually dependent components and assemblies that form a metal building system capable of withstanding structural and other loads, thermally induced movement, and exposure to weather without failure or infiltration of water into building interior.

B. Primary-Frame Type:

1. Rigid Clear Span: Solid-member, structural-framing system without interior columns.

C. Secondary-Frame Type: Manufacturer's standard purlins and joists and exterior-framed (bypass) girts.

D. Eave Height: Manufacturer's standard height, as indicated by clear height on Drawings.

E. Bay Spacing: As indicated on Drawings.

F. Roof Slope: 1/4 inch per 12 inches.

G. Roof System: Manufacturer's standard lap seam, tapered rib metal roof panels.

2.4 STRUCTURAL-STEEL FRAMING

A. Structural Steel: Comply with AISC 360, "Specification for Structural Steel Buildings."

B. Bolted Connections: Comply with RCSC's "Specification for Structural Joints Using High-Strength Bolts."

C. Cold-Formed Steel: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" for design requirements and allowable stresses.

D. Primary Framing: Manufacturer's standard primary-framing system, designed to withstand required loads and specified requirements. Primary framing includes transverse and lean-to frames; rafters, rake, and canopy beams; sidewall, intermediate, end-wall, and corner columns; and wind bracing.

1. General: Provide frames with attachment plates, bearing plates, and splice members. Factory drill for field-bolted assembly. Provide frame span and spacing indicated.

a. Slight variations in span and spacing may be acceptable if necessary to comply with manufacturer's standard, as approved by Engineer.

2. Rigid Clear-Span Frames: I-shaped frame sections fabricated from shop-welded, built-up steel plates or structural-steel shapes. Interior columns are not permitted.
3. Frame Configuration: One-directional, sloped.
4. Exterior Column: Uniform depth.
5. Rafter: Uniform depth or Tapered.

E. Secondary Framing: Manufacturer's standard secondary framing, including purlins, girts, eave struts, flange bracing, base members, gable angles, clips, headers, jambs, and other miscellaneous structural members. Unless otherwise indicated, fabricate framing from either cold-formed, structural-steel sheet or roll-formed, metallic-coated steel sheet, prepainted with coil coating, to comply with the following:

1. Purlins: C- or Z-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes; minimum 2-1/2-inch- wide flanges.

a. Depth: As needed to comply with system performance requirements.

2. Eave Struts: Unequal-flange, C-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes; to provide adequate backup for metal panels.
3. Flange Bracing: Minimum 2-by-2-by-1/8-inch structural-steel angles or 1-inch- diameter, cold-formed structural tubing to stiffen primary-frame flanges.
4. Sag Bracing: Minimum 1-by-1-by-1/8-inch structural-steel angles.
5. Purlin Clips: Manufacturer's standard clips fabricated from steel sheet. Provide galvanized clips where clips are connected to galvanized framing members.
6. Miscellaneous Structural Members: Manufacturer's standard sections fabricated from cold-formed, structural-steel sheet; built-up steel plates; or zinc-coated (galvanized) steel sheet; designed to withstand required loads.

F. Bracing: Provide adjustable wind bracing using any method as follows:

1. Rods: ASTM A36/A36M; ASTM A572/A572M, Grade 50; or ASTM A529/A529M, Grade 50; minimum 1/2-inch- diameter steel; threaded full length or threaded a minimum of 6 inches at each end.
2. Cable: ASTM A475, minimum 1/4-inch- diameter, extra-high-strength grade, Class B, zinc-coated, seven-strand steel; with threaded end anchors.
3. Angles: Fabricated from structural-steel shapes to match primary framing, of size required to withstand design loads.
4. Diaphragm Action of Metal Panels: Design metal building to resist wind forces through diaphragm action of metal panels.

G. Anchor Rods: Headed anchor rods as indicated in Anchor Rod Plan for attachment of metal building to foundation.

H. Materials:

1. W-Shapes: ASTM A992/A992M; ASTM A572/A572M, Grade 50 or 55; or ASTM A529/A529M, Grade 50 or 55.
2. Channels, Angles, M-Shapes, and S-Shapes: ASTM A36/A36M; ASTM A572/A572M, Grade 50 or 55; or ASTM A529/A529M, Grade 50 or 55.
3. Plate and Bar: ASTM A36/A36M; ASTM A572/A572M, Grade 50 or 55; or ASTM A529/A529M, Grade 50 or 55.
4. Steel Pipe: ASTM A53/A53M, Type E or S, Grade B.
5. Cold-Formed Hollow Structural Sections: ASTM A500, Grade B or C, structural tubing.
6. Structural-Steel Sheet: Hot-rolled, ASTM A1011/A1011M, Structural Steel (SS), Grades 30 through 55, or High-Strength Low-Alloy Steel (HSLAS) or High-Strength Low-Alloy Steel with Improved Formability (HSLAS-F), Grades 45 through 70; or cold-rolled, ASTM A1008/A1008M, Structural Steel (SS), Grades 25 through 80, or HSLAS, Grades 45 through 70.
7. Metallic-Coated Steel Sheet: ASTM A653/A653M, SS, Grades 33 through 80, or HSLAS or HSLAS-F, Grades 50 through 80; with G60 coating designation; mill phosphatized.
8. Metallic-Coated Steel Sheet Prepainted with Coil Coating: Steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A755/A755M.

    a. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653/A653M, SS, Grades 33 through 80, or HSLAS or HSLAS-F, Grades 50 through 80; with G90 coating designation.
    b. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A792/A792M, SS, Grade 50 or 80; with Class AZ50 coating.

9. Non-High-Strength Bolts, Nuts, and Washers: ASTM A307, Grade A, carbon-steel, hex-head bolts; ASTM A563 carbon-steel hex nuts; and ASTM F844 plain (flat) steel washers.

    a. Finish: Hot-dip zinc coating, ASTM F2329, Class C.

10. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M,Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.

    a. Finish: Hot-dip zinc coating, ASTM F2329, Class C.

11. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A490, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.

12. Unheaded Anchor Rods: ASTM F1554, Grade 36.

    a. Configuration: Straight.
    b. Nuts: ASTM A563 heavy-hex carbon steel.
    c. Plate Washers: ASTM A36/A36M carbon steel.
    d. Washers: ASTM F436 hardened carbon steel.
    e. Finish: Hot-dip zinc coating, ASTM F2329, Class C.

13. Headed Anchor Rods: ASTM F1554, Grade 36.

    a. Configuration: Straight.
    b. Nuts: ASTM A563 heavy-hex carbon steel.
    c. Plate Washers: ASTM A36/A36M carbon steel.
    d. Washers: ASTM F436 hardened carbon steel.
    e. Finish: Hot-dip zinc coating, ASTM F2329, Class C.

14. Threaded Rods: ASTM A36/A36M.

    a. Nuts: ASTM A563 heavy-hex carbon steel.
    b. Washers: ASTM F436 hardened carbon steel.
    c. Finish: Hot-dip zinc coating, ASTM F2329, Class C.

I. Finish: Factory primed. Apply specified primer immediately after cleaning and pretreating.

1. Clean and prepare in accordance with SSPC-SP2.
2. Coat with manufacturer's standard primer. Apply primer to primary and secondary framing to a minimum dry film thickness of 1 mil.

    a. Prime secondary framing formed from uncoated steel sheet to a minimum dry film thickness of 0.5 mil on each side.

2.5 METAL ROOF PANELS

A. Exposed Fastener, Tapered-Rib, Metal Roof Panels: Formed with raised, trapezoidal major ribs and intermediate stiffening ribs symmetrically spaced between major ribs; designed to be installed by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps.

1. Material: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.024-inch nominal uncoated steel thickness. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

    a. Exterior Finish: Two-coat fluoropolymer.
    b. Color: As selected by Engineer from manufacturer's full range.

2. Major-Rib Spacing: 12 inches o.c.
3. Panel Coverage: 36 inches.
4. Panel Height: 1.5 inches.

B. Finishes:

1. Exposed Coil-Coated Finish:

    a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

2.6 ACCESSORIES

A. General: Provide accessories as standard with metal building system manufacturer and as specified. Fabricate and finish accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes. Comply with indicated profiles and with dimensional and structural requirements.

1. Form exposed sheet metal accessories that are without excessive oil-canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.

B. Roof Panel Accessories: Provide components required for a complete metal roof panel assembly including copings, fasciae, corner units, ridge closures, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels unless otherwise indicated.

1. Closures: Provide closures at eaves and ridges, fabricated of same material as metal roof panels.
2. Clips: Manufacturer's standard, formed from steel sheet, designed to withstand negative-load requirements.
3. Cleats: Manufacturer's standard, mechanically seamed cleats formed from steel sheet.
4. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
5. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- thick, flexible closure strips; cut or premolded to match metal roof panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
6. Thermal Spacer Blocks: Where metal panels attach directly to purlins, provide thermal spacer blocks of thickness required to provide 1-inch standoff; fabricated from extruded polystyrene.

C. Flashing and Trim: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.018-inch nominal uncoated steel thickness, prepainted with coil coating; finished to match adjacent metal panels.

1. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers.
2. Opening Trim: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.030-inch nominal uncoated steel thickness, prepainted with coil coating. Trim head and jamb of door openings, and head, jamb, and sill of other openings.

D. Gutters: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.018-inch nominal uncoated steel thickness, prepainted with coil coating; finished to match roof fascia and rake trim. Match profile of gable trim, complete with end pieces, outlet tubes, and other special

pieces as required. Fabricate in minimum 96-inch- long sections, sized according to SMACNA's "Architectural Sheet Metal Manual."

1. Gutter Supports: Fabricated from same material and finish as gutters.
2. Strainers: Bronze, copper, or aluminum wire ball type at outlets.

E. Downspouts: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.018-inch nominal uncoated steel thickness, prepainted with coil coating; finished to match metal wall panels. Fabricate in minimum 10-foot- long sections, complete with formed elbows and offsets.

1. Mounting Straps: Fabricated from same material and finish as gutters.

F. Materials:

1. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide fasteners with heads matching color of materials being fastened by means of plastic caps or factory-applied coating.

    a. Fasteners for Metal Roof Panels: Self-drilling or self-tapping, zinc-plated, hex-head carbon-steel screws, with a stainless-steel cap or zinc-aluminum-alloy head and EPDM sealing washer.
    b. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws with hex washer head.
    c. Blind Fasteners: High-strength aluminum or stainless-steel rivets.

2. Corrosion-Resistant Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
3. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.
4. Metal Panel Sealants:

    a. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene-compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape of manufacturer's standard size.
    b. Joint Sealant: ASTM C920; one part elastomeric polyurethane or polysulfide; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended by metal building system manufacturer.

2.7 FABRICATION

A. General: Design components and field connections required for erection to permit easy assembly.

1. Mark each piece and part of the assembly to correspond with previously prepared erection drawings, diagrams, and instruction manuals.
2. Fabricate structural framing to produce clean, smooth cuts and bends. Punch holes of proper size, shape, and location. Members shall be free of cracks, tears, and ruptures.

B. Tolerances: Comply with MBMA's "Metal Building Systems Manual" for fabrication and erection tolerances.

C. Primary Framing: Shop fabricate framing components to indicated size and section, with baseplates, bearing plates, stiffeners, and other items required for erection welded into place. Cut, form, punch, drill, and weld framing for bolted field assembly.

1. Make shop connections by welding or by using high-strength bolts.
2. Join flanges to webs of built-up members by a continuous, submerged arc-welding process.
3. Brace compression flange of primary framing with steel angles or cold-formed structural tubing between frame web and purlin web or girt web, so flange compressive strength is within allowable limits for any combination of loadings.
4. Weld clips to frames for attaching secondary framing if applicable, or punch for bolts.
5. Shop Priming: Prepare surfaces for shop priming according to SSPC-SP 2. Shop prime primary framing with specified primer after fabrication.

D. Secondary Framing: Shop fabricate framing components to indicated size and section by roll forming or break forming, with baseplates, bearing plates, stiffeners, and other plates required for erection welded into place. Cut, form, punch, drill, and weld secondary framing for bolted field connections to primary framing.

1. Make shop connections by welding or by using non-high-strength bolts.
2. Shop Priming: Prepare uncoated surfaces for shop priming according to SSPC-SP 2. Shop prime uncoated secondary framing with specified primer after fabrication.

E. Metal Panels: Fabricate and finish metal panels at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements. Comply with indicated profiles and with dimensional and structural requirements.

1. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of metal panel.

2.8 SOURCE QUALITY CONTROL

A. Special Inspection: Owner will engage a qualified special inspector to perform source quality control inspections and to submit reports.

1. Accredited Manufacturers: Special inspections will not be required if fabrication is performed by an IAS AC472-accredited manufacturer approved by authorities having jurisdiction to perform such Work without special inspection.

a. After fabrication, submit copy of certificate of compliance to authorities having jurisdiction, certifying that Work was performed according to Contract requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with erector present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Before erection proceeds, survey elevations and locations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments to receive structural framing, with erector present, for compliance with requirements and metal building system manufacturer's tolerances.

1. Engage land surveyor to perform surveying.

C. Proceed with erection only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition.

B. Provide temporary shores, guys, braces, and other supports during erection to keep structural framing secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural framing, connections, and bracing are in place unless otherwise indicated.

3.3 ERECTION OF STRUCTURAL FRAMING

A. Erect metal building system according to manufacturer's written instructions and drawings.

B. Do not field cut, drill, or alter structural members without written approval from metal building system manufacturer's professional engineer.

C. Set structural framing accurately in locations and to elevations indicated, according to AISC specifications referenced in this Section. Maintain structural stability of frame during erection.

D. Base and Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.

1. Set plates for structural members on wedges, shims, or setting nuts as required.
2. Tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
3. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

E. Align and adjust structural framing before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with framing. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.
2. Make allowances for difference between temperature at time of erection and mean temperature when structure will be completed and in service.

F. Primary Framing: Erect framing level, plumb, rigid, secure, and true to line. Level baseplates to a true even plane with full bearing to supporting structures, set with double-nutted anchor bolts. Use grout to obtain uniform bearing and to maintain a level base-line elevation. Moist-cure grout for not less than seven days after placement.

1. Make field connections using high-strength bolts installed according to RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt type and joint type specified.

a. Joint Type: Snug tightened or pretensioned as required by manufacturer.

G. Secondary Framing: Erect framing level, plumb, rigid, secure, and true to line. Field bolt secondary framing to clips attached to primary framing.

1. Provide rake or gable purlins with tight-fitting closure channels and fasciae.
2. Locate and space wall girts to suit openings such as doors and windows.
3. Provide supplemental framing at entire perimeter of openings, including doors, windows, louvers, ventilators, and other penetrations of roof and walls.

H. Bracing: Install bracing in roof and sidewalls where indicated on erection drawings.

1. Tighten rod and cable bracing to avoid sag.
2. Locate interior end-bay bracing only where indicated.

I. Erection Tolerances: Maintain erection tolerances of structural framing within AISC 303.

3.4 METAL PANEL INSTALLATION, GENERAL

A. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. Examination: Examine primary and secondary framing to verify that structural-panel support members and anchorages have been installed within alignment tolerances required by manufacturer.

1. Examine roughing-in for components and systems penetrating metal panels, to verify actual locations of penetrations relative to seams before metal panel installation.

C. General: Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Field cut metal panels as required for doors, windows, and other openings. Cut openings as small as possible, neatly to size required, and without damage to adjacent metal panel finishes.

    a. Field cutting of metal panels by torch is not permitted unless approved in writing by manufacturer.

2. Install metal panels perpendicular to structural supports unless otherwise indicated.
3. Flash and seal metal panels with weather closures at perimeter of openings and similar elements. Fasten with self-tapping screws.
4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Locate metal panel splices over structural supports with end laps in alignment.
6. Lap metal flashing over metal panels to allow moisture to run over and off the material.

D. Lap-Seam Metal Panels: Install screw fasteners using power tools with controlled torque adjusted to compress EPDM washers tightly without damage to washers, screw threads, or metal panels. Install screws in predrilled holes.

1. Arrange and nest side-lap joints so prevailing winds blow over, not into, lapped joints. Lap ribbed or fluted sheets one full rib corrugation. Apply metal panels and associated items for neat and weathertight enclosure. Avoid "panel creep" or application not true to line.

E. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.

F. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal panel assemblies. Provide types of gaskets, fillers, and sealants indicated; or, if not indicated, provide types recommended by metal panel manufacturer.

1. Seal metal panel end laps with double beads of tape or sealant the full width of panel. Seal side joints where recommended by metal panel manufacturer.
2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

3.5 METAL ROOF PANEL INSTALLATION

A. General: Provide metal roof panels of full length from eave to ridge unless otherwise indicated or restricted by shipping limitations.

1. Install ridge and hip caps as metal roof panel work proceeds.
2. Flash and seal metal roof panels with weather closures at eaves and rakes. Fasten with self-tapping screws.

B. Lap-Seam Metal Roof Panels: Fasten metal roof panels to supports with exposed fasteners at each lapped joint, at location and spacing recommended by manufacturer.

1. Provide metal-backed sealing washers under heads of exposed fasteners bearing on weather side of metal roof panels.
2. Provide sealant tape at lapped joints of metal roof panels and between panels and protruding equipment, vents, and accessories.
3. Apply a continuous ribbon of sealant tape to weather-side surface of fastenings on end laps and on side laps of nesting-type metal panels, on side laps of ribbed or fluted metal panels, and elsewhere as needed to make metal panels weatherproof to driving rains.
4. At metal panel splices, nest panels with minimum 6-inch end lap, sealed with butyl-rubber sealant and fastened together by interlocking clamping plates.

C. Metal Fascia Panels: Align bottom of metal panels and fasten with blind rivets, bolts, or self-drilling or self-tapping screws. Flash and seal metal panels with weather closures where fasciae meet soffits, along lower panel edges, and at perimeter of all openings.

D. Metal Roof Panel Installation Tolerances: Shim and align metal roof panels within installed tolerance of 1/4 inch in 20 feet on slope and location lines and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.6 ACCESSORY INSTALLATION

A. General: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal roof panel assembly, including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
2. Install components for a complete metal wall panel assembly, including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
3. Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by manufacturer.

B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

1. Install exposed flashing and trim that is without excessive oil-canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

C. Gutters: Join sections with riveted-and-soldered or lapped-and-sealed joints. Attach gutters to eave with gutter hangers spaced as required for gutter size, but not more than 36 inches o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.

D. Downspouts: Join sections with 1-1/2-inch telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c. in between.

1. Provide elbows at base of downspouts to direct water away from building.
2. Tie downspouts to underground drainage system indicated.

3.7 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform field quality control special inspections and to submit reports.

B. Product will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.8 CLEANING AND PROTECTION

A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.

B. Touchup Painting: After erection, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted structural framing, bearing plates, and accessories.

1. Clean and prepare surfaces by SSPC-SP 2, "Hand Tool Cleaning," or by SSPC-SP 3, "Power Tool Cleaning."
2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.

C. Metal Panels: Remove temporary protective coverings and strippable films, if any, as metal panels are installed. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

1. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 133419

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SECTION 13205
WIRE AND STRAND WRAPPED PRESTRESSED CONCRETE TANK

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Furnish all labor, materials, and incidentals required to design, construct and test one 60-foot diameter by 28-foot wall height, domed-top prestressed concrete circular tank, complete, as shown on the Drawings and as specified herein.

2. Furnish and install all piping and fittings to the limits as shown on the Drawings and as specified herein and in other Sections.

3. Delegated Design.

B. Related Requirements:

1. Piping is included in Divisions 02 and 15.

1.03 PREINSTALLATION MEETINGS

A. Convene minimum one week prior to commencing Work of this Section.

1.04 ACTION SUBMITTALS

A. Product Data: Manufacturer's information, specifications, and installation instructions for the tank appurtenances. This submittal will be reviewed for operational requirements only. The tank design shall include the following accessories and features:

1. Membrane floor, prestressed concrete wall, and cast-in-place domed roof.

2. Stainless steel access wall manway.

3. Floor slab pipe penetrations.

4. Pipe supports.

5. Floor slab sloped at 1.5% to center sump.

6. Exterior coating system.

1.05 DELEGATED DESIGN SUBMITTALS

A. Design Data:

1. Upon the completion of the construction of the tank, submit the design calculations of the "as-built tank(s)" stamped by a professional engineer licensed in the State of Florida for the project records only. The calculations will not be reviewed by the Engineer. Calculations submitted prior to tank construction will be not be reviewed and will be returned for re-submittal upon completion of construction.

B. Shop Drawings:

1. Detailed erection shop drawings and construction procedures stamped by a professional engineer licensed in the State of Florida.

2. Provide complete details for the foundation, floor slab, walls, domed roof, pipe supports, exterior coating system, and all other details and accessories necessary to build the tanks.

3. The submittal will be reviewed for operational requirements only and will be used in the field by the Owner's representative during construction.

C. Certification:

1. The tank manufacturer is responsible for the design and construction of the prestressed concrete tank. Submit written certification prepared, sealed, and signed by a professional engineer licensed in the State of Florida that the design, details, and construction conform to the requirements of AWWA D110, this Section, and applicable city and state building codes.

2. Submit certification on Form 434163-A included at the end of this Section.

1.06 INFORMATIONAL SUBMITTALS

A. Statement of Qualification:

1. Submit experience record in the design and construction of wire wrapped prestressed concrete tanks as specified herein.

2. Submit experience record in shotcrete work of each nozzleman and foreman to be employed on the project as specified herein.

B. Manufacturer's Certificate: Certify that the tank meets or exceeds specified requirements.

C. Test and Evaluation Reports.

D. Manufacturers' Instructions.

E. Source Quality-Control Submittals: Indicate results of factory tests and inspections.

F. Field Quality-Control Submittals: Indicate results of Contractor furnished tests and inspections.

G. Manufacturer Reports.

H. Qualifications Statements:

1. Submit qualifications for manufacturer, applicator, installer, erector,

2. Submit manufacturer's approval of applicator, fabricator and installer.

1.07 CLOSEOUT SUBMITTALS

A. Project Record Documents.

B. Operation and Maintenance Data.

1.08 MAINTENANCE MATERIAL SUBMITTALS

A. Spare Parts:

1. Submit one set of manufacturer's recommended spare parts.

1.09 QUALITY ASSURANCE

A. Perform Work according to AWWA D110 standards except where otherwise specified herein.

B. Maintain one copy of each standard affecting the Work of this Section on Site.

1.10 QUALIFICATIONS

A. Manufacturer: Company specializing in tank design and construction specified in this Section with minimum ten years' experience in the design and construction of wire wrapped circular prestressed concrete tanks as specified in this section.

B. The design and construction of all aspects of the floor slab, walls, prestressing, shotcrete and roof of the wire wound circular prestressed concrete tank shall be performed by the tank manufacturer and shall not be subcontracted or otherwise assigned.

C. All excavation, backfill, grading and concrete tank work shall be under the supervision and responsibility of the tank manufacturer, including the base slab and foundation. The manufacturer shall have designed and constructed at least 5 wire wrapped prestressed concrete tanks with domed roofs conforming to AWWA D110 with Type II core wall(s) that have been put into service within the last 10 years. The tanks shall have a diameter and capacity of not less than 75 percent nor more than 150 percent of the diameter and capacity of the proposed tank.

D. Foreman supervising the placing of the shotcrete shall have a minimum of 3 years’ experience as a nozzleman. Each shotcrete nozzleman shall have a minimum of 2 years’ experience on similar applications and shall be able to demonstrate by tests, if required, their ability to satisfactorily gun shotcrete of the required quality.

E. Licensed Professional: Professional engineer experienced in design of specified Work and licensed in State of Florida.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Specific requirements, if any, shall be as specified in this Section.

B. Deliver materials in manufacturer's packaging including application instructions.

C. Inspect all materials and equipment.

D. Store all materials according to manufacturer's instructions.

1.12 AMBIENT CONDITIONS

A. Minimum Conditions: Do not install when under 35 degrees F for the daily minimum temperature.

1.13 WARRANTY

A. The tank Manufacturer shall warranty the tank structure against any defective materials or workmanship for a period of 5 years from the date of tank(s) acceptance. If any materials or workmanship prove to be defective within that period, they shall be replaced or repaired by the tank Manufacturer.

PART 2 PRODUCTS

2.01 SYSTEMS

A. Tank:

1. Wire wrapped prestressed concrete tank with a Type II core wall.

B. Manufacturers:

1. CROM LLC Gainesville, FL.

2. Or equal wire wrapped prestressed concrete tank with the specified core wall type.

2.02 COMPONENTS

A. Materials: New, of domestic manufacture, and conforming to AWWA D110 and the following material standards.

B. Concrete and reinforcing steel for the tank core wall:

1. Conform to the requirements of AWWA D110.

2. Admixtures causing accelerated or retarded set of the concrete, not allowed unless approved in writing by the Engineer.

3. Concrete Strength: Minimum concrete strength at 28 days.

a. Pipe Encasement f'c = 3000 psi
b. Footing and floors f'c = 4000 psi

c. Dome roof f'c = 4000 psi
d. Cast-in-place walls f'c = 4000 psi

C. Prestressed Wire:

1. Conform to ASTM A821, suitable for redrawing and having a minimum ultimate strength of 210,000 psi, unless otherwise approved in writing by the Engineer.

D. Shotcrete:

1. In accordance with AWWA D110. Shotcrete shall have a minimum f'c = 4000 psi at 28 days.

2. Steel Diaphragm:

a. The galvanized steel diaphragm used in the construction of the core wall shall be 26-gauge with a minimum thickness of 0.017-inches, vertically ribbed with reentrant angles spaced not more than 3-inches apart with a depth of 3/8-inch and conforming to the requirements of ASTM A653/A653M. Weight of zinc coating shall be not less than G 90 of Table 1 of ASTM A653/A653M.

E. Elastomeric Materials:

1. Waterstops:

a. Extruded from elastomeric plastic compound with virgin polyvinyl chloride as the basic resins.
b. Meet the performance criteria in the Corps of Engineers Specifications CRD-C572.

2. Elastomeric Bearing Pad:

a. Neoprene or Natural Rubber Pad conforming to ASTM D2000, line call-outs 2BC415A14B14 and 4AA420AB respectively.

3. Moisture Barrier:

a. Polyethylene Class A conforming to ASTM E1745. The thickness shall not be less than 6 mil.

F. Ventilators:

1. Type: Material: “Eye Lid”.

2. Precast Concrete Fiberglass.

3. Provide 20 mesh stainless steel fail safe pop out insect screen in case of blocked up screens.

4. Provide suitable anchor system for attachment to roof dome.

5. Design for operational and rapid draw down events.

6. Provide suitable stainless steel anchor system for attachment to concrete curb on roof.

7. Provide continuous 1/4-inch thick, 60 durometer neoprene sheet gasket under ventilator flange. Fasten flange through gasket.

G. Wall Manway:

1. Watertight elliptical rectangular shape made of Type 31604 stainless steel.

2. Clear Opening: 178-inch vertical by 5224-inch horizontal minimum.

3. Cover plate with a stainless-steel hinge shall be mounted on the inside.

4. Provide gasket between manway cover and wall sleeve and attached to the manway cover.

5. Manway shall be capable of being "dogged" tight from the exterior of the tank. The "dogs" shall have provisions for being padlocked.

H. Liquid Level Indicator:

1. Half travel gauge with an interior float.

2. Glass: Fiberglass with 4-inch black numbers on a white board.

3. Level Indicator: Red fiberglass target.

4. Zero Mark: Set even with the top of the tank wall.

5. Interior Float: Fiberglass or PVC guided vertically true.

I. Pipe support brackets in clear well shall be stainless steel. See Drawings for pipe required and provide supports to rigidly hold the pipe.

2.03 PERFORMANCE AND DESIGN CRITERIA

A. Delegated Design: Engage a qualified professional engineer, as defined in Sections 01300 “Submittals” and 01400 “Quality Control”, to submit the items listed in the DELEGATED DESIGN SUBMITTALS Article.

B. Tank Construction:

1. Floor: Non-prestressed cast-in-place reinforced concrete

2. Minimum thickness of the floor slab is 4-inches.

3. Provide thickened edge for the exterior wall footing. Footings for interior walls shall be thickened areas in the slab.

4. Floor Slabs less than 6-inches: Provide single layer of reinforcement in each direction.

5. Floor Slabs greater than 6-inches: Provide top and bottom reinforcement in each direction.

6. Provide a minimum percentage of 0.50 percent reinforcing steel in the floor. The minimum percentage shall apply to all thickened sections and shall extend a minimum of two feet into the adjacent floor.

7. The transition from the bottom of the footings and pipe encasements to the underside of the floor slab shall not be steeper than 2 horizontal to 1 vertical. The pipe encasements shall not be less than the OD of the pipe plus 24-inches. The clearance in all directions shall not be less than 12-inches. Pipe encasements shall be as shown on the on the Drawings.

8. Floor/Wall Joint -Translation and rotation allowed.

9. Wall: Type II Shotcrete core wall with metal diaphragm.

10. Horizontal prestressing shall be continuous. Discontinuous prestressing tendons or strands will not be allowed.

11. Roof: Cast-in-place concrete dome with a minimum thickness of 3-inches.

12. Dome shall have one-tenth rise and be free-span. Provide a minimum percentage of 0.25 percent reinforcing steel in the dome.

C. Design Loads:

1. Minimum loading in the design of the tank(s) and tank appurtenances:

2. Unit Weights:

   a. Concrete and Shotcrete - 150 pcf.
   b. Soil - 120 pcf.
   c. Water – 62.5 pcf.
   d. Steel – 490 pcf.

3. Live Load:

   a. Floor: 62.4 psf times the height of water to overflow plus 6-inches.
   b. Roof: 20 psf - horizontal projection to tank roof.

4. Wind Load:

   a. Ultimate Design Wind Speed: 134 mph.

   b. Normal Design Wind Speed: 104 mph.

   c. Exposure Category: C.

5. Earth Pressure:

   a. Equivalent fluid pressure above groundwater level - 1 foot above bearing elevation of clearwell floor.
   b. Live Load surcharge equivalent to 2-feet of earth.

6. Ventilator(s) Capacity Requirements:

   a. Normal Operation:

      1) Maximum fill rate: 2,050 cfm.
      2) Maximum draw down rate: 2,050 cfm.

   b. Emergency Condition:

      1) Rapid draw down rate: 3,000 cfm.

   Maximum pressure differential on tank components for the design of vents shall be plus or minus 6-inches of water.

PART 3 EXECUTION

3.01 INSTALLATION

A. Installation Standards: Install Work according to AWWA D110 standards.

B. Cementitious Finish: Cementitious finish shall extend down the exterior face of tank wall to at least 1-ft below finish grade. Exterior shall be coated with two coats of Tnemec series 156 Enviro-Crete Modified Waterborne Acrylate, or approved equal. Coating shall be 6 mils dry film thickness per coat.

3.02 TOLERANCES

A. Maximum Variation from Plumb: <0.1 percent.

B. Maximum Offset from Indicated Alignment: <0.1 percent.

3.03 FIELD TESTING

A. Requirements for testing, adjusting, and balancing:

1. A minimum of one test panel for each 30 cu yd of shotcrete shall be made as directed by the Engineer. Additional panels shall be made if deemed necessary by the Engineer. The test panels shall be made from the shotcrete as it is being placed and shall, as nearly as possible, represent the material being applied. The method of making the test samples shall be as follows:

   a. A rectangular frame of 4-mesh wire fabric 1-foot square and 4-inch depth shall be secured to a plywood panel and hung or placed in the location where shotcrete is being placed. This form shall be filled in layers simultaneously with the nearby application. After 24 hours, the fabric and plywood back up shall be removed and sample slab placed in a safe location at the site. The sample slabs shall be sent to a recognized testing laboratory and tested at the age of 7 days. Nine 3-inch cubes or cores shall be cut from each sample slab and subjected to compression tests in accordance with current ASTM Standards. Three cubes or cores shall be tested at the age of 7 days, three shall be tested at the age of 28 days, and the remaining three held in reserve.

2. Testing the Completed Tank(s):

    a. After the tank(s) have been completed, but before any backfill is placed, the tank(s) shall be filled slowly in the presence of the Engineer. Careful observation for leaks shall be made and any leaks that occur shall be immediately repaired.
    b. The tank(s) shall be kept full of water until the Engineer is satisfied that all defects have been discovered and repaired. There shall be no flowing water allowed through the walls or floor slab. Damp spots that glisten on the surface of the tank(s) and spots where moisture can be picked up on a dry hand will not be allowed. Damp spots on the top of footing projections that are not from flowing water shall not be considered to be leakage.
    c. The maximum allowable leakage for a 24-hour period, after a 48-hour period, in which the entire tank interior surface has been wetted, shall not exceed 0.05 percent of the tank volume. If the liquid volume loss exceeds this amount, leakage shall be considered excessive and the tank shall be repaired and retested.
    d. Water required for testing will be provided by the District through pumping facilities and raw water transmission mains constructed by others under separate contracts.
    e. All water for the first test will be furnished by the District. The District shall be reimbursed for water required for retesting at the normal water rate. The use of this water supply shall be such that it does not adversely affect the normal pressure and flow in the distribution system.

3.04 APPENDICES

A. FORM 434163-A / P.E. Certification Form

END OF SECTION

END OF SECTION

FORM 13205-A
P.E. CERTIFICATION FORM

The undersigned hereby certifies that the undersigned is a professional engineer licensed in the

State of Florida and that has been employed by

_____ to design
(Name of Contractor)

one 60-foot diameter domed-top prestressed concrete circular tank in conformance with Section 13205 for the Black Creek Water Resource Development Project Aquifer Recharge Area.

The undersigned further certifies that the undersigned has performed the design of the tank, that said design is in conformance with all applicable local, state and federal codes, rules, and regulations, including the requirements AWWA D110 and that its signature and P.E. stamp have been affixed to all calculations and drawings used in, and resulting from, the design.

A. The undersigned hereby agrees to make all “as-built” design drawings and calculations available to the St. Johns River Water Management District or Owner's representative within seven days following written request therefor by the Owner.

_____
P.E. Name

_____
Signature

_____
Address

_____
Contractor's Name

_____
Signature

_____
Title

_____
Address

SECTION 13300
INSTRUMENTATION AND CONTROLS (I&C) – GENERAL PROVISIONS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall procure the services of a Process Control System Supplier (PCSS) to furnish and install all materials, equipment, labor, and services required to achieve a fully integrated and operational system as specified herein, in the Specification Sections listed below, and in related drawings, except for those services and materials specifically noted.

1. Section No Title

13302	Testing
13305	Control Descriptions
13306	Application Engineering services
13310	Computer System Hardware
13311	PLC Hardware and Software
13323	Cellular Telemetry System
13330	Control Panel Enclosure and Panel Equipment
13340	Instruments

2.

2. The PCSS shall program and configure the PLC programming, SCADA, and Remote datalogger and provide graphics development for Operator Interface Terminal (OIT/SCADA).

3. The PCSS shall provide the necessary programming and configuration to ensure the data transfer between the PLC and the Remote Datalogger.

4. The PCSS shall program and configure the cellular modem and firewall to achieve secure and reliable communication between the Black Creek Pump Station and the District's secure network.

5. The PCSS shall coordinate with the District the methods, interconnection, and protocol to be used to connect the PLC to the Black Creek Pump Station and Remote datalogger and the District workstation, as shown in the drawings.

6. Auxiliary and accessory devices necessary for system operation or performance, such as transducers, relays, signal amplifiers, intrinsic safety barriers, signal isolators, software, and drivers to interface with existing equipment or equipment provided by others under other Sections of these specifications, shall be included whether they are shown on the Drawings or not.

B. All equipment and installations shall satisfy applicable Federal, State, and local codes.

C. Use the equipment, instrument, and loop numbering scheme shown on the Drawings and specifications in the development of the submittals. Do not deviate from or modify the numbering scheme without the Engineer's approval.

1.02 RELATED WORK

A. Instrumentation and Controls conduit systems are specified in Section 16110.

B. Instrumentation signal cable and alarm and status wiring are specified in Section 16120.

1.03 BID ALLOWANCE

A. The Contractor shall include a $ 8,000 allowance in the contract for technical support and/or programming services for the Campbell Scientific data logger. The allowance shall be used to cover the costs of a Campbell Scientific integrator/distributor to assist the PCSS with integrating the data logger and PLC-1100 to facilitate the logging of the signals shown on the P&IDs and described in section 13305. The monitoring and controls shall include the work required to integrate the data with the LoggerNet application on the District's workstation.

B. The PCSS shall solicit a quotation for the Campbell Scientific integrator/distributor and submit it for approval with other documentation necessary to substantiate the cost of services contracted under the allowance. The PCSS shall include all scope of work required to provide, program, configure, document, and train on the application provided within the allowance as if it were specified herein and not part of the allowance unless specifically stated otherwise.

C. The District reserves the right to approve the scope of services to be provided under this allowance.

1.04 SUBMITTALS

A. General Requirements:

1. Refer to Section 01300 for general submittal requirements.

2. Shop drawings shall demonstrate that the equipment and services to be furnished comply with the provisions of these specifications and shall provide a complete record of the equipment as manufactured and delivered.

3. Submittals shall be complete, giving equipment specifications, details of connections, wiring, ranges, installation requirements, and specific dimensions. Submittals consisting of only general sales literature shall not be acceptable.

4. Substitutions on functions or type of equipment specified shall not be accepted unless specifically noted.

5. Separate submittals shall be made for each submittal listed below.

B. Qualifications Submittal:

1. Submit, within 30 calendar days after the effective Date of the Agreement, detailed information on staff and organization to show compliance with the Quality Assurance requirements of this Section. The Qualifications submittal shall be submitted and approved before any further submittals will be accepted. Failure to meet the minimum requirements shall be grounds for rejection as a PCSS. The Qualifications Submittal shall, as a minimum, contain the following:

a. Notarized statement from the firm's financial institution demonstrating the ability of the firm to meet the obligations necessary for the performance of the work.
b. Copy of UL-508 certificate for panel fabrication facilities.
c. Project references for water or wastewater projects as defined in the Quality Assurance paragraphs.
d. Documentation to demonstrate the ability to complete this project including resumes of key staff, financial capacities, details on engineering, design, fabrication, and field service capacity, and location of staff responsible for responding to the site within four hours to resolve startup issues.

C. Project Plan, Deviation List, and Schedule Submittal:

1. Submit, within 45 calendar days after the Effective Date of the Agreement, a Project plan. The Project Plan shall be submitted and approved before further submittals shall be accepted. The Project Plan shall, at a minimum, contain the following:

a. Overview of the proposed control system describing the understanding of the project work, a preliminary system architecture drawing, interfaces to other systems, schedule, startup, and coordination. A discussion of startup, replacement of existing equipment with new, switchover (Maintaining Plant Operations during system transition), approach to testing and training, and other tasks as required by these specifications shall be included as applicable.
b. Preliminary list of OIT/SCADA, PLC software, and PLC hardware, including version numbers, solely to determine compliance with the requirements of the Contract Documents prior to beginning development of system programming. Review and approval of software and hardware systems as part of this Project Plan stage shall not relieve the PCSS of meeting all the functional and performance requirements of the system as specified herein. Substitution of the manufacturer or model of these systems after the submittal is approved is not allowed without Engineer approval.
c. Project personnel and organization, including the PCSS project manager, project engineer, and lead project technicians. Include the resumes of each of these individuals and specify in writing their commitment to this project. These do not need to be submitted again if already submitted in the Qualification submittal.
d. Sample formats of the shop drawings to be submitted and in conformance with the requirements of the Specifications. At a minimum, include samples of panel fabrication drawings, loop, and I/O wiring diagrams.

2. Exceptions to the Specifications or Drawings shall be clearly defined in a Deviation List. The Deviation List shall consist of a paragraph-by-paragraph review of the Specifications indicating acceptance or any proposed deviations, the reason for the exception, the exact nature of the exception, and the proposed substitution so that an evaluation may be made by the Engineer. If no exceptions are taken to the specifications or drawings, the PCSS shall make a statement as such. If there is no statement by the PCSS, then it is acknowledged that no exceptions are taken.

3. Project schedule shall be prepared in Gantt chart format, clearly showing task linkages for all tasks and identifying critical path elements. PCSS schedule must be based on the General Contractor schedule and must meet all field installation, testing, and start-up milestones in that schedule. The project schedule shall illustrate I&C related major project milestones including the following:

a. Schedule for all subsequent project submittals. Include the time required for Contractor submittal preparation, Engineer's review time, and a minimum of two complete review cycles.
b. Proposed dates for all project coordination meetings.
c. Hardware purchasing, fabrication, and assembly (following approval of related submittals).
d. Software purchasing and configuration (following approval of related submittals).
e. Shipment of instrument and control system equipment.
f. Installation of instrument and control system equipment.
g. Testing: Schedule for all testing.
h. Schedule for system cutover, startup, and/or going on-line for each major system. At a minimum include the schedule for each process controller and OIT server/workstation provided under this Contract.
i. Schedule for all training including submittal and approval of O&M manuals, factory training, and site training.
j. Incorporate time constraints for AESS activities as defined in Section [13301].

D. Input/Output (I/O) List Submittal:

1. Submit, within 60 days after Effective Date of the Agreement, a complete system Input/Output (I/O) address list for equipment connected to the control system under this Contract.

2. I/O list shall be based on the P&ID's, the Drawings, the design I/O list (if included), and requirements in the Specifications.

3. The I/O list shall be submitted in both a Microsoft Excel readable electronic file format and an 8-1/2 inch by 11-inch hard copy.

4. The I/O list shall reflect all active and spare I/O points. Add points to accommodate spare I/O as required in the specifications.

5. The I/O list shall be arranged such that each control panel has a dedicated worksheet. At a minimum, I/O worksheet shall include the following information:

a. TAG NUMBER(S): As indicated in the Drawings, the identifier is assigned to a device that performs a function in the control system. As part of this information, the loop number of the tag shall be broken out to allow for sorting by the loop.
b. DESCRIPTION: A description of the function of the device (text that includes signal source, control function, etc.) Include the text "Spare Points" for all I/O module points that are not connected to equipment.
c. PHYSICAL LOCATION: The Control Panel designation of where the I/O point is wired to.
d. Physical POINT ADDRESS: Rack, Slot, and Point (or Channel) assignment for each I/O point.
e. I/O TYPE: use DO - Discrete Output, DI - Discrete Input, AO - Analog Output, AI - Analog Input, PI - Pulse Input, or PO - Pulse Output.
f. RANGE/STATE: The range in engineering units corresponding to an analog 4-20 mA signal, or, the state at which the value of the discrete points are "1."
g. ENGINEERING UNITS: The engineering units associated with the Analog I/O.

h. ALARM LIMITS: Include alarm limits based on the control descriptions and the Drawings.
i. P&ID - the P&ID or drawing where the I/O point appears on. Mark as "NA" (Not Applicable) if the I/O point is derived from a specification requirement and is not on the P&IDs.

6. The I/O list shall be sorted in order by:

a. Physical location.
b. I/O Type.
c. Loop Number.
d. Device Tag.

7. Once the I/O list is approved, the PLC I/O addresses shall not be modified without approval by the Engineer.

8. For I/O layout requirements, see the PLC Section 13311.

E. Field Instruments Submittal:

1. Refer to the Instruments section for submittal requirements.

F. Hardware and Software Packages Submittal:

1. Refer to the sections below for specific Hardware and Software Packages submittal requirements:

a. 13311 - PLC Hardware and Software.
b. 13330 - Control Panels and Panel Mounted Equipment.

2. For each hardware and software package component specified in the sections above, submit a cover page that lists, at a minimum, date, specification number, product name, manufacturer, model number, Location(s), and power required. The preferred format for the cover page is ISA-TR20.00.01-2007 , a general data sheet; however, other formats will be acceptable provided they contain all required information.

3. Refer to the Control Panels section for submittal requirements.

G. Spares, Expendables, and Test Equipment Lists Submittal:

1. Submit a list of and descriptive literature for spares, expendables, and test equipment.

2. Submit a list of and descriptive literature for additional spares, expendables, and test equipment recommended by the manufacturer.

3. Submit unit and total costs for the additional spare items specified or recommended for each subsystem.

H. Operations and Maintenance (O&M) Manuals:

1. Submit in accordance with Section 01730

2. The operations and maintenance manuals shall, at a minimum, contain the following information:

a. Table of Contents:

1) A Table of Contents shall be provided for the entire manual with the specific contents of each volume clearly listed. The complete Table of Contents shall appear in each volume.

b. Instrument and Equipment Lists:

1) The following lists shall be developed in Microsoft Excel format and provided not only as a hardcopy in O&M but also electronically on a CD.
2) An instrument list for all devices supplied including tag number, description, specification section and paragraph number, manufacturer, model number, serial number, range, span, location, manufacturer phone number, local supplier name, local supplier phone number, completion year replacement cost, and any other pertinent data.
3) An equipment list for all non-instrument devices supplied listing description, specification section and paragraph number, manufacturer, model number, serial number, location, manufacturer phone number, local supplier name, local supplier phone number, completion year replacement cost, and any other pertinent data.

c. Equipment Operations and Maintenance Information:

1) ISA-TR20.00.01-2007 data sheets shall be provided for all field instruments. For non-field instrumentation devices, provide a cover page for each device, piece of equipment, and OEM software that lists date, specification number, product name, manufacturer, model number, Location(s), and power required. Preferred format for the cover page is ISA-TR20.00.01-2007, general data sheet; however, other formats will be acceptable provided they contain all required information.
2) Vendor O&M documentation for each device, piece of equipment, or OEM software shall be either new documentation written specifically for this project, or modified standard vendor documentation. All standard vendor documentation furnished shall have all portions that apply clearly indicated with arrows or circles. All portions that do not apply shall be neatly lined out or crossed out. Groups of pages that do not apply at all to the specific model supplied shall be removed.

d. As-Built Drawings:

1) Complete as-built drawings, including all drawings and diagrams specified in this section under the "Submittals" section. These drawings shall include all termination points on all equipment the system is connected to, including terminal points of equipment not supplied by the PCSS.

2) As built documentation shall include information from submittals, as described in this Specification, updated to reflect the as-built system. Errors in or modifications to the system resulting from the Factory and/or Functional Acceptance Tests shall be incorporated in this documentation.

e. Original Licensed Software:

1) Submit original software diskettes or CD-ROMs of all software provided under this Contract. Submit original paper based and electronic documentation for all software provided. Submit license agreement information including serial numbers, license agreements, User Registration Numbers and related information. All software provided under this Contract shall be licensed to the District at the time of purchase. Provide media in software sleeves within O&M manual.

f. Electronic O&M Information:

1) In addition to the hard copy of O&M data, provide an electronic version of all equipment manuals and data sheets, along with any software back-up of configuration files, on CDROM or DVD. Electronic documents shall be supplied in Adobe Acrobat format.
2) Provide electronic files for all custom-developed manuals including training manuals. Text shall be supplied in both Microsoft Office format and Adobe Acrobat format.
3) Provide electronic files for all drawings produced. Drawings shall be in AutoCAD ".dwg" format and in Adobe Acrobat format. Drawings shall be provided using the AutoCAD eTransmit feature to bind external references, pen/line styles, fonts, and the drawing file into individual zip files.
4) Each computer system hardware device shall be backed up onto CDROM or DVD after Substantial Completion and shall be turned over to the District.
5) If specified in the training section, provide digital copies of all training videos. Videos shall be in a format that is readable by standard DVD players and by standard PC DVD drives. Format shall be a minimum of 800 by 600 pixels and shall include sound.

3. The cover and edge of each volume shall contain the information as specified in Section 01730.

1.05 COORDINATION MEETINGS

A. Schedule the mandatory coordination meetings as described herein. The meetings shall be held at the District's designated location and shall include attendance by the District, the Engineer, the Contractor, and the PCSS's Project Engineer. Other Division 13 specifications may require additional meetings. Prepare and distribute an agenda for this meeting a minimum of one week before the scheduled meeting date. The meeting shall be scheduled a minimum of one week before the requested meeting date.

1. A project kickoff coordination meeting shall be held within two weeks after submitting the Project Plan. The purpose of the meeting shall be to discuss the PCSS's Project Plan, to summarize the PCSS's understanding of the project; discuss any proposed substitutions or alternatives; schedule testing and delivery deadline dates; provide a forum to coordinate

hardware and software related issues, and request any additional information required from the District. The meeting will last up to one business day.

2. Regular on-site meetings when the PCSS staff is at the plant site.

1.06 REFERENCE STANDARDS

A. Publications are referred to in the text by basic designation only. Where a date is given for reference standards, that edition shall be used. Where no date is given for reference standards, the latest edition in effect at the time of bid opening shall apply.

B. International Society of Automation (ISA):

1. ISA S5.2, Binary Logic Diagrams for Process Operations.

2. ISA S5.3, Graphic Symbols for Distributed Control/Shared Display Instrumentation Logic and Computer Systems.

3. ISA S5.4, Instrument Loop Diagrams.

4. ISA S20, Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves.

5. ISA RP60.3, Human Engineering for Control Centers.

6. ISA RP60.6, Nameplates, Labels, and Tags for Control Centers.

7. ISA-99, Industrial Automation and Control Systems Security.

C. National Electrical Manufacturers Association (NEMA).

D. National Fire Protection Agency (NFPA):

1. NFPA 70, National Electrical Code (NEC).

2. NFPA 79, Industrial Control Equipment.

E. Underwriters Laboratories, Inc. (UL):

1. UL 508 - Industrial Control Equipment - for custom fabricated equipment.

2. A nationally recognized testing laboratory, as approved by the Authority having jurisdiction, may substitute for UL listing on commercial off the shelf products.

1.07 QUALITY ASSURANCE

A. The Process Control System Supplier (PCSS) shall be a "systems integrator" regularly engaged in the design and the installation of instrumentation systems and their associated subsystems as they are applied to the municipal water and wastewater industry. For the purposes of this Specification Section, a "systems integrator" shall be interpreted to mean an organization that complies with all of the following criteria:

1. Employs personnel on this project who have successfully completed ISA or manufacturers training courses on general process instrumentation and configuration and implementation of the specific programmable controllers, computers, and software proposed for this project. Key personnel shall hold ISA CCST Level 1 certification or have a minimum of 10 years of verifiable plant startup experience. Key personnel shall include, as a minimum, the lead field technician.

2. Has successfully completed work of similar or greater complexity on at least three previous projects within the last five years. Successful completion shall be defined as a finished project completed on time, without any outstanding claims or litigation involving the PCSS. Potential references shall be for projects where the PCSS's contract was of similar size to this project.

3. Has been actively engaged in the type of work specified in this Section for a minimum of five years.

B. The PCSS shall maintain a permanent, fully staffed and equipped service facility within 200 miles of the project site with full time employees capable of designing, fabricating, installing, calibrating, and testing the systems specified herein. At a minimum, the PCSS shall be capable of responding to on-site problems within 12 hours of notice. Provide an on-site response within four hours of notification starting at two months before scheduled startup to two months after startup completion.

C. PCSS shall hold a valid UL-508 certification for their panel fabrication facility.

D. Actual installation of the instrumentation system need not be performed by the PCSS's employees; however, the PCSS as a minimum shall be responsible for the technical supervision of the installation by providing on site supervision to the installers of the various components.

E. The selected PCSS shall be one of the following:

1. Rocha Controls, 5025 W. Rio Vista Ave Tampa, FL 33634, Phone: 813-267-3235

2. Revere Control Systems, 4245 Pipkin Rd S, Lakeland, FL 33811, Phone: (863) 860-0574

3. Locher Environmental, 752 Commerce Dr., Suite 3 Venice, FL 34292, Phone: (941) 483-3000

F. Being listed in this specification does not relieve any potential PCSS from meeting the qualifications specified in this Section.

1.08 DELIVERY, STORAGE AND HANDLING

A. Delivery, storage, and handling shall be in accordance with Section [01 66 10] [01600].

B. Shipping Precautions:

1. After completion of shop assembly, factory test and approval of all equipment, cabinets, panels and consoles shall be packed in protective crates and enclosed in heavy duty (five mil) polyethylene envelopes or secured sheeting to provide protection from damage, dust and moisture. Dehumidifiers shall be placed inside the polyethylene coverings. The equipment shall then be skid-mounted for final transport. Lifting rings shall be provided

for moving without removing protective covering. Boxed weights shall be shown on shipping tags together with instructions for unloading, transporting, storing and handling at the job site.

2. Manufacturer's special instructions for field handling, storage and installation required for protection, shall be securely attached to the packaging for each piece of equipment prior to shipment. The instructions shall be stored in resealable plastic bags or other means of protection.

3. None of the control and monitoring equipment shall be shipped to the site until the control room areas comply with specified ambient temperature and humidity. Have qualified personnel accept the equipment on delivery and supervise unloading within the control room areas.

4. If any apparatus has been damaged, such damage shall be repaired at no additional cost to the District.

1.09 NOMENCLATURE AND IDENTIFICATION

A. Field Instrument Tags:

1. See Section 13340.

B. Panel Nameplates:

1. See Section 13330.

1.10 WARRANTY

A. Provide warranty per Section 01740, Warranties and Bonds, and as specified herein.

1.11 MAINTENANCE CONTRACT

A. A written proposal for a maintenance contract executed by the PCSS shall be provided to the District for on-site preventive maintenance services related to the Instrumentation and Control system. The cost of this maintenance contract shall not be included in the Contract Price.

B. This proposal shall be provided within 30 days after final acceptance for the purpose of entering a contract for annual maintenance subsequent to the first year of maintenance. Standard per diem rates for providing breakdown service shall be set forth in the contract. Such rates shall be fair and reasonable and reflect the lowest rates offered to most favored customers. The fee quoted shall be firm for a minimum of 90 days from date of issue.

C. This maintenance contract shall include all labor, parts, and emergency calls providing on-site response within 24 hours, to provide complete system maintenance for a period of one year after the date of Substantial Completion of the system for all equipment and software provided as part of the PCSS scope of work.

D. Provide software updates throughout the maintenance contract period. Provide the latest official released version for all software provided under this Contract. The District shall have the latest software releases at the end of the maintenance contract period.

E. The maintenance contract shall also include a minimum of one preventive maintenance visit by qualified service personnel of the Supplier who is familiar with the type of equipment provided for this project. Each preventive maintenance visit shall include routine adjustment, calibration, cleaning, and lubrication of system equipment and verification of correct operation.

F. Visits to the sites to correct deficiencies under warranty shall not be included in this preventive maintenance service contract.

G. Emergency maintenance procedures or plant visits may coincide with a preventive maintenance visit; however, they shall not replace the work intended to be performed during a preventive maintenance visit. The Supplier shall have full responsibility for the system hardware preventive and corrective maintenance.

H. During the one-year maintenance period, observation of maintenance operations by plant personnel and the instruction of said personnel in the details of the maintenance work being performed, shall be provided.

I. Temperature:

1. Outdoor areas' equipment shall operate between -30 to 50 C degrees ambient.

2. Equipment located in indoor locations shall operate between 10 to 35 C degrees ambient minimum.

3. Storage temperatures shall range from 0 to 50 C degrees ambient minimum.

4. Additional cooling or heating shall be furnished if required by the equipment as specified herein.

J. Relative Humidity. Air-conditioned area equipment shall operate between 20 to 95 percent relative, non-condensing humidity. All other equipment shall operate between five to 100 percent relative, condensing humidity.

PART 2 PRODUCTS

2.01 GENERAL

A. All instrumentation and electronic equipment shall be of the manufacturer's latest design, utilizing printed circuitry and epoxy or equal coating to prevent contamination by dust, moisture and fungus. The field mounted equipment and system components shall be designed for installation in dusty, humid and slightly corrosive service conditions.

B. All instruments shall be provided with mounting hardware and floor stands, wall brackets, or instrument racks unless otherwise noted. Fasteners for securing control panels and enclosures to walls and floors shall be either hot-dipped galvanized after fabrication or stainless steel. Provide stainless steel fasteners only in corrosive areas rated NEMA 4X on the Drawings or as defined under Section 16000. Provide minimum size anchor of 3/8-inch.

C. All indicators shall be linear in process units, unless otherwise noted. All transmitters shall be provided with indicators in process units, accurate to two percent or better.

D. All equipment, cabinets and devices furnished shall be heavy-duty type, designed for continuous industrial service. The system shall contain similar products of a single manufacturer, and shall consist of equipment models, which are currently in production. All equipment provided shall be of modular construction and shall be capable of field expansion.

E. All electronic/digital equipment shall be provided with radio frequency interference protection.

F. Electrical:

1. Equipment shall operate on a 60 Hertz alternating current power source at a nominal 120 volts, plus or minus 10 percent, except where specifically noted. Regulators and power supplies required for compliance with the above shall be provided between power supply and interconnected instrument loop. Where equipment requires voltage regulation, constant voltage transformers shall be supplied.

2. With the exception for field device network connected devices, all electronic instrumentation shall utilize linear transmission signals of isolated 4 to 20 mA DC (milliampere direct current) capable of driving a load up to 750 ohms, unless specified otherwise. However, signals between instruments within the same panel or cabinet may be 1-5 VDC (volts direct current).

3. Outputs of equipment that are not of the standard signals as outlined, shall have the output immediately raised and/or converted to compatible standard signals for remote transmission. No zero-based signals will be allowed.

4. All switches shall have double-pole, double-throw contacts rated at a minimum of 600 VA, unless noted otherwise.

5. Switches and/or signals indicating an alarm, failure or upset condition shall be wired in a fail-safe manner. A fail-safe condition is an open circuit when in an alarm state.

6. Materials and equipment shall be UL approved whenever such approved equipment and materials are available.

7. All equipment furnished shall be designed and constructed so that in the event of power interruption, the systems specified herein shall go through an orderly shutdown with no loss of memory and shall resume normal operation without manual resetting when power is restored, unless otherwise noted.

2.02 ELECTRICAL SURGE PROTECTION

A. General - Surge protection shall be provided to protect the electronic instrumentation system from induced surges propagating along with the signal and power supply lines from lightning, utility, or the plant electrical system. The protection systems shall be such that the protective level shall not interfere with the normal operation but shall be lower than the instrument surge withstand level. Protection shall be maintenance-free and self-restoring. Devices shall have a response time of fewer than 50 nanoseconds and be capable of handling a discharge surge current (at an 8x20µs impulse waveform) of at least eight kA. Ground wires for all instrumentation device surge protectors shall be connected to a low resistance ground in accordance with Section 16660.

B. Provide protection of all analog signal (4-20 mA) circuits where any part of the circuit is outside of the building envelope. Circuits shall be protected at both the transmitter and the control system end of the circuit. Protection devices located near the transmitter shall be mounted in a separate NEMA 4X stainless steel enclosure (plastic is not acceptable) or conduit mounted and shall be SURGETRAB S-PT, or equal. Substitution of a single device to protect both 120 VAC and 4-20 mA wires to an instrument is acceptable. Protection devices in control panels shall be PLUGTRAB PT-IQ, or equal. Provide remote signaling on PLC/OIT for each surge protection status at PLC/OIT.

C. Inductive Loads - Provide coil surges suppression devices, such as varistors or interposing relays, on all process controller outputs or switches rated 120 VA or less that drive solenoid, coil, or motor loads.

2.03 SPARE PARTS

A. All spare parts shall be wrapped in bubble wrap, sealed in a polyethylene bag complete with dehumidifier, then packed in cartons and labeled with indelible markings. Complete ordering information including manufacturer's contact information (address and phone number), part name, part number, part ordering information, and equipment name and number(s) for which the part is to be used shall be supplied with the required spare parts. The spare parts shall be delivered and stored in a location directed by the District or Engineer.

B. Furnish one of each type of installed Surge protection device.

C. Other spare parts are specified in each section. An overview follows:

1. Devices within Control Panels - See the control panels section.

2. Computer Hardware and Software spare parts - See the Computer System Hardware section.

3. PLC spare parts - See the PLC section.

4. Network and Communications System - See the Control and Data Network Equipment section.

5. Instrument related Spare Parts - see the Instrument section(s).

2.04 TEST EQUIPMENT

A. Provide all test equipment, instruction manuals, carrying/storage cases, unit battery charger, special tools, calibration fixtures, cord extenders, patch cords, test leads, and miscellaneous items for checking field operation of all supplied equipment.

B. All test equipment shall be wrapped in bubble wrap, sealed in a polyethylene bag with a dehumidifier, then packed in cartons and labeled with indelible markings. Complete ordering information including manufacturer's part number, and equipment name shall be supplied. The test equipment shall be delivered and stored in a location directed by the Engineer.

C. As a minimum, furnish the following test equipment:

1. One complete electronic process calibrator sets with rechargeable batteries, cases, spare fuses, test leads, and PC-based software. Provide model 830 as manufactured by Altek, or equal.

2. One portable digital multimeter (DMM) with rechargeable battery and test leads, and carrying case, Fluke 289 Industrial Digital Multimeter, or equal. Combing the features of the electronic process calibrator and the DMM such as the Fluke 787 Process meter is acceptable.

3. One calibration pump, Model A-396A as manufactured by Dwyer Instruments, Inc., or equal.

PART 3 EXECUTION

3.01 GENERAL INSTALLATION

A. Instrumentation and accessory equipment shall be installed in accordance with manufacturer instructions. The indicated locations of equipment, transmitters, alarms, and similar devices indicated are approximate only. The exact locations of all devices shall be as approved by the Engineer during construction. Obtain in the field, all information relevant to the placing of process control equipment and in case of interference with other work, proceed as directed by the Engineer and furnish all labor and materials necessary to complete the work in an approved manner at no additional cost to the District.

B. Provide brackets and hangers required for mounting of equipment.

C. The shield on each process instrumentation cable shall be continuous from source to destination and be grounded at only one ground point for each shield.

D. Investigate each space in the building through which equipment must pass to reach its final location. If necessary, ship material in sections sized to permit passing through restricted areas in the building. Provide on-site service to oversee the installation, the placing and location of system components, their connections to the process equipment panels, cabinets and devices, subject to the Engineer's approval. Certify that field wiring associated with the equipment is installed in accordance with best industry practice. Coordinate work under this Section with that of the electrical work specified under applicable sections of Division 16

E. Provide sunshades for equipment mounted outdoors in direct sunlight. Sunshades shall include standoffs to allow air circulation around the cabinet. Orient equipment outdoors to face to the North or as required to minimize the impact of glare and ultraviolet exposure on digital readouts.

END OF SECTION

SECTION 13302
TESTING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required to complete the testing of all devices and systems furnished and installed as detailed on Drawings, and as specified herein.

B. Refer to Section 13300 for other general requirements.

1.02 RELATED WORK

A. Refer to Section 13300.

1.03 SUBMITTALS

A. Refer to Section 13300.

B. Testing Submittals - Submit, in one submittal, the following testing related documents:

1. Status signoff forms:

    a. Develop and submit project specific I/O Status and Automatic Control Strategy signoff forms to be used during factory and field testing to organize and track each loop's inspection, adjustment, calibration, configuration, and testing status and sign off. Include sign-off forms for each testing phase showing all loops.
        1) Example forms are shown in the Appendices.
        2) Separate forms for factory and field testing can be used, or they can be combined, at the discretion of the PCSS.
        3) Submit testing forms prior to start of testing.

2. Testing Procedures:

    a. Submit detailed procedures proposed to be followed for each of the tests specified herein. The test procedures shall serve as the basis for the execution of the required tests to demonstrate that the system meets and functions as specified.
    b. Documents shall be structured in an orderly and easy to follow manner to facilitate an efficient and comprehensive test.
    c. Test procedures shall indicate all pre-testing setup requirements, all required test equipment, and simulation techniques to be used.
    d. Test procedures shall be structured in a cause and effect manner where the inputs are indicated, and the outputs are recorded.
    e. Test procedures shall include the demonstration and validation under normal operating conditions and under various failure scenarios as specified in Contract Documents.
    f. Testing may not start until all Testing Submittals have been approved.

C. Test Documentation:

1. Upon completion of each required test, document the test by submitting a copy of the signed off Testing Status forms. Testing shall not be considered complete until the signed-off forms have been submitted and approved. Submittal of other test documentation, including "highlighted" wiring diagrams with field technician notes, are not acceptable substitutes for the formal test documentation.

1.04 MAINTENANCE

A. Refer to Section 13300.

1.05 COST OF TRAVEL

A. Scheduled tests will only be attended once by Engineer /District. If test is not successful, all subsequent tests will be performed at Contractor's expense. Reimburse District for all costs, including labor and expenses, invoiced by Engineer and incurred by District for subsequent retests.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 TESTING - GENERAL

A. Refer to Section 13300.

B. Results of all testing shall be tracked on a project specific status sign off form or similar document. PCSS shall be responsible for maintaining the sheet. Appendix of this Section has an example template for this sheet.

C. Tests the PCSS is required to perform are as follows:

1. Factory Testing:

a. Unwitnessed Factory Test (UFT).
b. Witnessed Factory Test (WFT).

2. Field Testing:

a. Operational Readiness Test (ORT).
b. Functional Demonstration Test (FDT) (required separately for both Interim Milestone and Final FDT).
c. Site Acceptance Test (SAT) (required separately for both Interim Milestone and Final FDT).

D. Wherever possible, perform tests using actual process variables, equipment, and data. Where it is not practical to test with real process variables, equipment, and data, provide all special testing materials and equipment required for a suitable means of simulation.

E. PCSS shall coordinate all required testing with Contractor, affected Subcontractors, Engineer, and District.

F. No equipment shall be shipped to jobsite until Engineer or District has received all Factory Testing results and approved the system as ready for shipment.

G. Engineer reserves the right to test or re-test any functions.

H. Correction of Deficiencies:

1. Deficiencies in workmanship and/or items not meeting specified testing requirements shall be corrected to meet specification requirements at no additional cost to District.

2. Testing, as specified herein, shall be repeated after correction of deficiencies is made until specified requirements are met. This work shall be performed at no additional cost to District.

3.02 FACTORY TESTING - UNWITNESSED FACTORY TEST (UFT)

A. Purpose of UFT is for PCSS to check system prior to Engineer and/or District attending factory testing. This type of testing shall be part of any quality firm's internal QA/QC procedures.

B. Temporary network connections will be required to confirm the network configuration. Temporary wiring of primary elements, final control elements, and field-mounted transmitters is not required.

C. Hardware to be tested shall include all control system devices shown on System Architecture drawings and provided by PCSS.

D. Tests to be performed shall include, but not be limited to, the following. Each of these tests shall be specifically addressed in Test Procedure submittal.

1. All panels and enclosures being provided shall undergo a thorough inspection to verify integrity of cabinet enclosures, frame structures, paint work and finish, etc. Review panel drawings to ensure they accurately reflect panel layout and wiring.

2. Perform a system audit to verify all components have been staged for test and have been documented properly with correct model numbers, serial numbers, etc. Following documentation of audit shall be provided at factory test and submitted as part of O&M Manual Documentation:

a. For each OIT , list of all software installed (including the operating system), with software revision number, software improvement modules or patches installed, license number and District registration information, warranty period, vendor and local distributor names and contacts.
b. For each microprocessor-based component connected to control communication backbone in system (PLCs, managed switches, protocol converters, communication cards on final field devices, radios, etc.), list firmware revision, vendor and local distributor information, and system, warranty information, configuration parameters (e.g., communication settings, fail position settings, etc.)

3. Panel wire pull tests shall be performed to ensure all wiring has been connected with appropriate torque to prevent wires from coming loose.

4. UPS shall be tested to verify UPS switch power correctly while keeping all UPS powered loads online. Testing of UPS to determine if they have been sized correctly to maintain specified run time shall be performed during field testing.

5. A 100 percent I/O point checkout shall be performed to verify proper operation of input/output points from panel terminations OIT nodes. At a minimum, I/O checkout shall consist of four steps.

    a. Discrete input signals shall be jumpered at field terminal blocks in control panels to verify proper status in OIT nodes.
    b. Analog input signals shall be connected to a signal generator at field terminal blocks in control panels to verify proper status in OIT nodes and signals shall be verified at zero percent, 50 percent, and 100 percent of full scale.
    c. Discrete output signals shall be tested by switching equipment to manual control at OIT nodes and turning the output on or other means to turn the output on. Then verify the output is on by connecting a digital multimeter to measure continuity at terminations, thus verifying command from PLC has properly executed contact closure.
    d. Analog output signals shall be tested by switching the equipment to manual control at OIT nodes and turning output on or other means to turn the output on. Then verify output by utilizing a digital multimeter to measure current or voltage generated at termination points.
    e. All the records transferred and calculated to the Remote Datalogger must be include as part of the I/O test.

6. All control strategies shall be verified using simulation or other means to verify logic performs as expected. Verify faults and logical failure conditions for control strategies such instrument failures, equipment failures, loss of communication between HMI and PLC, loss of peer-to-peer communication, out of range testing (over and under scale) for analog inputs, and all other strategies specified in control strategy document.

7. For each hardware enclosure, inspection shall include, but not be limited to, cabinet enclosures, frame structure, paint work and finish, dimensions, and hardware operability (i.e., fans, door hinges, keylocks, etc.).

8. For each subpanel, inspection shall include, but not be limited to, I/O subsystem physical layout, power supply sizing and mounting, cable routing, wire runs across hinges properly installed, fans and blowers unobstructed and mounted to maximize air flow, power conditioning correctly installed, and overall layout and installation of components meets manufacturer's recommendations and standard industry accepted practices.

9. All other control panel circuitry.

10. Following systems tests shall be performed:

    a. Demonstrate ability to share data between PLC and SCADA.
    b. Demonstrate ability of each workstation to reproduce data provided by PLC.
    c. Demonstrate communication failure and recovering self-healing ring testing.

E. Upon successful completion of UFT, PCSS shall submit a record copy of test results as specified in PART 1. As part of this test results submittal, notify Engineer and District in writing that system is ready for WFT. No other notice of Factory test will be accepted. Engineer and/or District shall schedule a test date within 30 days of receipt of this submittal.

3.03 FACTORY TESTING - WITNESSED FACTORY TEST (WFT)

A. Purpose of WFT is to allow Engineer and/or District representatives to witness functionality, performance, and stability of entire hardware and software system as a complete integrated system. WFT shall be run by PCSS and conducted at PCSS's facility.

B. Required Documents for Test:

1. Clean set of approved panel drawings and wiring diagrams.

2. Set of Contract Documents - all drawings and specifications.

3. All design change related documentation.

4. Master copy of the PCSS developed factory testing signoff forms.

5. Testing procedures.

C. System shall operate continuously throughout WFT without failure, except where initiated per established test procedures. Unanticipated failures may, at District or Engineer's option, result in overall WFT being deemed unsuccessful. All deficiencies identified during these tests shall be corrected and re-tested prior to completing WFT or shipment of panels to jobsite as determined by District/Engineer.

D. Tests to be performed during the WFT shall include, but not be limited to, the following:

1. A repeat of all tests specified in the UFT.

E. Daily schedule during these tests shall be as follows:

1. Morning meeting to review the day's test schedule.

2. Scheduled tests and sign-offs.

3. End of day meeting to review day's test results and to review or revise next day's test schedule.

4. Unstructured testing period by witnesses.

F. Upon successful completion of WFT, PCSS shall submit a record copy of test results as specified in PART 1.

3.04 FIELD TESTING - OPERATIONAL READINESS TEST (ORT)

A. Purpose of ORT is to check with Engineer and/or District representatives that process equipment, instrument installation, instrument calibration, instrument configuration, field

wiring, control panels, and all other related system components are ready to monitor and control the processes. This test will determine if equipment is ready for operation.

B. This test shall take place prior to FDT and startup. Prior to starting this test, relevant process equipment shall be installed and mechanically tested, instruments installed, control panels installed, and field wiring complete.

C. Required Documents for Test:

1. Master copy of the PCSS developed field testing signoff forms.

2. Testing procedures.

3. Calibration forms.

D. These inspections, calibrations, and tests do not require witnessing. However, Engineer may review and spot-check testing process periodically. All deficiencies found shall be corrected by PCSS prior to commencement of Functional Demonstration Test.

E. PCSS shall maintain Sign-off forms and Calibration forms at job site and make them available to Engineer/District at any time.

F. Following tests shall be performed as part of ORT:

1. Instrument calibration, configuration, and set-up.

2. Input/Output (I/O) Testing to OITs.

3. Testing of control strategies.

G. Instrument calibration, configuration, and set-up:

1. Calibrate, configure, and set-up all components and instruments to perform specified functions.

2. Calibration form:

a. For any component or instrument requiring dip switch settings, calibration, or custom configuration, maintain a calibration form in field documenting this information. These forms shall provide a summary of the actual settings used in the field to allow an Instrument technician to replace the device entirely and configure it to function as it did before.
b. This information shall be added to Instrument data sheet, shall be added to a copy of manufacturer's standard "Configuration Sheet", or a separate form shall be created.

1) If a separate form, the form shall list Project Name, Loop Number, ISA Tag Number, I/O Module Address, Manufacturer, Model Number/Serial Number, Output Range and Calibrated Value.

c. Some examples of required information are:

1) For Discrete Devices: Actual trip points and reset points.
2) For Instruments: Any configuration or calibration settings entered into instrument
3) For Controllers: Mode settings (PID).
4) For I/O Modules: Dip switch settings, module configuration (if not documented in native programming documentation).

d. Maintain a copy of these forms in field during testing, and make them available for inspection at any time.
e. For any device that allows a software back-up of configuration files to a laptop, make configuration files available to Engineer/District for inspection. Submit as part of Final System Documentation as specified in Section 13300.

H. I/O Testing:

1. Purpose of I/O testing is to check that process equipment, instrument installation, calibration, configuration, field wiring, and control panels are set-up correctly to monitor and control the processes. This test is commonly referred to as a "loop test" or an I/O checkout.

2. PCSS in conjunction with Contractor shall test signals under process conditions. Preferred test method will always be to execute test wherever possible to end elements. For example, preferred test will prove valve open/close limit switches by operating valve, not by installing a jumper on limit switch contacts. However if equipment or process is not available to test a signal over its entire calibrated range, PCSS may test using a simulation methods and make a note on sign-off form.

3. The following I/O tests shall be performed:

a. Discrete Input: At device or instrument, change signal condition from inactive to active state. Observe results on all indicators within loop such as, OIT screens, pilot lights, horns, beacons, etc.
b. Analog Input: Test analog signal over entire engineering range at various intervals including 0, 50%, and 100% as well as on increasing and decreasing range. Observe results on all indicators within loop such as, OIT screens, recorders, digital indicators, etc.
c. Discrete output signals shall be tested by switching equipment to manual control at the OIT nodes and turning output on or using other means to turn output on. Then verify equipment responds accordingly.
d. Analog output signals shall be tested by switching equipment to manual control at OIT nodes and turning output on or other means to turn output on. Then verify equipment responds accordingly.

I. Testing of Automatic Control Strategies:

1. All automatic control strategies shall be verified using actual process equipment and instruments, or other means, to verify logic performs as expected. Verify faults and logical failure scenarios for control strategies such as instrument failures, equipment failures, loss of communication between HMI and PLC, loss of peer-to-peer communication, out of

range testing for analog inputs, loss of power, and all other strategies specified in control strategy document.

J. Repeat all systems tests specified under factory testing.

K. UPS shall be tested to verify UPS switch power correctly while keeping all UPS powered loads online. Also, test sizing of UPS by switching off line power to UPS and verify if they maintain specified run time.

L. For all panels with enclosures modified by this Contract, internal control panel temperature shall be tested under full running conditions to ensure proper cooling/ventilation is being provided.

M. Upon successful completion of ORT, PCSS shall submit a record copy of test results as specified in PART 1 and request scheduling of FDT.

3.05 FIELD TESTING - FUNCTIONAL DEMONSTRATION TEST (FDT)

A. After facility is started-up and running treatment process in automatic control to extent possible, a Functional Demonstration Test shall be performed. Purpose of FDT is to allow Engineer and/or District representatives to witness actual functionality, performance, and stability of system while connected to process equipment. An Interim Milestone FDT and Final FDT shall be performed. See Section 11214 Vertical Turbine Pumps and the Agreement for requirements of an Interim Milestone and Delayed Startup/Testing Schedule. Communications with the Districts remote workstation shall be included in both the Interim Milestone FDT and Final FDT.

B. Required Documents for Test:

1. Set of panel drawings and wiring diagrams from ORT with corrections noted

2. Set of Contract Documents - all drawings and specifications.

3. All design change related documentation.

4. Signed-off master copy of the PCSS developed field testing signoff forms.

5. Testing procedures.

6. Copy of completed calibration forms.

7. One copy of all O & M Manuals for PCSS supplied equipment.

C. A witnessed FDT shall be performed on each process area. To extent possible, repeat testing performed during ORT.

D. Daily schedule specified to be followed during factory tests shall also be followed during FDT.

E. After coordinating with Operations, a "Black Start" of the plant shall be performed to confirm plant operation recovers as specified in Contract Documents. Black start means shutting off power to the plant and turning it back on. Separate tests shall be performed by recovering the plant while on generator (if a generator is specified) and while on utility power.

F. Punch list items and resolutions noted during test shall be documented on Punch list/Resolution form. In event of rejection of any part or function test procedure, PCSS shall perform repairs, replacement, and/or retest within 10 days.

G. Upon successful completion of the FDT, PCSS shall submit a record copy of test results as specified in "Part 1 - General".

3.06 FIELD TESTING - SITE ACCEPTANCE TEST (SAT)

A. After completion of FDT, and system is started-up and running treatment process in automatic control to extent possible, system shall undergo a test as defined in Division 01 "Equipment Testing and Start-up" Section.

An Interim Milestone SAT Final SAT shall be performed. See Section 11214 Vertical Turbine Pumps and the Agreement for requirements of an Interim Milestone and Delayed Startup/Testing Schedule.

B. While this test is proceeding, Engineer and District shall have full use of system. Only plant operating personnel shall be allowed to operate equipment associated with live plant processes. Plant operations shall remain responsibility of District and decision of plant operators regarding plant operations shall be final.

C. During this test, PCSS personnel shall be present as required to address any potential issues that would impact system operation. PCSS is expected to provide personnel for this test who have an intimate knowledge of hardware and software of system. When PCSS personnel are not on-site, PCSS shall provide cell phone/pager numbers that District personnel can use to ensure that support staff is available by phone and/or on-site within four hours of a request by operations staff.

D. Any malfunction during test shall be analyzed and corrections made by PCSS. In event of rejection of any part or function, PCSS shall perform repairs or replacement within five days.

E. Throughout duration of SAT, no software or hardware modifications shall be made to system without prior approval from District or Engineer.

3.07 CERTIFICATE OF INSTALLATION

A. Following successful completion of SAT test, PCSS shall submit a Certification of Installation for system as required in Division 01 "Equipment Testing and Start-up" Section.

END OF SECTION

APPENDIX 13302-A: EXAMPLE INPUT/OUTPUT (I/O) STATUS SIGN OFF FORM

An example template for I/O Status signoff form to be used for documenting testing results to District is attached. PCSS is required, prior to testing, to create a project specific I/O Status signoff form based on attached template or approved equal. PCSS may obtain an electronic copy of template from Engineer or develop it on their own.

APPENDIX 13302-B: EXAMPLE AUTOMATIC CONTROL STRATEGIES SIGN OFF FORM

An example template for Automatic Control Strategies signoff form to be used for documenting testing results to District is attached. PCSS is required, prior to testing, to create a project specific Automatic Control Strategies signoff form based on attached template or approved equal. PCSS may obtain an electronic copy of template from Engineer or develop it on their own.

4-Jun-14

[Project Name] Appendix A - Input/Output (I/O) Status Sign-Off Form

All Sections below are required to be filled out by PCSS as part of Field Testing.
Instrument Alarm Setpoint - Setpoint for any alarms set in PCSS
Wiring Complete - Signal wired from field device to PLC
I/O Tested - Signal tested from field device to SCADA HMI

PLC	Signal Tag	Description	Range or Active State when closed	P&ID	Signal	Rack	Slot	Channel	Instrument Alarm Setpoint	Calibrate, config., and Wiring complete	Date	PCSS I/O testing	Date	I/O Testing to the HMI	Date	Notes
PLC-SC	LIT-4000-3	Secondary Clarifier No. 1 Sludge Level	0-10 ft	8	AI	2	1	0								
PLC-SC	LIT-4010-3	Secondary Clarifier No. 3 Sludge Level	0-10 ft	8	AI	2	1	1								
PLC-SC	SI-4100-1	RAS Pump No. 1 Speed Feedback	0-100%	14	AI	2	1	2								
PLC-SC	SI-4100-4	RAS Pump No. 4 Speed Feedback	0-100%	15	AI	2	1	3								
PLC-SC	FIT-4102-1	RAS Flow Pumps 1-3	0-1900 GPM	14	AI	2	1	4								
PLC-SC	SI-4110-1	WAS Pump No. 1 Speed Feedback	0-100%	14	AI	2	1	5								
PLC-SC	N/A	Spare Slot	N/A	N/A	Spare	2	5	N/A								
PLC-SC	SC-4100-1	RAS Pump No. 1 Speed Setpoint	0-100%	14	AO	2	7	0								
PLC-SC	SC-4100-2	RAS Pump No. 2 Speed Setpoint	0-100%	14	AO	2	7	1								
PLC-SC	SC-4100-3	RAS Pump No. 3 Speed Setpoint	0-100%	14	AO	2	7	2								
PLC-SC	SC-4110-1	WAS Pump No. 1 Speed Setpoint	0-100%	14	AO	2	7	3								
PLC-SC	Spare	Spare	N/A	N/A	AO	2	7	4								
PLC-SC	Spare	Spare	N/A	N/A	AO	2	7	5								
PLC-SC	TSH-4000-1	Secondary Clarifier No. 1 High Temp	Normal	8	DI	3	1	0								
PLC-SC	XA-4000-1	Secondary Clarifier No. 1 Motor Overload	Normal	8	DI	3	1	1								
PLC-SC	WAH-4000-1	Secondary Clarifier No. 1 High Torque	Normal	8	DI	3	1	2								
PLC-SC	WAHH-4000-1	Secondary Clarifier No. 1 High High Torque	Normal	8	DI	3	1	3								
PLC-SC	YRI-4000-1	Secondary Clarifier No. 1 On/Off	On	8	DI	3	1	4								
PLC-SC	YCI-4000-1	Secondary Clarifier No. 1 In Remote	In Remote	8	DI	3	1	5								
PLC-SC	YFI-4100-1	RAS Pump No. 1 VFD Fault	Normal	14	DI	3	1	6								
PLC-SC	FAL-4100-1	RAS Pump No. 1 Low Flow	Normal	14	DI	3	1	7	50 GPM	RJM	12/18/2011	JAS	12/22/2011	MIC	12/29/2011	Example completed line
PLC-SC	Spare	Spare	Normal	14	DI	3	1	8								
PLC-SC	YRI-4100-1	RAS Pump No. 1 Running	Running	14	DI	3	1	9								
PLC-SC	YCI-4100-1	RAS Pump No. 1 In Remote	In Remote	14	DI	3	1	10								
PLC-SC	YFI-4110-1	WAS Pump No. 1 VFD Fault	Normal	14	DI	3	1	11								
PLC-SC	FAL-4110-1	WAS Pump No. 1 Low Flow	Normal	14	DI	3	1	12								
PLC-SC	Spare	Spare	Normal	14	DI	3	1	13								
PLC-SC	YRI-4110-1	WAS Pump No. 1 Running	Running	14	DI	3	1	14								
PLC-SC	YCI-4110-1	WAS Pump No. 1 In Remote	In Remote	14	DI	3	1	15								
PLC-SC	HSS-4000-2	Secondary Clarifier No. 2 Start Command	Start	8	DO	4	6	0								
PLC-SC	Spare	Spare	N/A	N/A	DO	4	6	1								
PLC-SC	HSS-4100-2	RAS Pump No. 2 Start Command	Start	14	DO	4	6	2								
PLC-SC	HSS-7000-2	Sludge Holding Tank Blanket No. 2 Start Command	Start	17	DO	4	6	3								
PLC-SC	HSS-4100-5	RAS Pump No. 5 Start Command	Start	15	DO	4	6	4								
PLC-SC	Spare	Spare	N/A	N/A	DO	4	6	5								
PLC-SC	HSS-4105-1	Secondary Scum Pump No. 2 Start/Stop	Start	15	DO	4	6	6								
PLC-SC	HSS-4110-2	WAS Pump No. 2 Start/Stop Command	Start	15	DO	4	6	7								
PLC-SC	7160-FQI-1	Sludge Loadout LCP Pumping Indicator	Pumping	17	DO	4	6	8								
PLC-SC	Spare	Spare	N/A	N/A	DO	4	6	9								
PLC-SC	HSS-7115-2	Sludge Holding Tank Mixer No. 2 Start	Start	17	DO	4	6	10								
PLC-SC	Spare	Spare	N/A	N/A	DO	4	6	11								
PLC-SC	HSO-7117-2	Sludge Holding Tank Discharge Valve No. 2 Open CMD	Open	17	DO	4	6	12								
PLC-SC	HSC-7117-2	Sludge Holding Tank Discharge Valve No. 2 Close CMD	Close	17	DO	4	6	13								
PLC-SC	HSS-7120-2	TS Transfer Pump No. 2 Start Command	Start	17	DO	4	6	14								
PLC-SC	Spare	Spare	N/A	N/A	DO	4	6	15								

Page 1 of 1

4-Jun-14

[Project Name] Appendix B - Automatic Control Strategies Sign-Off Form

All Sections below are required to be filled out by PCSS as part of Testing

Auto. Control Strategies. - Loop operational in Automatic as defined in Control Stategies

Control Strategies Loop #	Control Strategy Description	P&ID	Auto. Control Strategy	Date	Notes
LOOP 281 - 284	LOW FLOW PUMPS	8			
LOOP 290	LOW EQ CHANNEL FLOW NO.4	8			
LOOP 300	MICROFILTRATION AIR SUPPLY LOW PRESSURE	10			
LOOP 351, 352	SITE LIFT STATION PUMP NO.1 AND NO. 2	12			
LOOP 355	SITE LIFT STATION HIGH AND LOW LEVEL CONTROL	12			
LOOP 371, 372	SLUDGE HOLDING TANK NO.1 AND NO. 2 LEVEL	14			
LOOP 381, 382	SLUDGE TRANSFER PUMPS	14			
LOOP 385	SLUDGE TRANSFER PUMPS REMOTE START/STOP COMMAND	14			
LOOP 700	EFFLUENT PUMPING STATION LEVEL	14			
LOOP 701, 702, 703	EFFLUENT PUMP NO.1	14			
LOOP 840	POST AERATION CHANNEL AIR FLOW CONTROL	15			
LOOP 900	SLUDGE TRANSFER PUMPS DISCHARGE FLOW	8			
LOOP 971	CENTRIFUGE SLUDGE FEED PUMP NO.1	8			
LOOP 1001	CENTRIFUGE NO.1 SLUDGE FEED FLOW CONTROL	8			
LOOP 1411, 1412	SODIUM HYPOCHLORITE STORAGE TANKS LEVEL	8			
LOOP 1421, 1422	SODIUM HYPOCHLORITE PUMPS	8			
LOOP 1430	SODIUM HYPOCHLORITE STORAGE TANKS CONTAINMENT AREA HIGH LEVEL DETECTION	14			
LOOP 2051, 2052, 2053	DIESEL ENGINE GENERATOR STATUS	14			
LOOP 2055	TRANSFER SWITCH STATUS	14			
LOOP 2060	GENERATOR KILOWATTS MONITORING	14			
APPENDIX ONE	EQUIPMENT RESTART DURING A POWER LOSS WITH THE GENERATOR RUNNING	14			
APPENDIX TWO	EQUIPMENT RESTART WITH POWER RESTORED AFTER A POWER LOSS	14			
N/A	SELF-HEALING CAPABILITIES OF NETWORK	N/A			
N/A	REDUNDANT SCADA SERVER FAILOVER AND RECOVERY	N/A			

SECTION 13305
CONTROL DESCRIPTIONS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section is provided to clarify the control strategies to be used to program the system.

B. All PLC controller programming and SCADA Operator Interface Terminal (OIT) or Operator Workstation Station (OWS) graphics and programming shall be performed as defined in Section 13300.

1.02 RELATED WORK

A. Refer to Section 13300 “I & C - General Provisions.”

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. The control descriptions are broken into areas. The following is a list of areas and the loop numbers associated with each area.

1.	Tank Monitoring	2010
2.	Cell Flow monitoring	2030/2060
3.	Cells Sequence	2020/204X (X = 1/2/3/4/5/6)

B. The control descriptions are sorted by loop number for each area. The loop index has three columns associated with it; Loop Number, Loop Description, and Page. Each loop is associated with a specific PLC I/O cabinet location to which it shall communicate.

C. The control descriptions are broken into a hierarchical layer concept. There may be one layer or multiple layers per loop, depending upon that loop. An example of multiple layered loop is as follows. The lowest layer of control, local control, is at that piece of equipment or that piece of equipment's panel or drive. The second layer of control is at an intermediate control panel, if shown on drawings, between the equipment and the PLC I/O or vendor's PLC I/O. The third layer would be at the vendor's PLC or microprocessor touchscreen station. The highest layer of control is by the PLC System, if shown on drawings, with its Local Operator Interface Terminal (OIT) and SCADA workstation (VTSCADA), if shown on drawings, in the main control room, remote office locations, or local PLC panel.

D. Integrate data to remote datalogger in PLC

3.02 CONTROL FUNCTION DEFINITIONS AND GENERAL CRITERIA

A. The hardware and/or software functions noted by this paragraph reference are to be implemented by the OIT/PLC control system specified herein.

B. The following list of ISA abbreviations is typical of those utilized. The description, following the abbreviation, summarizes the basic function to be implemented in the OIT/PLC software.

1. HS: Represent selector switches or pushbuttons, which shall be implemented by keyboard entry. Function shall be similar to their hardware counterparts. Examples are as follows:

   a. HS-Valve Open Command
   b. HS-Valve Close Command
   c. HS-Motor Start/Stop Command

2. RL/HS/XS: Represents equipment status (i.e., availability, running, in remote, etc.) implemented by a change of color on the OIT symbol for this equipment. For motor driven equipment such as pumps, blowers, compressors, etc., availability contact represents remote operation and no alarm conditions. Examples are as follows:

   a. HS-Selector switch in computer, auto or remote position
   b. RL-Motor running status
   c. XS-Motor failure or overload status

3. PAL, AAH, UA, etc.: Represent high or low alarms implemented on the OWS.

4. FIC, PIC, AIC, etc.: Represent PID process controllers implemented in a computer logic algorithm incorporating proportional, integral, and/or derivative modes. Local/remote and manual/auto capabilities shall be provided.

5. FIK, PIK, AIK, etc.: Represent control stations implemented in logic (via keyboard entry and CRT display) to allow downloading of a set point to a FIC, PIC, AIC, etc., and display of the process variable or controller output.

6. FI, PI, AI, etc.: Represent digital output display on the CRT of a process variable in engineering units and/or a dynamic representation of the variable by symbol or graphical means.

7. FIR, PIR, AIR, Represent values stored on the hard disk to provide the data for historical trend graphics of process variables against time (or other selected variables).

8. ZSH, ZSL etc.: Represent high or low, open or close limit positions implemented on the OWS

C. All interlocks that are represented, before the local operational descriptions, or are stated as hardwired interlocks, shall interlock all the controls locally and at the OIT/PLC or at the vendor PLCs.

D. All flow shall be totalized and show the following register on the OIT screen:

1. Total today
2. Yesterday Total.
3. Total current month
4. Total last month.

E. All status and register shall be able to be recorded on the Remote datalogger.

F. All interlocks that are represented in a particular layer of the operational descriptions, shall interlock all the controls in that layer and the layer after it. However, the interlock shall not interlock the commands in the layer before it.

G. The OIT system shall stop a motor or drive in its program if it does not receive the auto or remote status or one of its software interlocks trip. If the drive or motor is in hand or remote it will continue to run but the OIT start/stop output will be open.

H. All motor operated valves that are requested to open by an operator or an automatic program shall alarm if the open feedback status for that valve does not activate within ten seconds. All valves that are requested to close by an operator or an automatic program shall alarm if the close feedback status for that valve does not activate within 10 seconds.

I. Motors operator's that have an H/O/A shall indicate to the operator that the motor operator's is being run in the "Hand" position. A motor operator's is being run in "Hand" when the "Auto" position is not true, and the run confirm status is true. If not in "Auto" the PLC shall open up its output contact to stop (shutdown) the pump from OIT.

J. Motors operators shall be programmed to restart on normal power if that motor is still in auto when the motor stops due to a power outage. If a motor stops and the HOA switch is not in auto, the motor shall not be restarted automatically by the OIT without operator or OIT logic intervention. Thus, the only way that motor when placed back in auto can be started by the OIT is if the operator reinitiates the start command for that motor on the OWS or when that motor operators control at the OWS is placed in complete automatic mode and the SCADA computer through logic/interlocks requests the motor to run.

K. Terminology associated with interlocks is as follows:

1. When a contact or status is true, the OIT computer will receive power to its input channel. The OIT computer registers this as a binary bit of one.

2. When a contact or status is false, the OIT computer will receive no power (open circuit) to its input channel. The OIT computer registers this as a binary bit of zero.

L. When an analog signal goes outside the 4-20 mA range due to a failure at the instrument or PLC card, the following OIT programming shall take place:

1. Alarm the signal at any local OITs

2. If the analog signal is used in a calculation, that calculation shall use the last good analog signal. The computer shall place the control loop in manual if using the calculation.

M. All interlocks that shutdown (Stop a piece of equipment and prevent it from being restarted or moved) shall be shown on the faceplate pop-up graphic for that piece of equipment.

N. The run confirms or on status of all motors and lamps shall be accumulated to calculate a run time status of the equipment on the OIT graphic. Each run time accumulation shall come with a reset button on the OIT screen.

O. All flow indications shall be totalized. Do not totalize if the analog signal is outside the 4-20 mA range. Each flow totalization shall come with a reset button on the HMI screen. Do not totalize if the value of the flow input is less than two percent of the full range of the input.

LOOP INDEX

LOOP 2100/204X TANK MONITORING

General: Level monitoring
Control:

Local:

None

PLC /OIT:

The PLC shall provide instant level to be display on the OIT

Alarms / Monitoring:

Local:

None

PLC/OIT:

Level indications (LI-2010/204X)
High - High Level alarm (LSHH-2010/204X))
High Level alarm (LSH-2010/204X))
Low Level alarm (LSL-2010/204X))
Low – Low Level alarm (LSLL-2010/204X))

SCADA/ Remote DataLogger:

Events
- High - High Level alarm (LSHH-2010/204X))
- High Level alarm (LSH-2010/204X))
- Low Level alarm (LSL-2010/204X))
- Low – Low Level alarm (LSLL-2010/204X))

Record
- Level indications (1 Hour sample)
- Level average (1 Hour rolling average)

Daily Level Max
Daily Level Min

LOOP 2030/2060 FLOW MONITORING

Flow monitoring and flow totalization
Control:

Local:

None

PLC /OIT:

The PLC shall provide instant flow and flow totalization to be display on the OIT The PLC shall calculate the effluent flow FI-2060 based on the level of the Weir structure according to the following equations.

$Q = 3.33 \times L \times (H^{1.5})$

where:

Q = flow (cfs)
L = weir length (ft.)
H = height of water above weir crest (ft)

Alarms / Monitoring:

Local:

None

PLC/OIT:

Flow indications FIT-2030/2060 (cfs/gpm)
Flow Totalization FQ-2030/2060 (cf/gallons)

SCADA/Remote Datalogger:

Record
Flow indications (1 Hour sample)
Daily Flow average
Daily Flow Max
Daily Flow Min
Flow Totalization
Daily Totalization

`

LOOP 2220/204X CELLS SEQUENCE

General: Control water flow through phosphorous elimination media

Control:

Local:

The valves must be able to be locally open or close through actuator O/S/C and HS selectors as shown on P&IDs.

Remote:

The O/C valves must be able to manually be open or close by the operator remotely from the OIT.
The Modulate valves must be able to manually be positioned by the operator remotely from the OIT.

PLC /OIT:

Interlock.

1) The cell X (X=1/2/3/4/5/6).in the lead position for treatment will be ready for automatic treatment when the level is below the low limit for LSL-204X and all the cell valves MOV-204XA, MOV-204XB and MOV-205 are in remote automatic mode.

Automatic.

1) The operator must be able to enable/disable each cell from the sequence from the OIT and SCADA workstation.
2) The operator must be able to define from the OIT and SCADA workstation the lead cell X to be placed in the sequence queue. (X=1/2/3/4/5/6).
3) The operator must be able to define the position on the queue for automatic treatment from OIT and SCADA workstation.
4) The operator must be able to define from the OIT and SCADA workstation the cell treatment level setpoint LHK-2010 and desire volume to be treated FQK-2030A.
5) The operator must be able to define the flow setpoint FK-2030A to be dosage to the Cell X from the OIT and SCADA workstation.
6) The operator must be able to define from the OIT and SCADA workstation the cell maximum level limit setpoint for each cell LHS204X.
7) The operator must be able to define from the OIT and SCADA workstation the residence time KK-2020A of water in the media before opening the cell outlet valve MOV-205X
8) When the LT-2010 is above LHK-2010, the cell X in the lead position for treatment the following steps must executed:

    a) The cell outlet valve MOV-205X must be commanded to close and desire treated volume totalizer in FIRQ-2030 must be reset to zero.

b) When MOV-205X close limit switch is active, the two-inlet valve MOV-204XA and MOV-204XB and the tank outlet valve MOV-2020 enable to modulate by a PID Flow Controller to maintain the flow setpoint FK-2030A
c) As soon as any of the valves in step 8.b are in transit to open the PLC will proceed to totalize the volume into the cell X by FIQ-2030A.
d) When FIQ-2030 reach the desire treated volume setpoint FQK-2030A. or when LT-204X is above the setpoint for LHS204XAA the inlet valves MOV-204XA and MOV-204XB and the tank outlet valves MOV-2020 must closed.
e) When both valves MOV-204XA and MOV-204XB are closed, the residence timer of water on the media will start counting. The cell outlet valve MOV-205X will remain closed until the residence timer is completed, when the valve MOV-205X must be commanded to open.
f) The sequence for a cell will be considered complete when the cell level reach low-low level or when the displace volume through FIQ2060 reach the treated volume in FQ2030A
g) When a current active cell open MOV-205X the next cell available in the sequence queue must be set lead position.

9) The sequence must go to step 8.

Alarms / Monitoring:

PLC/OIT:

Cells Valves Open/Close status and mode of operation MOV-204XA/B
Outlet Tank position and mode of operation MOV-2020
Cell outflow valve status and mode of operation MOV-205X
Tank Inlet Flow and total FIRQ-2000
Tank level LIR-2010
Tank High Level alarm LAHH-2020
Tank Outlet Flow and Total FIRQ-2030
Tank Outlet Flow PID controller FIC-2030
Daily Volume treated inflow by Cell FIRQ-2030
Daily Volume treated outflow by Cell FIRQ-2060
Cell Level LIR-204X
Cells Outflow and Total FIRQ-2060
Cell residence remaining timer.
Cell Inlet Low Flow Alarm when FIT-2030 is below low dosage limit
Cell Outlet Low Flow Alarm when FIT-2060 is below low cell outflow

SCADA:

Events
Treatment Cell X treatment start
Treatment Cell X Treatment End
Treatment Cell X common alarm.

Command

Tanks Low Level setpoint LLK-2010
Tank High Level setpoint LHK-2010
Cells Low Level setpoint LLK-204X
Cells High Level setpoint LHK-204X
Cells Dosage Interval setpoint XK-204X
Cells Enable/Disable HS-204XA
Cells Volume Treated setpoint FKQ-2030
Tank Outlet Flow setpoint FK-2030
Cell Residence time setpoint

Status/Indication/Alarm

Cells Valves Open/Close status and mode of operation MOV-204XA/B
Outlet Tank position and mode of operation MOV-2020
Cell outflow valve status and mode of operation MOV-205X
Tank Inlet Flow and total FIRQ-2000
Tank level LIR-2010
Tank High Level alarm LAHH-2020
Tank Outlet Flow and Total FIRQ-2030
Tank Outlet Flow PID controller FIC-2030
Daily Volume treated inflow by Cell FIRQ-2030
Daily Volume treated outflow by Cell FIRQ-2060
Cell Level LIR-204X
Cells Outflow and Total FIRQ-2060
Cell residence remaining timer.
Cell Inlet Low Flow Alarm when FIT-2030 is below low dosage limit
Cell Outlet Low Flow Alarm when FIT-2060 is below low cell outflow

SCADA/Remote Datalogger:

Daily Total Volume treated inflow by Cell FIRQ-2030
Daily Total Volume treated outflow by Cell FIRQ-2060

END OF SECTION

SECTION 13306
INSTRUMENTATION AND CONTROLS – APPLICATIONS ENGINEERING SERVICES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Refer to Section 13300.

B. If referred to anywhere else in the project manual, Application Engineering (AE) or Applications Engineering System Supplier (AESS) services are those services specified in this Section. If the Process Control System Supplier (PCSS) is providing Application Engineering services, then the terms PCSS and AESS shall be considered equivalent.

C. Provide all programming, configuration, and related services required to achieve a fully integrated and operational system as specified herein. All equipment shall be controlled in full conformity with the contract drawings, process control descriptions, specifications, engineering data, instructions, and recommendations of the equipment manufacturer. Coordinate the control system for proper operation with related equipment and materials furnished by other suppliers under other Sections of these specifications and with related existing equipment.

1. Provide programming of the Programmable Logic Controllers (PLCs) provided for all equipment shown on the drawings, except for controls equipment shown being provided as part of a vendor package system.

2. Provide configuration of the Operator Interface Terminals, datalogger and related software and drivers provided for all equipment shown on the drawings, including equipment provided by vendor package systems.

3. Provide configuration of firewall and cellular equipment.

4. Provide for and test communications and functionality between all connected devices such as PLCs, the OIT, Dataloggers, and related software packages, including devices supplied by others, as depicted on the system architecture drawings in order to provide a comprehensive working system of data collection, storage, and reporting.

5. Provide integrations of data provided from SJRWMD as shown in drawings.

D. All work shall be coordinated with plant operating personnel to minimize impacts on daily operation. Delays caused for any reason shall be noted and formally submitted to the Engineer and the District in the form of a letter.

1.02 RELATED WORK

A. Refer to Section 13300.

1.03 SUBMITTALS

A. Provide all required submittals in accordance with Section 01300, Submittals. The submittals listed below shall be provided as a minimum.

1. System Standards and Conventions

2. Operator Interface

3. Controller Program

4. Operations and Maintenance Manuals

5. Remote Datalogger

B. Supplement to Project Plan Submittal

1. Supplement the "Project Plan, Deviation List, and Schedule" submittal in Section 13300 by adding the following items to the submittal requirements:

a. List of all graphics intended to be created for this project.
b. List of all PLC programs that will be created or modified for this project.

C. Supplement to Input/Output (I/O) List Submittal

1. Supplement the "Input/Output (I/O) List " submittal in Section 13300 by adding the following item to the submittal requirements:

a. LOGICAL POINT ADDRESS: I/O address of each point.

D. System Standards and Conventions Submittal

1. Submit the standards and conventions that will be used on this project. The submittal shall define, at a minimum:

a. Graphic display standards, including color conventions, equipment symbols, display format, equipment control pop-up displays, trend displays, and display navigation. Include samples of each proposed type of graphic display (i.e., overview, detail, diagnostic, tabular, etc.)
b. System naming conventions, such as graphic display naming, database naming, tag names, and computer naming.
c. System configuration, including network addressing for all provided equipment.
d. Alarm configuration standards, including priorities and logging
e. Security configuration standards, including user groups and privileges
f. PLC standard programming modules, including analog input scaling, flow totalization, equipment runtime, motor start/stop, valve open/close, and any other standard logic planned to be used.

2. To facilitate the District's future operation and maintenance, the submitted standards and conventions shall be used as the basis for programming and configuration of the system. System programming and configuration shall not begin prior to the System Standards and Conventions Submittal.

E. Operator Interface

1. Following the approval of the standards and conventions submittal, submit a draft of all proposed graphic displays, examples of each type of pop-up (faceplate) display, and examples of trends. For those graphics which will be duplicated more than once for a similar type of equipment, submit the graphics for the first equipment only.

2. Following the draft graphics review meeting and prior to the factory test, submit a ready-for testing version of all graphic displays. These graphics should be completely finished other than the incorporation of comments and changes resulting from testing.

3. Submitted graphic displays and trends shall be no less than A4 paper and in full color.

F. PLC/Remote Datalogger Program Submittal

1. For each controller, submit the following using the controller manufacturers built in printing functions. Electronic submission of Adobe Portable Document Format ("pdf") files in lieu of paper submittals is acceptable. A review will be for general program organization, level of documentation, and overall programming standards (basic pump and valve control, for example). The review will not attempt to confirm the logic works correctly for every loop.

    a. Programs showing ladder logic, Scripting program for Remote datalogger, function block, high-level language, or other controller language used. Include individual rung, network, and/or command descriptions with abundant comments to clearly identify the function and intent of each code segment. Each logic segment shall be clearly presented, the function of each timer described, the purpose of each subroutine call labeled and defined, etc. Program documentation shall be sufficiently clear to allow determination of compliance with the process control requirements included in the control descriptions and with the Drawings. The submittal shall demonstrate that all logic provided under this project follows the same structure and format and reflects a common programming approach.
    b. Submit a memory usage report for the PLC and Remote datalogger. This report shall indicate total memory capacity and unused memory capacity.
    c. Submit cross-reference index of I/O allocation and controller memory address. Every physical I/O point, as well as calculated or virtual I/O required for the implementation of the process scheme, shall be included.
    d. Remote Datalogger configuration, data record, data management, and real-time monitoring as shown in drawings.
    e. Communication configuration for integration with data provided by SJRWMD as shown in drawings.

2. Submit details of control system communication. Submit a "memory map" or other means showing which signals are exchanged between PLCs. Also, submit an OIT tag database showing all signals exchanged between the PLCs and OIT. Any specific communication block memory addresses shall be defined.

G. O&M Manuals - Software Maintenance Manuals

1. Include these manuals as part of 13300 "Final System Documentation". This required information is in addition to any requirements of Section 13300.

2. Software Listings and Databases- Submit hard copies of the same information required in the "Controller Program Submittal" except including files updated to reflect the as built system. Include PDF versions of these files in the CD specified below.

3. PID Loop Tuning Parameters - Submit annotated chart recorder traces or computer system trend screen printouts showing tuned control loop response to plus and minus 40 percent of full span step changes of loop setpoint for each individual loop. For cascade loops, submit charts showing the response of the secondary loop with secondary setpoint on manual and also the response of the entire cascade control loop in automatic mode. Include a description of the tuning methodology used.

4. If available as part of the software provided, supply hard copies of configuration information for the OIT, Remote datalogger, and any other programs developed under this Contract.

5. Machine Readable Documentation – Provide two sets of as-built software documentation on CD-ROMs in original electronic format for all PLC, OIT, reporting systems, Historian Systems, and any other programs developed under this Contract. Any changes made during or after testing, start-up, and commissioning shall be incorporated.

H. O&M Manuals – Operator Manuals

1. Provide Operator’s Manuals prior to final acceptance of the system.

2. These manuals shall be separately bound and shall contain all information necessary for the operator to monitor and control the plant from the control system. The manuals shall be written in non-technical terms and shall be organized for quick access to each detailed description of the operator’s procedure. Manuals shall contain, but not be limited to, the following information:

   a. A comprehensive table of contents of the manual.
   b. A simple overview of the entire system indicating the function and purpose of each piece of equipment.
   c. A detailed description of the operation of the OIT including all appropriate displays. Including a screenshot of each OIT display screen and annotating each function in the text is an acceptable format for presenting this information.
   d. Step-by-step procedures for starting up or shutting down an individual component of the control system and also of the entire system.
   e. Login/logout procedures.
   f. Complete, step-by-step procedures for printing reports and entering manual data.
   g. Complete, step-by-step procedures for performing system or selected file backup and restoration including archiving historical data. Include recommended archiving schedule for historical data.
   h. A complete glossary of terms and definitions of acronyms.
   i. List of personnel to be contacted for warranty and emergency services, including name, address, telephone number, pager or cell phone number, fax number, and email address

3. Include these manuals as part of 13300 “Final System Documentation”. This required information is in addition to any requirements of Section 13300.

1.04 MAINTENANCE

A. Refer to Section 13300.

1.05 WARRANTY:

A. Refer to Section 13300 and supplement that with the requirements below.

B. All application work shall be warranted in accordance with Section 01740.

C. Provide telephone technical support within four hours of warranty claim. If failure cannot be resolved by telephone, provide onsite technical support within 24 hours of warranty claim.

1.06 COORDINATION MEETINGS AND WORKSHOPS

A. Refer to Section 13300.

B. Schedule and conduct a draft graphics review meeting. The purpose of this meeting shall be to present draft graphics for the District's and Engineer's review and feedback prior to creating the full set of graphics for review. For repetitive graphics such as graphics for multiple process trains, include an example of the first graphic only for discussion. Include a discussion of process and overview displays, examples of pop-ups, trends, and system navigation tools. Expect major comments and incorporate any changes resulting from those comments.

C. Schedule and conduct a factory testing coordination meeting two weeks prior to factory testing. The purpose of this meeting is to discuss the specifics of the proposed tests and to provide a forum for coordinating the required factory testing.

D. Schedule and conduct a field-testing coordination meeting two weeks prior to field testing. The purpose of this meeting is to discuss the specifics of the proposed tests and to provide a forum for coordinating the required field testing.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. The system specified herein shall perform the following generalized functions:

1. The system shall allow the operator to control equipment such as pumps and valves as shown on the Drawings and as defined in Section 13305 control descriptions.

2. Perform real-time process control, including proportional integral derivative control action, sequencing, process calculations, etc.

3. Collect, calculate, and store accurate, reliable operating information for present and future uses.

4. Assist remote site operating personnel by noting and communicating off normal operating conditions and equipment failures.

5. Accumulate and store equipment running times for use in preventative maintenance.

6. Provide color graphic displays and reports for use by the system operating and supervisory personnel.

7. Provide trending for all analog values.

8. Provide control system diagnostics.

9. All process control functions including PID, calculations, sequencing, timing, etc., shall be done in the process controller. The OIT software shall perform the real-time database, report generation, graphic screens, program development, setpoint modification, data archiving, etc.

10. The system shall allow the operator to manually control (by keyboard entry and mouse type pointing device) the status of pumps, valves, etc. (i.e., on-off, open-close, setpoint value, etc.) when viewing the appropriate graphic screen on the OIT.

3.02 CONTROLLER PROGRAMS (PLC)

A. All application programs shall be developed in a structured manner and shall follow an intuitive arrangement so that an instrumentation technician with basic programming knowledge will be able to understand. Programs shall utilize standard program templates or subroutines for repetitive logic such as equipment control, flow total calculations, and equipment runtime calculations.

B. Make changes to the application programs and software configuration based on comments during the submittals, the factory tests, the field tests, and during the commissioning process to meet the design intent at no additional cost to the District.

3.03 GRAPHIC DISPLAYS – GENERAL (OIT/SCADA)

A. All displays shall contain and continuously update the displayed process variables, date, and time of day. All process values shall be displayed in engineering units. All displays shall incorporate references to both instru-mentation tag numbers and plant equipment numbers. All process variables shall be displayed on their associated display(s) with the correct engineering units. Process variables shall display their associated data quality flags.

B. All operator commands related to controlling field devices or system attributes shall require multiple keystrokes or mouse actions to protect against inadvertent operations. The operator shall receive confirmation of the selected point to be controlled, at which time cancellation of the control can be affected.

C. Process graphic displays shall be based on the P&IDs, site plan drawings, mechanical drawings, and electrical drawings included in these Contract Documents. The graphic displays shall depict process flow streams, process structures, and all major items of process equipment and control devices in a schematic format.

D. All main graphical screens shall include a title bar, main graphic area, navigational buttons, and alarm summary bar. The title bar shall be displayed on the top of each screen and include the display name, description, and time/date. The main graphical area shall contain primary screen

data in graphical format. Navigational buttons shall include a minimum of the main menu, trends, main alarm summary, and security log in. The alarm summary bar shall display the last three valid alarms on the bottom of each screen.

E. Animation shall be provided to mimic level changes in tanks or vessels, and to mimic rotation of rotating equipment when running. Valve colors shall change when opened and closed.

F. Unless specifically noted, all timers, setpoints, alarm actuation levels, etc., shall be adjustable from the operator interface.

G. The system shall show field conditions with text that can alternate (i.e., OPEN/CLOSE, START/STOP, HIGH/LOW) and change color correspondingly. Field devices that are tri state must be represented in three conditions.

H. Conditions in the field designated as alarm conditions shall report to the operator workstation, actuate an audible alarm, and provide a visual blinking image on the associated graphic page. All alarms and events should be displayed on the screen and archived.

I. All interlocks that affect equipment operation shall be identified both by alarm and by OIT indication.

J. All analog inputs shall be checked for out of range (via high and low limit checks) and alarmed.

K. All process flow streams shall be labeled and color-coded using the project color schedule in Division 9. All structures and equipment shall be identified by name and appropriate equipment and loop tags.

L. Color coding for equipment status and alarms shall be as follows:

1. Red for on or open.

2. Green for off or closed.

3. Active, unacknowledged alarms are indicated by flashing amber.

4. Active, acknowledged alarms are indicated solid amber.

M. Automatically record all alarm and events should any of the following sequences or events occur:

1. Date/Time entry

2. Limit changes

3. Any commanded or uncommanded change of any point

4. Alarm conditions

5. PLC activation or deactivation

6. Operator login or logout activity

N. There may be additional general programming requirements listed in PART 1 of the Section 13305 control descriptions section that impact the OIT configuration.

3.04 SPECIFIC GRAPHIC SCREENS (OIT/SCADA)

A. At a minimum, provide the following types of the graphic screen indicated below.

1. Main menu screen shall be developed to link to all screens and process areas. The screen shall be a complete and logical listing of the names and numbers of all screens

2. Overall plant process block flow diagram screen shall show all major processes in block form with flow arrows. Each block shall include a text description of key individual treatment processes. Navigational buttons to the individual treatment processes shall be performed by pressing on the text description.

3. Individual unit process screens depicted from the P&IDs are used for control and screen of each major item of process equipment, process variables, and control devices, including pumps, blowers, valves, gates, mixers, drives etc. Navigational buttons shall consist of the P&ID's flow arrows to other individual unit processes. The unit process screens shall provide the ability for the operator to go to individual equipment popup screens. These diagrams shall be generally depicted from the P&ID's and there shall be at least two screens per P&ID on average.

4. Popup screens shall be provided for each piece of equipment to start/stop equipment, open/close valves, implement automatic control, adjust set points, establish and adjust tuning parameters, set alarm limits and initiate a sequence.

5. Communications diagnostic screens, showing the details of network status, communications status of all major components .

6. Trend screens with the capability to screen up to eight, operator-assigned, analog and/or digital process variables. Each analog value will be shown on a trend screen.

7. Main alarm summary screen shall screen the following information on each alarm: Time, tag name, description, alarm type, current value and status. An acknowledge alarm button shall acknowledge all new unacknowledged alarms. The acknowledged and unacknowledged alarms shall be different colors. Acknowledged alarms shall clear automatically after the condition is corrected.

8. Analog variable screens showing a tabular summary of all plant process variables, in operator assigned groupings.

3.05 SECURITY (OIT/ SCADA)

A. The system shall be configured and implemented with security to prevent unauthorized access. The system shall allow authorized changes to system operation through defined user accounts and password verification.

B. Coordinate with District user account information, including login name and password for each account.

C. Security levels of "display only", "operator mode", "supervisor mode", and "engineer mode" shall be available through assignable passwords. On system startup, the "display only" security level shall automatically be entered. In the "display only" mode, information is available to be displayed on the screen but no changes may be made. In the "operator mode", changes may be made to process set points, times, etc.; however, the overall control concepts may not be modified. In the "supervisor mode", all operator functions can be modified and any special reports or critical process setpoints (data can be modified; however, the overall control concepts may not be modified). In the "engineer mode" level, all user-modifiable parameters of the system shall be available for modification.

3.06 ALARM/EQUIPMENT STATUS REPORTING (OIT/SCADA)

A. The alarm log shall display all alarms as they occur. The alarm message shall include the time of occurrence, tag name, tag number, and whether it is a low, high, or failure alarm. When the point in alarm returns to normal, the time, point identifica-tion number, and return to normal shall be displayed. All reports shall include the plant equipment number of the associated device.

B. The equipment status shall be logged whenever a change in status occurs (i.e., start, stop). The equipment status log shall include the time, equipment name, tag number, and the particular change in status.

3.07 TESTING

A. Refer to Section 13302.

B. Supplement to Field Testing requirements

1. Prior to leaving the site, use the District's programming computer to monitor all PLC processors online, make online changes, and upload and download the processor to ensure programming software version compatibility.

2. Loop Tuning - All PID control loops (single or cascade) shall be tuned following device installation but prior to the commencement of the Functional Demonstration Test.

    a. Optimal loop tuning shall be achieved either by auto-tuning software or manually by trial and error, Ziegler-Nichols step-response method, or other documented process tuning method.
    b. Determine and configure optimal tuning parameters to assure stable, steady state operation of final control elements running under control PID. Each control loop that includes anti-reset windup features shall be adjusted to provide optimum response following startup from an integral action saturation condition.
    c. Tune all PID control loops to eliminate excessive oscillating final control elements. Loop parameters shall be adjusted to achieve a decay ratio of 1 / 4 or better. In addition, loop steady state shall be achieved at least as fast as the loop response time associated with critical damping.
    d. Loop performance and stability shall be verified by step changes to setpoint in the field.
    e. Submit loop tuning documentation as specified in Part 1 of these Specifications.

3.08 TRAINING

A. Furnish training is shown in the table below.

Description	Minimum Course Duration (hours)	Maximum Number of Trainees per Course	Number of Times Course to be Given	Intended Audience
Onsite Training				
Operator Training (Pre start-up)	2	4	2	Operations
Operator Training (Post-start-up)	2	4	2	Operations
Software Maintenance	4	4	2	Maintenance

B. Operator Control System Training (pre and post start-up)

1. Operator training shall cover plant operation with the control system and use of the OIT display screens, including at a minimum all the following items:

   a. Basics of OIT control and navigation
   b. Alarming and Interlocks
   c. Auto functionality of automated processes and OIT control.
   d. Failure modes of equipment and operator responses.

2. Minimum of two operator training sessions (Pre-Startup) for operators shall be held 1 week before system startup. The pre-startup training shall make use of the Simulator specified in this project. Additional one or two operator training sessions (post-Startup) for operators shall be held one week after system startup.

3. Operator training shall be held at the convenience of the District. This training may be held during the day, late at night, or very early in the morning to accommodate the District's shift schedule.

4. Operator training shall be introductory in nature during pre-startup training and more in-depth and detailed during post-startup training.

5. At a minimum, the following teaching aids shall be available for distribution during Operator training sessions:

   a. Preliminary O&M Manuals (pre-startup); Final O&M Manuals (post-startup).
   b. P&IDs.
   c. Daily syllabus.

6. Fifty percent of all Operator training shall be "hands-on" utilizing the installed Control System to the fullest extent possible. Confirm the operability of the Control System before commencing training. Training performed using a non-functioning Control System shall be rejected and repeated.

C. Software Maintenance

1. Provide training of how to back-up PLCs, OITs, DATALOGGER and any other software in this system.

2. Provide training on all aspects covered in the O&M Software Maintenance Manuals.

3. Provide training on PLC program structure, OIT configuration structure, tips in how to edit programming code, and other items which will supplement the maintenance staff's ability to edit and maintain the programs.

END OF SECTION

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SECTION 13311
PLC HARDWARE AND SOFTWARE

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section includes Programmable logic controllers for control of process equipment, process-oriented machinery, and process systems.

1.02 RELATED WORK

A. Section 13300 “Instrumentation and Controls - General Provisions.”

B. Section 13330 "Control Panel Enclosures and Panel Equipment."

1.03 SUBMITTALS

A. Refer to Section 13300.

B. Descriptive literature, bulletins, catalog cuts and Drawings for the equipment specified herein.

C. Submit list of three firms that are located within 100 miles of the project site that are actively installing, programming, supporting, and maintaining the submitted PLC.

D. Complete bill of materials for the equipment.

E. Any deviation of the hardware or software systems from the preliminary submittal included in the Project Plan shall be described in detail.

F. Spare parts list.

1.04 REFERENCE STANDARDS

A. ASTM D 999-91: Vibration.

B. (CFR) Title 47, Part 18 (European EN 55011 (formerly CISPR 11)).

C. CSA Certification Class I, Division 2, Group A, B, C, D Hazardous or non-hazardous locations.

D. IEC 60068-2.1 Environmental testing – Part 2-1: Tests - Test A: Cold, 2.2 Environmental testing - Part 2: Tests. Tests B: Dry heat, 2.3, 2.6 Environmental testing - Part 2: Tests - Test Fc: Vibration (sinusoidal) and 2.27 Environmental testing. Part 2: Tests. Test Ea and guidance: Shock.

E. IEC 61000 Electromagnetic compatibility (EMC) - Testing and measurement techniques:

1. Part 4-2: Electrostatic discharge immunity test.

2. Part 4-3: Radiated, radio-frequency, electromagnetic field immunity test.

3. Part 4-4: Electrical fast transient/burst immunity test.

4. Part 4-5: Surge immunity test.

5. Part 4-6: Immunity to conducted disturbances, induced by radio-frequency fields.

F. IEC 61131-3: Programmable controllers - Part 3: Programming languages.

G. IEC 801-3: RFI Immunity.

H. IEC 801-5: Ground Continuity.

I. IEC 801-2: Electrostatic Discharge.

J. IEEE 472-1974/ANSI C37.90/90A-1974 (Surge Withstand) IEEE Standard for Relays and Relay Systems Associated with Electric Power Apparatus.

K. MIL STD 461B CS02: RFI/EMI Susceptibility.

L. NEMA Pub No ICS2-230.42: Showering Arc Test.

M. NSTA Project 1A.

N. UL 508 and CSA Standard C22.2 No. 142 (Isolation Voltages).

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer shall be capable of providing training, parts, and coordination of emergency maintenance and repairs.

B. To be considered for the work under this Section, there shall be at least three firms located within 100 miles of the project site that have local staff actively installing, programming, supporting, and maintaining the submitted PLC for the PLC to be considered as an "or equal" to the listed manufacturers.

C. Programmable controller and all of the corresponding components within the family of controller products shall be manufactured by a company who regularly manufactures and services this type of equipment.

D. Manufacturer shall comply with ISO9001 standards for "Quality Systems - Model for Quality Assurance in Design/Development, Production, Installation, and Servicing".

E. Manufacturer shall provide complete technical support for all of the products. This shall include factory or on-site training, regional application centers, local or factory technical assistance, and a 24/7/365 technical support phone service.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver PLC components in packaging designed to prevent damage from static electricity and physical damage.

B. Store PLC equipment according to manufacturer requirements. At a minimum, store indoors in clean, dry space with uniform temperature to prevent condensation. Protect PLCs from exposure to dirt, fumes, water, corrosive substances, and physical damage. Also, protect the PLC from all forms of electrical and magnetic energy that could reasonably cause damage.

1.07 NOMENCLATURE AND IDENTIFICATION DEFINITIONS

A. AI: Analog Input.

B. AO: Analog Output.

C. Fixed I/O: A PLC style consisting of a fixed number of I/O, a processor, and a power supply all in one enclosure. Some fixed PLCs have limited expansion ability.

D. CPU: Central Processing Unit.

E. DI: Discrete Input.

F. Distributed I/O: Hardware specially designed to function as Remote I/O.

G. DO: Discrete Output.

H. HMI: Human-Machine Interface.

I. I/O Input and/or Output.

J. Master/Slave: Communication between devices in which one device, the master, controls all communications. The other devices, the slaves, respond only when queried by the master. Typically used in a Remote I/O application.

K. Modular: A PLC style consisting of cards that are assembled to comprise a complete unit. All I/O, CPU, and Power Supply are dedicated cards. Typically, these cards are inserted into a chassis.

L. Peer to Peer: Communication between two or more devices, typically PLCs, in which each device can control the communication exchange.

M. PID: Control action, proportional plus integral plus derivative.

N. PLC: Programmable Logic Controller.

O. Remote I/O: I/O that is located remotely from the processor. Remote I/O can communicate over a variety of communication protocols and can use standard rack based I/O, or special Remote I/O hardware referred to as Distributed I/O.

P. SCADA: Supervisory Control and Data Acquisition.

1.08 SPARE I/O AND SLOTS

A. Each panel containing PLC I/O shall include at least 20 percent (minimum of four) points of each type (AI, AO, DI, and DO) for future use, regardless of whether any of those point types are used in that panel or not. The spares shall be the same type of I/O modules supplied.

B. For chassis-based PLC systems, provide at least two spare slots for addition of future I/O in each chassis provided. For non-chassis-based PLC systems, provide adequate space to the right of the last I/O card in each row of I/O cards for at least two future I/O cards (width should be based on the widest I/O card provided in panel).

C. Spare output points that require the use of an external relay shall be supplied with the external relay.

D. Regardless of the spare requirement, all installed unused points on all I/O modules shall be wired to terminal blocks in the order that they occur on the I/O modules. Unwired spares shall not be acceptable.

1.09 MANUFACTURER SUPPORT

A. Provide a written proposal for a manufacturer support agreement for products specified herein for a minimum of 12 months starting at completion of the project. The cost of this manufacturer support agreement shall not be included in the Contract Price. The support agreement shall be executed in the name of, and for the benefit of, the District. At a minimum, this agreement shall provide the District with:

1. 8 AM to 5 PM, five day per week manufacturer telephone support.

2. Access to the manufacturer's technical support website.

3. Software and firmware updates.

PART 2 PRODUCTS

2.01 PROGRAMMABLE LOGIC CONTROLLER SYSTEM

A. General:

1. Provide Programmable Logic Controller equipment with the required memory and functional capacity to perform the specified sequence of operation with the scheduled input and output points.

2. Processor Systems shall include processor, power supply, input/output modules, communication modules, redundancy modules, and remote interface modules as required to meet system requirements.

3. Furnish products listed and classified by Underwriters Laboratories (UL), CSA, or FM approval as suitable for purpose specified and indicated.

4. All equipment and devices furnished hereunder shall be designed for continuous industrial service. The system shall contain products of a single manufacturer, insofar as possible, and shall consist of equipment models that are currently in production.

5. All equipment furnished shall be designed and constructed so that in the event of power interruption the systems shall go through an orderly shutdown with no loss of memory, and resume normal operation without manually resetting when power is restored.

6. PLCs shall communicate between the operator workstation and field-mounted transducers, switches, controllers, and process actuators. Communications protocol shall be completely transparent to process operators at the Human Machine Interface (HMI).

7. PLC shall be capable of stand-alone operation in the event of failure of the communication link to the HMI subsystem.

8. Backup Processor Systems, if indicated on the drawings, shall consist of two chassis with power supplies, each containing a processor, redundancy module and communications module(s). Remote chassis shall be provided with communication modules to meet I/O and communication requirements.

9. Remote Input/Output Units shall include input/output modules, interface modules, communication modules, and power supply to meet system input and output requirements.

10. Agency and environmental specifications:

    a. Electrical supply voltage to the PLC shall be 120VAC, plus or minus "15 percent, 48 - 63Hz. PLC system power supplies shall be fused for overload protection.
    b. Vibration: 3.5 mm Peak-to-Peak, 5 - 9 Hz: 1.0G, 9 - 150\Hz. The method of testing is to be based upon IEC 68-2-6 and JIS C 0911 standards for vibration. The system is to be operational during and after testing. Vibration Rating of 2.0G maximum peak acceleration for 10 to 500Hz. in accordance with at least one of the following:

        1) Installed rating: DIN rail mounted PLC: 10 - 57 Hz, amplitude 0.075 mm, acceleration 25-100 Hz.
        2) Panel or plate mounted PLC: 2 - 25 Hz, amplitude 1.6mm, acceleration 25 - 200 Hz.
        3) In compliance with IEC 60068 and IEC 61131.

11. Shock: 15G, 11 msec. Method of testing is to be based upon IEC 68-2-27 and JIS C 0912 standards for shock. The system is to be operational during and after testing.

12. Temperature: All PLC hardware shall operate at an ambient temperature of 0° to 60° C (32° to 140° F), with a storage ambient temperature rating of -25° to 70° C (-40° to 185° F).

13. Relative Humidity: Programmable Controller hardware shall function continuously in the relative humidity range of 10 percent to 95 percent non-condensing.

14. Noise Immunity: Programmable Controller system shall be designed and tested to operate in the high electrical noise environment of an industrial plant as governed by the following regulations: IEEE 472, IEC 801, MILSTD 461B, IEC 255-4, NEMA ICS 2-230.40, and ANSI/IEEE C-37.90A-1978.

15. Altitude:

    a. Operation: 0 - 6,500 feet.
    b. Storage: 0 - 9,800 feet.

16. Degree of protection: NEMA 1 (IP20).

17. All products shall have corrosion protection.

B. All major assemblies and sub-assemblies, circuit boards, and devices shall be identified using permanent labels or markings indicating:
   1. Modules product type such as analog or digital.
   2. Modules catalog number.
   3. Modules major revision number.
   4. Modules minor revision number.
   5. Module manufacturer vendor.
   6. Module serial number.

C. All necessary cables shall be included. All cables and connectors shall be as specified by the manufacturer. Cables shall be assembled and installed per the manufacturer recommendations.

D. Central Processing Unit (CPU):

   1. CPU shall be, at a minimum, a 16-bit microprocessor that provides system timing and is responsible for scheduling I/O updates, with no user programming required to ensure discrete or analog update. It shall execute user relay ladder logic programs, communicate with intelligent I/O modules, and perform on-line diagnostics. The CPU shall consist of a single module which solves application logic, stores the application program, stores numerical values related to the application processes and logic, and interfaces to the I/O.

   2. CPU shall sample all the discrete and analog inputs and outputs including internal coils and registers, and service special function modules every scan. The CPU shall process the I/O with user program(s) stored in memory, then control the outputs based on the results of the logic operation.

   3. Supply the CPU with a battery-backed time of day clock and calendar.

   4. CPU family shall allow for user program transportability from one CPU model to another.

E. Diagnostics:

   1. CPU shall perform on-line diagnostics that monitor the internal operation of the PLC. If a failure is detected, the CPU shall initiate system shutdown and fail-over. The following, at a minimum, shall be monitored: Memory failure, memory battery low, and general fault, communications port failure, scan time over run, I/O failure, and analog or special function I/O module failure.

   2. All diagnostic information shall be accessible to the host communications interfaces and to the PLC program.

   3. PLC shall have indicators and on-board status area to indicate the following conditions:

      a. CPU run.
      b. CPU error or fault.
      c. I/O failure or configuration fault.

d. Status of Battery or back-up power module.
e. Communications indicator.

F. Memory:

1. User program and data shall be contained in non-volatile battery backed memory of type CMOS RAM program memory or equivalent.

2. Memory Backup System: provide lithium battery backup or equivalent capable of retaining all memory for a minimum of three months and a Flash memory system capable of reloading program in the event of memory loss.

   a. Backup Storage: The backup battery or module shall be capable of being replaced without disrupting memory integrity. Provide a visual indication of low battery voltage or module error and an alarm bit in the PLC program.
   b. SD Memory Card: Memory card storage capacity shall be greater than processor memory capacity. Memory cards shall be installed in processors for factory testing.

3. Operating system shall be contained in non-volatile firmware. The memory containing the operating system shall be field updateable via a separate update tool.

G. Programming Environment:

1. Programming port: The PLC shall utilize a serial USB or Ethernet port for programming.

2. On-Line programming: Application programs may be modified or stored while the CPU is running, with minimal impact on the scan time.

3. Online programming including runtime editing.

4. IEC 61131-3 programming languages supported: Ladder logic, function block, sequential function chart, and structure text.

5. Supply all hardware and software necessary to program the CPU in these languages.

H. Communication Ports:

1. CPU shall be expandable and supplied with additional modules to support the required communication interfaces.

I. Power Supplies:

1. PLC shall have chassis mounted power supplies to power the chassis backplane, and provide power for the processor and applicable modules.

2. Power supplies shall have a clearly visible LED to indicate that the incoming power is acceptable, and the output voltage is present.

3. Power supplies shall feature over-current and over-voltage protection and should be designed to operate in most industrial environments without the need for isolation transformers.

4. Power supplies shall be sized to accommodate the anticipated load plus 30%.

5. DC power supplies shall be capable of handling ripple up to 2.4V peak to peak.

6. AC Line Voltage rating of 85 to 265Vac, 47 - 63Hz.

7. Power supplies shall allow for brown outs of at least 1/2 of a cycle, a harmonic rate of 10%, and will sustain continuous operation through momentary interruptions of AC line voltage of 10ms or less.

8. Automatically shut down the Programmable Controller system whenever its output power is detected as exceeding 125% of its rated power.

9. Provide surge protection, isolation, and outage carry-over up to two cycles of the AC line.

J. Discrete Input & Output Modules:

1. General:

   a. Digital input and output modules shall provide ON/OFF detection and actuation.
   b. I/O count and type shall be as required to implement the functions specified plus an allowance for active spares, as noted below.
   c. Modules shall be designed to be installed or removed while chassis power is applied.
   d. Modules shall have indicators to display the status of communication, module health and input / output devices.
   e. Each module shall have the following status indicators.
      1) On/Off state of the field device.
      2) Module's communication status.

2. Module Specifications (120VAC Input Module):

   a. Nominal Input Voltage: 120VACc.
   b. On-State Current: 15mA @132V AC, 47 - 63Hz maximum.
   c. Maximum Off-State Voltage: 20V.
   d. Maximum Off-State Current: 2.5mA.
   e. Number of Points per Card: 16.

3. Module Specification (120 VAC Solid State Output Module):

   a. Each triac type discrete output shall have an associated interposing relay located in the same control panel. 120 VAC power for relay outputs shall be provided from the associated motor starter control circuit (when used with motor starters) or other 120 VAC source (when I/O is not associated with a particular motor starter).
   b. Output Voltage Range: 74 - 265 VAC, 47 - 63 Hz.
   c. Output Current Rating:

      1) Per Point: 0.5A maximum @ 30 degrees C; 0.25A maximum @ 60 degrees C; Linear Derating.
      2) Per Module: 4A maximum @ 30 degrees C; 2A maximum @ 60 degrees C; Linear Derating.

d. Surge Current per Point: 5A for 43ms each, repeatable every 2s @ 60 degrees C.
e. Minimum Load Current: 10mA per point.
f. Maximum On-State Voltage Drop: 1.5V peak @ 2.0A and 6V peak @ load less than 50mA.
g. Maximum Off-State Leakage: 2.5mA per point.
h. Number of Points per Card: 16.

K. Analog Input & Output Modules:

1. General:

a. Analog input modules shall convert an analog signal that is connected to the module's screw terminals into a digital value. The digital value representing the magnitude of the analog signal shall be transmitted on the backplane. Analog output modules shall convert a digital value that is delivered to the module via the backplane into an analog signal on the module's screw terminals.
b. Modules shall be designed to be installed or removed while chassis power is applied.
c. Modules shall have indicators to display the status of communication, module health and input / output devices.
d. Each analog module shall provide both hardware and software indication when a module fault has occurred. Each module shall have an LED fault indicator and the programming software shall display the fault information.
e. Analog modules shall be software configurable through the I/O configuration portion of the programming software.
f. Following status shall be capable of being examined in ladder logic:

1) Module Fault Word: Provides fault summary reporting.
2) Channel Fault Word: Provides under-range, over-range and communications fault reporting.
3) Channel Status Words: Provides individual channel under-range and over-range fault reporting for process alarm, rate alarms and calibration faults.

g. 24 VDC power for analog instrument loops shall be provided as a part of the system. 24 VDC power supply shall be derived from the 120 VAC input power circuit to the PLC. Field side of the 24 VDC power sources(s) shall have individual or grouped (of logically associated circuits) fusing and be provided with a readily visible, labeled blown fuse indicator.

2. Isolated Analog Output Current Module:

a. Output Current Range: 4 to 20 mA.
b. Current Resolution: 12 bits across 20 mA.
c. Open Circuit Detection: None.
d. Output Overvoltage Protection: 24V ac/dc maximum.
e. Output Short Circuit Protection: 20 mA or less (electronically limited).
f. Calibration Accuracy: Better than 0.1% of range from 4 mA to 20 mA.
g. Calibration Interval: 12 months typical.
h. Number of Points per Card: Eight.

L. Communications Interfaces:

1. PLC will be capable of the following communication protocols as shown on the drawings:

a. 10BASE-T/100BASE-TX Ethernet communication.
b. EthernetI/P
c. Modbus TCP
d. Asynchronous serial link capable of communicating up to 19.2 Kbps.

2. When required provide a Communications Interface Module mounted in the chassis or the equivalent port directly on the CPU.

M. Manufacturers:

1. Provide all PLCs from a single manufacturer. If the PLC manufacturer has authorized third party vendors to provide modules that are compatible with their platforms, then products manufactured by these authorized third-party vendors will be acceptable.

2. Provide the PLC system by one of the following:

a. Rockwell Automation: CompactLogix. 5370
b. No substitution.

2.02 PLC SOFTWARE

A. Provide a PLC configuration and application development software package complete with documentation and disks. The PLC software package and associated licensing and/or activation shall be installed on the computers shown on the Drawings.

B. Software package shall allow on-line/off-line program development, annotation, monitoring, debugging, uploading, and downloading of programs to the PLCs.

C. All required hardware (including cables, cable adapters, etc.) for connection to PLCs shall be furnished.

D. All software licenses required to achieve the functionality described in the Specifications shall be provided.

E. Software package shall include a software license agreement allowing the District the right to use the software as required for any current or future modification, documentation, or development of the PLCs furnished for this project.

F. Software provided shall be capable of the following IEC 61131-3 functions:

1. Ladder logic.
2. Function block.
3. Sequential function chart.
4. Structure text.

G. In addition to the above editors, an add-on instruction editor shall work with any of the above-mentioned editors to create custom reusable function blocks. This software shall allow any of the derived function blocks to be modified on-line.

H. Software shall be Microsoft Windows-based and run on the supplied computers.

I. Software shall include a security feature to prevent unauthorized personnel from modifying and downloading the programs.

J. Provide an I/O simulator which allows the PLC application load program to be tested on a PC with simulated analog and digital inputs and outputs, allowing I/O testing and debugging to be performed in a safe, isolated environment without the need for running the PLC CPU and process I/O boards.

2.03 OPERATOR INTERFACE TERMINAL (OIT)

A. OITs shall be mounted on control panels and shall run its own interface software

B. Manufacturers:

1. Provide operator interface terminals (OIT) from one of the following:

a. Allen-Bradley PanelView Plus 7 series.
b. No substitution.

C. Software:

1. Operator Interface Terminal shall be pre-packaged with all configuration and programming software necessary to perform functions as shown on drawings and within the specifications.

2. Integrated OIT software shall have the following features:

a. Trending.
b. Data Logging.
c. Alarms.
d. Graphic Symbols.
e. Animations.

D. I/O Ports and Devices:

1. OIT shall have a minimum of one Ethernet 10/100 Mbps for connectivity or programming.

2. Compact flash ports shall be Type 2.

3. OIT shall have a minimum of one USB port.

E. Display:

1. OIT display size shall be a minimum of 10".

2. The type of display for the OIT shall be Color Active Matrix TFT.

3. Display resolution shall be a minimum of 320 x 240 for four-in. to six-in. displays, 800 x 600 for eight-in. to 12" displays, 1024 x 768 for 15" displays, and 1280 x 1024 for 19" displays.

F. Environmental:

1. Rating: OIT shall be rated to maintain the rating of the control panel it will be mounted in.

2. Temperature: Operating temperature range of the OIT shall range 0 - 50 °C.

2.04 SPARE PARTS

A. General requirements for spare parts are specified in Section 13300.

B. The following PLC spare parts shall be furnished:

1. Processors: Provide spare processor unit(s) for each unique processor installed.

PART 3 EXECUTION

3.01 GENERAL INSTALLATION

A. Maintain area free of dirt and dust during and after installation of programmable controller products.

B. Anchor PLCs within enclosures as recommended by the PLC manufacturer.

C. Ventilation slots shall not be blocked or obstructed by any means.

D. Examine areas, surfaces, and substrates to receive PLCs for compliance with requirements, installation tolerances, and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

E. Install in accordance with manufacturer's instructions.

F. Unload, unpack and transport equipment to prevent damage or loss.

G. Replace damaged components as directed by Engineer.

3.02 PANEL LAYOUT

A. Coordinate size and configuration of enclosure to meet project requirements. Drawings indicate maximum dimensions for PLC , minimum clearances between PLCs, and adjacent surfaces and other items.

B. Comply with indicated maximum dimensions and clearances, or with PLC vendors required distances if they are greater than the distances indicated.

1. Provide spacing around PLC as required by the manufacturer to ensure adequate cooling. Ensure that the air surrounding the PLC has been conditioned to maintain the required temperature and humidity range.

2. Wires entering and exiting PLC components shall be sized to comply with the PLC manufacturers requirements. Doors on all components shall be able to be fully closed when all the wires are installed.

3. For chassis mounted PLCs, no wiring, wire ducts, or other devices shall obstruct the removal of cards from the rack.

4. PLC lights, keys, communication ports, and memory card slots shall be accessible at all the times. Lights shall be visible always when enclosure door is opened.

C. Control panel designer shall provide independent line fuses or circuit breakers, per the PLC manufacturer recommendation, for each power supply, input module, output module, and other modules with separately derived power requirements.

D. Control panel designer shall insure that communication signals, 4-20 mA signals (including those with embedded HART), are properly conditioned for the PLC and protected from all sources of radiated energy or harmonics.

E. Each PLC (including all I/O) shall be powered from the UPS power conditioning system in Section 13330.

F. Where multiple sets of mechanical equipment are provided for process redundancy, arrange their field connections to I/O modules so that the failure of a single I/O module will not disable the redundant system. This applies to all I/O types. The acceptability of the I/O arrangement shall be at the discretion of the Engineer.

G. Provide all required cables, cords, and connective devices for interface with other control system components.

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SECTION 13323
INSTRUMENTATION AND CONTROLS – CELLULAR TELEMETRY SYSTEMS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor and materials required and install a complete and functional cellular telemetry system as shown on the drawings and as specified herein.

B. Auxiliary and accessory devices necessary for system operation or performance shall be included whether specified or not.

C. Obtain required construction permits for equipment installation.

D. Cellular telemetry hardware shall be installed at the Black Creek Pump Station and the District's control center. The PCSS shall utilize a 4G LTE Network and configure a Virtual Private Network (VPN) to communicate data transfer across these two sites and the Pump Station and the datalogger workstation.

E. Meet all applicable federal (FCC, etc.), state, and local codes and regulations.

F. After installation, submit field cellular measurements that confirm that the minimum signal strength requirements of each communication link are met.

1.02 RELATED WORK

A. Furnish materials, labor, and services specified in the following Sections as required to supply a single coordinated cellular telemetry system:

1. Electrical is included in Division 16.

2. Section 13330 Control Panels and Panel Mounted Equipment.

B. Refer to Section 13300.

1.03 SUBMITTALS

A. Provide shop drawings and product data, in accordance with Section 13300, showing materials of construction and details of installation for:

1. Data sheet sets and catalog literature for hardware (modems, antenna, cabling, and accessories)

2. Physical dimension drawings of all hardware and components

3. Antenna installation details

4. Installation and interconnection/wiring diagrams depicting the proposed installation of the equipment in conformance to the requirements specified on the Plans. These drawings

shall be detailed to the extent possible and then modified after installation to reflect "AS-BUILT" conditions as part of Operations and Manuals.

5. A complete telemetry system block diagram(s) showing in schematic form, the interconnections between major hardware components. The diagram shall reference all interconnecting cabling requirements for digital components of the system including any data communication links.

6. Equipment specification sheets shall fully describe the device, the intended function, how it operates and its physical environmental and performance characteristics. As a minimum the specification sheets shall include the following:

   a. Dimensions and any clearance requirements.
   b. Mounting or installation details.
   c. Connection requirements.
   d. Electrical power requirements.
   e. Materials of construction.
   f. Environmental characteristics.
   g. Performance characteristics.

7. Furnish specific system information regarding the following:

   a. A narrative of the communication strategy
   b. Any assumptions made in developing the system.

8. Cellular Survey, as stated on the Control Block Diagram, I-3, Note 5.

1.04 REFERENCE STANDARDS

A. Refer to Section 13300.

1.05 DELIVERY, STORAGE AND HANDLING

A. Refer to Section 13300.

1.06 MAINTENANCE

A. Refer to Section 13300.

B. SPARE PARTS

1. Modems: Provide 1 cellular modem of each model provided with same revision firmware as those installed.

2. Provide a kit of cellular antenna, cable, and surge protection.

PART 2 PRODUCTS

2.01 GENERAL

A. Equipment shall perform under conditions ranging between minus 30 degrees C and plus 60 degrees C, and humidity range of five to 90 percent, non-condensing.

B. Transmission Cable and Accessories

1. A single continuous piece of transmission cable shall be provided and installed between each 4G LTE cellular modem and antenna.

2. Connectors

a. Furnish connectors for terminating both ends of each transmission cable.
b. The connectors shall be sealed with three-inch sections of Alpha FIT321-1-0 sealant shrink tubing or equivalent.
c. All outdoor coaxial connectors shall be wrapped with two layers of Scotch Super 88 UV resistant tape, and then coated with two layers of Scotch-Kote or equivalent.

3. Grounding Kit

a. Coaxial cable grounding kits shall be furnished. Furnish two kits for each transmission cable.

4. Jumper Cable

a. Provide one three-foot section of "super flexible" jumper cable with type N and type SMA connectors to connect between the modem and the bulkhead surge protector where the transmission cable connects to the control panel.

5. Coaxial Cable Clamping Hardware

a. Provide coaxial cable hanger kits and clamping hardware. The coax cable shall be secured to the mast/pole with E.V.A.-coated 316 stainless steel cable ties. The cable ties shall meet or exceed the quality, reliability, and performance of AE112 cable ties manufactured by Band-It.

2.02 OMNI-DRECTIONAL ANTENNAS

A. Antennas shall be provided and installed at each site configured for cellular telemetry.

B. Identical antennas shall be used as much as possible throughout the system to reduce spare parts inventory.

C. Where a site uses multiple antennas in the same frequency band (or integer multiples of that band) install them with no less than 10 feet of vertical separation for signal isolation.

D. Technical Specifications:

1. Operational Temperature: -22°F to +140°F

2. Radiation: Omni-directional

3. Frequency Range: 806 – 924 / 1850 – 1990 MHz

4. Gain: 5 dBi (at both Frequency Ranges)

5. Bandwidth: 118/140 MHz

6. Maximum Power Input: 10 watts

7. VSWR: Less than 2.0

8. Polarization: Vertical

9. Input Impedance: 50 Ohms

E. Physical:

1. Material of construction: Fiberglass

2. Connector: Female type N

3. Mounting Hardware: U-bolt and screw assembly for attachment to handrail on top of the tank.

F. Manufacturers

1. SureCall SC-100S.

2. Or Approved Equal.

2.03 FIREWALL

A. General:

1. Firewall appliance for secure connection of the wired Ethernet data from a PLC/Datalogger for transmission over a 4G LTE cellular communications network.

2. Firewall shall be configured for compatibility with the District's existing cellular virtual private network.

B. Physical:

1. Supply voltage range of 9 VDC to 30 VDC, nominal 24 VDC. Capable of accepting redundant power inputs. Power connections shall be pluggable.

2. 4 copper 10/100/1000 Base-T RJ45 Ethernet port

3. USB 2.0 Micro-B Connector

4. 3 Antenna Connectors (on wireless models only)

5. DIN Rail mountable.

6. Alarm contact to indicate malfunction with power supply unit or loss of port communication.

7. Capable of accepting a SD card for securely storing configuration file of device.

8. Operating temperature of -20 C to 60 degrees C.

9. LED Indicators:

    a. Two LEDs for indicating port status.

C. Networking:

1. Copper ports shall be 10/100 base-T(X), auto-negotiation and auto-crossing. Ports shall be configurable to be enabled/disabled via the management interface.

2. Device shall have a transparent or stealth mode for drop in protection of end devices regardless of network configuration.

3. Device shall support stateful inspection as a firewall.

4. Device shall support Deep Packet Inspection for Modbus TCP and OPC Classic protocols.

5. Firewall rules shall be configurable by the user and include inspection on Source/Destination IP address, MAC address, protocols and/or Source/Destination TCP/UDP port.

6. Provide four-port managed 10/100 Mbps integrated switch with DMZ port for further network segregation.

7. Support protection against IP Spoofing, Denial of Service and Syn Flood Protection.

8. Support Virtual Private Network (VPN) functionality up to 250 licenses with ability to act as client or server of VPN requests. IPSec shall be the supported VPN protocol with encryption meeting the military standard of AES-256. Provide hard-wired contact to initiate VPN tunnel.

9. Support static routing between two or more networks.

10. Support One to One Network Address Translation (NAT) routing.

11. Support dynamic device addressing via BootP.

12. Supports multiple VLANs.

13. Supports the use of SNMP management, up to v3 for maximum security.

D. Manufacturer:

1. Phoenix Contact, mGuard 4000 Series.

2. Or approved equal.

2.04 CELLULAR MODEM

A. General:

1. Modem for converting wired Ethernet data from a PLC/Datalogger for transmission over a 4G LTE cellular communications network.

2. Shall support Allen-Bradley Ethernet/IP communications.

B. Physical:

1. RS-232 Serial Port on DB-9 connector

2. 10/100 Base-T RJ45 Ethernet Port

3. USB 2.0 Micro-B Connector

4. 3 SMA antenna connectors (Primary, Secondary/Diversity, GPS)

5. Active GPS antenna support

6. LED Indicators:

a. Power
b. Activity (transmit / receive status)
c. Signal (color indicates quality of RSSI)
d. Network (color indicates LTE network readiness)

C. Performance:

1. Power: 9 VDC – 36 VDC

2. Accuracy: less than two m (50%); less than five m (90%)

3. Satellite Acquisition Time: 1s Hot start

4. Satellite Tracking Sensitivity: -145 dBm

5. Operating Temperature: -22°F to +158°F

6. Relative Humidity: 90% at 140°F

7. Supported Frequency Bands:

a. LTE: 1900 (B2), AWS (B4), 850 (B5), 700 (B13), 700 (B17), 1900 (B25)
b. WCDMA: 2100 (B1), 1900 (B2), AWS (B4), 850 (B5), 900 (B8)

D. Manufacturer:

1. Sierra Wireless Air Link GX-450/ RV50

2. Or Approved Equal.

2.05 TRANSMISSION CABLE AND ACCESSORIES

1. Provide cable and accessories compatible for cellular modem.

2.06 SURGE PROTECTION

A. Surge protection shall be provided for all telemetry sites and shall include both coaxial surge suppressors and AC line surge protectors.

B. For AC line surge protection refer to Section 13300

C. RF Bulkhead Coaxial RF Surge Protector

1. An in-line coaxial cable surge protector shall be furnished for each transmission cable.

2. Surge protector shall be a DC pass arrestor for applications with active antenna systems requiring DC voltage such as GPS, 3G and 4G.

3. Supply with N-connectors

4. Manufacturer

a. Polyphaser model GTH-NFM-AL.
b. Or Approved Equal.

PART 3 EXECUTION

3.01 TESTING

A. Refer to Section 13300 for testing requirements.

3.02 INSTALLATION

A. Install the cellular telemetry system as shown on the Drawings and in accordance with manufacturer's instructions and approved shop drawings.

B. The equipment locations are approximate only. Exact locations shall be as approved by the Engineer/District during construction. Obtain in the field all information relevant to the placing of work and in case of any interference with other work, proceed as directed by the Engineer/District and furnish all labor and materials necessary to complete the work in an approved manner.

C. All work shall be executed in full accordance with codes and local rulings. Should any work be performed contrary to said rulings, ordinances and regulations, the system supplier shall bear full responsibility for such violations and assume all costs arising there from.

D. Brackets, hangers, etc., required for mounting of equipment shall be provided. They shall be installed in a workmanlike manner and not interfere with any other equipment.

3.03 FIELD TESTS AND ACCEPTANCE

A. Prior to start-up, cellular communications equipment shall be inspected for proper alignment, proper connection and satisfactory performance.

B. The grounding of all antennas assemblies shall be checked for the antenna, mast, supports, and where applicable, towers.

C. The installed RF feedlines and antennas shall be tested for VSWR and other losses using a time domain reflectometer (TDR). Submit test results for approval.

D. The received signal at all locations not be less than 20 dB fade margin based on the cellular modem manufacturer's published receiver sensitivity of 10-6 bit error rate.

3.04 ADJUSTMENTS

A. Transmitter power shall be adjusted if needed to comply with FCC rules and regulations before acceptance testing.

END OF SECTION

SECTION 13330
CONTROL PANEL ENCLOSURES AND PANEL EQUIPMENT

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Refer to Section 13300.

B. Furnish and install control panels and panel mounted equipment as specified herein and shown on the Drawings.

C. All new panels and panel components shall match existing equipment makes and models wherever possible, so that system additions can be most easily integrated with respect to operation and maintenance training, spare parts inventory, and service contracts. Even when exact matches are not possible, equipment furnished must be fully compatible with the existing system. Color, size, and material of new panels should conform to that of existing panels.

D. Each panel shall be supplied with full sub-panels with the minimum specified dimensions regardless of the quantity of mounted components inside the panel. All panel mounted components shall be mounted on the single rear-of-panel sub-panel unless the density of devices exceeds the panel mounting space permitted by the minimum panel dimensions specified. Side panel mounted components shall only be permitted after review and approval of the Engineer.

E. Furnish the following panels [and consoles].

PANEL SCHEDULE

Panel Designation	Minimum Panel Size	Maximum Space Available	Enclosure Rating & Type
PLC Enclosure PLC-1200	64-inch high by 48-inch wide by 24-inch deep	72-inch high by 48-inch wide by 24-inch deep	NEMA 4X, 1-door, 316SS construction, free-standing. Front Access Only. Sunshield on top, sides, and rear if outdoor installation with direct sunlight.

1.02 RELATED WORK

A. Refer to Section 13300 “I & C - General Provisions.”

1.03 SUBMITTALS

A. Refer to Section 13300.

B. Descriptive literature, bulletins, catalog cuts and Drawings for the equipment specified herein.

C. Complete bill of materials for the equipment.

D. Spare parts list.

E. Panel Layout Drawings and Wiring Diagrams Submittal:

1. Where direct hardwired interfaces exist between the PCSS control panels and vendor provided control panels furnished under other Divisions, Contractor shall provide to PCSS approved submittals in order for PCSS to provide complete wiring diagrams showing all wiring connections in the I/O system. This includes but is not limited to terminal block numbering, relay contact information, instruments, equipment, and control panel names. These drawings shall be included in Final O&M submittal. Leaving this information blank on Final Documentation drawings is not acceptable.

2. Panel Layout Drawings: Submit Drawings for all panels, consoles, and equipment enclosures specified. Panel assembly and elevation drawings shall be drawn to scale and detail all equipment in or on the panel. Panel drawings shall be 11"x17" in size. At a minimum, the panel drawings shall include the following:

   a. Interior and exterior panel elevation drawings to scale.
   b. Nameplate schedule.
   c. Conduit access locations.
   d. Panel construction details.
   e. Cabinet assembly and layout drawings to scale. Assembly drawing shall include a bill of material on the drawing with each panel component clearly defined. Bill of material shall be cross-referenced to the assembly drawing so that a non-technical person can readily identify all components of the assembly by manufacturer and model number.
   f. Fabrication and painting specifications including color (or color samples).
   g. Construction details, NEMA ratings, intrinsically safe barrier information, gas sealing recommendations, purging system details, etc. for panels located in hazardous locations or interfacing to equipment located in hazardous areas.
   h. For every control panel, heating and cooling calculations for each panel supplied indicating conformance with cooling requirements of the supplied equipment and environmental conditions. Calculations shall include the recommended type of equipment required for both heating and cooling.
   i. Submit evidence that all control panels shall be constructed in conformance with UL 508 and bear the UL seal confirming the construction. Specify if UL compliance and seal application shall be accomplished at the fabrication location or by field inspection by UL inspectors. Costs associated with obtaining the UL seal and any inspections shall be borne by Contractor.

3. Panel Wiring Diagrams: Panel wiring diagrams depicting wiring within and on the panel as well as connections to external devices. Panel wiring diagrams shall include power and signal connections, UPS and normal power sources, all panel ancillary equipment, protective devices, wiring and wire numbers, and terminal blocks and numbering. Field device wiring shall include the device ISA-tag and a unique numeric identifier. Diagrams shall identify all device terminal points that the system connects to, including terminal points where I/O wiring lands on equipment not supplied by the PCSS. Wiring labeling used on the drawings shall match that shown on the Contract Documents or as developed by the PCSS and approved by the Engineer. I/O wiring shall be numbered with rack number, slot number, and point number.

   Two-wire and four-wire equipment shall be clearly identified, and power sources noted. Submit final wire numbering scheme. Panel drawings shall be 11" x17" in size.

1.04 COORDINATION MEETINGS

A. Refer to Section 13300.

1.05 REFERENCE STANDARDS

A. Refer to Section 13300.

1.06 QUALITY ASSURANCE

A. Refer to Section 13300.

1.07 DELIVERY, STORAGE AND HANDLING

A. Refer to Section 13300.

1.08 NOMENCLATURE AND IDENTIFICATION

A. Refer to Section 13300.

1.09 MAINTENANCE

A. Refer to Section 13300.

1.10 AWARRANTY

A. Refer to Section 13300.

PART 2 PRODUCTS

2.01 GENERAL

A. Refer to Section 13300.

2.02 LIGHTNING/SURGE PROTECTION

A. Refer to Section 13300.

2.03 CONTROL PANEL GENERAL REQUIREMENTS

A. Dimensions within this Section and on Contract Drawings are for general reference only. Ensure that final enclosure sizing and panel arrangements accommodate all required equipment for a fully integrated and operational system as specified herein and in Contract Documents.

B. Each control panel and terminal cabinet shall bear the UL label. UL label shall apply to the enclosure, the specific equipment supplied with the enclosure, and the installation and wiring of the equipment within and on the enclosure. If required for UL labeling, provide ground fault protective devices, isolation transformers, fuses and any other equipment necessary to achieve compliance with UL 508 requirement. Drawings do not detail all UL 508A requirements.

C. Panel doors shall have a lock installed in door handle, or a hasp and staple for padlocking. Locks for all panels provided under this Contract shall be keyed alike.

D. Devices designated for rear-of-panel mounting shall be arranged within the panel according to respective panel drawings and in a manner to allow for ease of maintenance and adjustment. Heat generating devices such as power supplies shall be located at or near the top of the panel.

E. Panels shall be completely fabricated, instruments and devices installed and wired at the PCSS's facility.

F. Components shall be mounted in a manner that shall permit servicing, adjustment, testing, and removal without disconnecting, moving, or removing any other component. Components mounted on the inside of panels shall be mounted on removable plates and not directly to the enclosure. Mounting shall be rigid and stable unless shock mounting is required otherwise by the manufacturer to protect equipment from vibration. Component mounting shall be oriented in accordance with manufacturer's recommendations. Internal components shall be identified with suitable plastic or metal engraved nametags mounted adjacent to (not on) each component identifying the component in accordance with the drawing, specifications, and PCSS's data.

G. Exterior panel mounted equipment shall be installed with suitable gaskets, faceplates, etc. required to maintain the NEMA rating of the panel.

H. Nameplates:

1. Panels and panel devices shall be supplied with suitable nameplates, which identify the panel and individual devices as required. Unless otherwise indicated, each device nameplate shall include up to three lines with the first line containing the device tag number as shown on the drawings, the second line containing a functional description (e.g., Recirculation Pump No. 1), and the third line containing a functional control description (e.g., Start).

2. Unless escutcheon plates are specified or unless otherwise noted on the Drawings, nameplates shall be 3/32-inch thick, black and white, Lamicoid with engraved inscriptions. The letters shall be Black [White] against a White [Black] background unless otherwise noted. Edges of the nameplates shall be beveled and smooth. Nameplates with chipped or rough edges will not be acceptable.

3. Nameplate fasteners and mounting shall be epoxy adhesive or stainless-steel screws for cabinet mounted nameplates

4. For every panel, provide a panel nameplate with a minimum of one-in. high letters. Provide legend plates or one-in. by three-in. engraved nameplates with 1/4-in. lettering for identification of door mounted control devices, pilot lights, and meters.

5. Single lamicoid nameplates with multiple legends shall be used for grouping of devices such as selector switches and pilot lights that relate to one function.

I. Mounting Elevations:

1. ISA Recommended Practice RP60.3 shall be used as a guide in layout and arrangement of panels and panel mounted components. Dimensions shall account for all housekeeping pads that panels will sit on once they are installed.

2. Centerline of indicators and controllers shall be located no lower than 48-inches or higher than 66-inches above the floor on a panel face.

2.04 PANEL MATERIALS AND CONSTRUCTION

A. Structure and Enclosure:

1. Panels shall be of continuous welded-steel or FRP construction as shown on the Panel Schedule. Provide angle stiffeners as required on the back of the panel face to prevent panel deflection under instrument loading or operation. Internally the panels shall be supplied with a structural framework for instrument support purposes and panel bracing. Internal framework shall permit panel lifting without racking or distortion. Provide removable lifting rings designed to facilitate simple, safe rigging, and lifting of the control panels during installation.

2. Each panel shall be provided with full height, fully gasketed access doors where shown. Doors shall be provided with a three-point stainless steel latch (except for NEMA 4X panels) and heavy duty stainless steel locking handle. Rear access doors (if included) shall be conveniently arranged and sized such that they extend no further than 24-inches beyond the panel when opened to the 90-degree position. Front and side access doors shall be as shown. Panel access doors shall be provided with full length, continuous, piano type stainless steel hinges with stainless steel pins. Front access doors with mounted instruments or control devices shall be of sufficient width to permit door opening without interference from flush mounted instruments.

3. Panels, including component parts, shall be free from sharp edges and welding flaws. Wiring shall be free from kinks and sharp bends and shall be routed for easy access to other components for maintenance and inspection purposes.

4. Panel shall be suitable for top and bottom conduit entry as required by the Electrical Drawings. For top mounted conduit entry, panel top shall be provided with nominal one-foot square removable access plates, which may be drilled to accommodate conduit and cable penetrations.

Conduit and cable penetrations shall be provided with ground bushings, hubs, gasketed locknuts, and other accessories as required to maintain the NEMA rating of the panel and electrical rating of the conduit system.

5. Panels in indoor, dry, non-corrosive environments shall be NEMA 12 unless otherwise noted. Panels in outdoor, wet, and non-chemically corrosive environments shall be NEMA 4 unless otherwise noted. Panels in chemically corrosive environments shall be NEMA 4X unless otherwise noted. Panels located in a hazardous location shall be rated for the type of hazard (e.g., NEMA 7 for Class 1, Division 1).

B. Freestanding and Floor-Mounted Vertical Panels:

1. Freestanding and floor-mounted vertical panels shall meet the NEMA classification as shown on the drawings or specified herein. Panels shall be constructed of 12 gauge sheet steel, suitably braced internally for structural rigidity and strength. All NEMA 4X rated panels shall be constructed of Type 316 stainless steel, unless FRP is specifically indicated

to be provided. Front panels or panels containing instruments shall be not less than 10 gauge stretcher leveled sheet steel, reinforced to prevent warping or distortion.

C. Wall and Unistrut Mounted Panels:

1. Wall and Unistrut mounted panels shall meet the NEMA classification as shown on the Drawings or specified herein. Panels shall be constructed of not less than USS 14 gauge steel, suitably braced internally for structural rigidity and strength. NEMA 4X rated wall mounted panels shall be constructed of Type 316 stainless steel, unless FRP is specifically indicated. FRP panels shall be used in chlorine areas. FRP panels located in direct sunlight shall be provided with a protective coating and sun shield to prevent discoloration and cracking.

D. Manufacturer:

1. Shaefer's

2. Saginaw

3. Hoffman

E. Terminal box outdoor in submersible area.

1. NEMA 6P / IP68 protection rater against water and dust ingress at depths up to 15ft / 5m

2. Manufactured from 14 gauge Type 316 Marine Grade Stainless Steel

3. Seams continuously welded.

4. Manufacturer:

a. Slayson
b. NEMACO
c. Approved equal.

F. Finish Requirements:

1. Sections shall be descaled, degreased, filled, ground and finished. Enclosure when fabricated of steel shall be finished with two rust resistant phosphate prime coats and two coats of enamel, polyurethane, or lacquer finish which shall be applied by either the hot air spray or conventional cold spray methods. Brushed anodized aluminum, stainless steel, and FRP panels will not require a paint finish.

2. Panels shall have edges ground smooth and shall be sandblasted and then cleaned with a solvent. Surface voids shall be filled and ground smooth.

3. Immediately after cleaning, one coat of a rust-inhibiting primer shall be applied inside and outside, followed by an exterior intermediate and top coat of a two-component type epoxy enamel. A final sand-ing shall be applied to the intermediate exterior coat before top coating.

4. Apply a minimum of two coats of manufacturer's standard, flat light-colored lacquer, on the panel interior after priming.

5. Unless otherwise noted, the finish exterior colors shall be ANSI 61 gray with a textured finish.

G. Print storage pockets shall be provided on the inside of each panel. Storage pockets shall be steel, welded on to the door, and finished to match the interior panel color. Storage pocket shall be sufficient to hold all of the prints required to service the equipment, and to accommodate 8.5 inch by 11 inch documents without folding.

H. A folding shelf shall be provided on the inside of the door on all free-standing and floor-mounted panels. Shelf shall be suitable for a laptop computer and shall be placed such that an open laptop computer does not interfere with any door-mounted devices. Folded shelf shall not interfere with any internal panel components when the door is closed. Folding shelf shall automatically lock in the horizontal position when raised. Folding shelf shall be approximately 18 inches wide by 12 inches deep and shall have a minimum distributed load rating of 100 pounds. Parts shall be made of heavy gauge steel and shall be painted white or finished to match the interior panel color.

A. ENVIRONMENTAL CONTROL

1. Provide force air ventilation or air conditioning units as required to prevent temperature buildup inside of panel.

2. Heat Load Calculations:

   a. Submit heat load calculations for all control panels located in areas where either venting is not possible due to NEMA rating of panel or control panel is located in an area or building without air conditioning.
   b. Utilize manufacturer available thermal calculators to determine heating/cooling requirements (i.e. Saginaw SCE thermal calculator, nVent Hoffman cooling selection tool, or equivalent).
   c. Considered solar load heat when calculating heat load calculations, for panel with direct sunlight.
   d. Ensure the internal temperature of the panel is regulated between 45 to 104 degrees Funder all conditions.
   e. Account for the following conditions in the heat load calculations:

1. Sun Shields:

   a. Provide custom fabricated sun shields for all outdoor panels in accordance with the following requirements:
   b. Fabricate sun shields from a material suited for the area classification rating of its environment.
   c. Design, fabricate, install, and support the unit to fully cover and shade the top, sides, and back of the enclosure, and to partially shade the front panel of the enclosure from direct exposure to sunlight from sunrise to sunset.
   d. Depending on overall size, sun shields may be fabricated in single or multiple segments for attachment to the enclosure support framing or to separate free standing framing around the enclosure, to preserve rigidity.

e. Design and mount sun shields with a minimum 3-inch air gap around the enclosure for air circulation and heat dissipation.
f. Drilling holes to the enclosure for sun shield mounting is not permitted.
g. Slope the top section of the sun shield a minimum angle of 5 degrees from horizontal.

1) Wall mounted enclosures: slope the top section downward away from the wall and towards the front of the enclosure.
2) Free standing, floor mounted, and frame mounted enclosures: slope the top section downward towards the back side of the enclosure.

h. Incorporate a narrow and more steeply sloped drip shield segment on the front edge of the top section to shed water away from the front of the enclosure and prevent dripping or running directly onto the front panel of the enclosure.
i. Fabricate sun shields with continuous seam welds that are ground smooth.
j. Smooth round or chamfer exposed corners, edges, and projections to prevent injury.

2.05 CORROSION CONTROL

A. Panels shall be protected from internal corrosion by the use of corrosion-inhibiting vapor capsules as manufactured by Northern Technologies International Corporation, Model Zerust VC; Hoffman Model AHCI; or equal.

2.05 CONTROL PANEL - INTERNAL CONSTRUCTION

A. Internal Electrical Wiring:

1. Interconnecting wiring shall be stranded, type MTW, and shall have 600 volt insulation and be rated for not less than 90 degrees Celsius. Wiring for systems operating at voltages in excess of 120 VAC shall be segregated from other panel wiring either in a separate section of a multi-section panel or behind a removable Plexiglas or similar dielectric barrier. Panel layout shall be developed such that technicians shall have complete access to 120 VAC and lower voltage wiring systems without direct exposure to higher voltages.

2. Power distribution wiring on the line side of fuses or breakers shall be 12 AWG minimum. Control wiring on the secondary side of fuses shall be 16 AWG minimum. Electronic analog circuits shall utilize 18 AWG shielded, twisted pair, cable insulated for not less than 600 volts.

3. Power distribution blocks shall be covered with protective guards to meet “finger-safe” requirements of IP20.

4. Power and low voltage DC wiring systems shall be routed in separate wireways. Crossing of different system wires shall be at right angles. Different system wires routed parallel to each other shall be separated by at least six inches. Different wiring systems shall terminate on separate terminal blocks. Wiring troughs shall not be filled to more than 60 percent visible fill.

5. Terminations:

    a. Wiring shall terminate onto single tier terminal blocks, where each terminal is uniquely and sequentially numbered. Direct wiring between field equipment and panel components is not acceptable.
    b. Multi-level terminal blocks or strips are not acceptable unless they are approved by the Engineer in advance of panel wiring diagrams. If approved, they shall be mounted on angled din rail elevated from the back panel.
    c. Terminal blocks shall be arranged in vertical rows and separated into groups (power, AC control, DC signal). Each group of terminal blocks shall have a minimum of 25 percent spares.
    d. Terminal blocks shall be the compression type, fused, unfused, or switched as shown on the Contract Drawings or specified elsewhere in Division 13.
    e. Discrete inputs and outputs (DI and DO) shall have two terminals per point with adjacent terminal assignments. All active and spare PLC and controller points shall be wired to terminal blocks.
    f. Analog inputs and outputs (AI and AO) shall have three terminals per shielded pair connection with adjacent terminal assignments for each point. The third terminal is for shielded ground connection for cable pairs. Ground the shielded signal cable at the PLC cabinet. All active and spare PLC and controller points shall be wired to terminal blocks.
    g. Wire and tube markers shall be the sleeve type with heat impressed letters and numbers.
    h. Only one side of a terminal block row shall be used for internal wiring. Field wiring side of the terminal shall not be within six inches of the side panel or adjacent terminal or within eight inches of the bottom of free standing panels, or within three inches of stanchion mounted panels, or three inches of adjacent wireway.
    i. Circuit power from the PLC cabinet out to field devices (switches, dry contacts etc.) that are used as discrete inputs to the PLC input cards shall be isolated with an isolating switch terminal block with flip cover that is supplied with a dummy fuse. Isolation switch block shall be an Allen Bradley Model 1492-H7 or equal. One isolating switch terminal block per loop numbered piece of equipment and one per spare I/O point is acceptable.
    j. All PLC discrete outputs to the field shall be isolated with an isolating fuse switch terminal block with a flip cover and a neon blown fuse indicator. The single circuit fusible terminal block shall be an Allen Bradley 1492-H4 or equal.

6. Wiring to hand switches and other devices, which are live circuits independent of the panel's normal circuit breaker protection, shall be clearly identified as such.

7. Wiring shall be clearly tagged and color coded. Tag numbers and color coding shall correspond to panel wiring diagrams and loop drawings prepared by the PCSS. Power wiring, control wiring, grounding, and DC wiring shall utilize different color insulation for each wiring system used. Color coding scheme shall be:

    a. Incoming 120 VAC Hot – Black.
    b. 120 VAC Hot wiring downstream of panel circuit breaker – Red.
    c. 120 VAC Hot wiring derived from a UPS system – Red with Black stripe.
    d. Three phase power – Brown, Orange, Yellow, and Green ground or as specified in Division 16.
    e. 120 VAC neutral – White.

f. Ground – Green.
g. DC power or control wiring – Blue.
h. DC analog signal wiring – Black (+), White (-).
i. Foreign voltage – Yellow.

8. Provide surge protectors on all incoming power supply lines at each panel per requirements of Section 13300.

9. Each field instrument furnished under Division 13 and shown on the Drawings as deriving input power from the control panel(s) shall have a separate power distribution circuit with a circuit breaker or fuse and blown fuse indication. Instruments requiring 120VAC power shall be powered from the UPS source in the panel where the instrument signals lands.

10. Provide redundant 24 VDC power supplies to power field instruments and panel devices. Twenty-four VDC power supplies shall be as specified in this Section.

11. Wiring trough for supporting internal wiring shall be plastic type with snap-on covers. Side walls shall be open top type to permit wire changing without disconnecting. Trough shall be supported to the subpanel by stainless steel screws. Trough shall not be bonded to the panel with glue or adhesives.

12. Each panel shall have a single tube, fluorescent light fixture, 20 Watt in size, mounted internally to the ceiling of the panel. Light fixture shall be switched and shall be complete with the lamp.

13. Each panel shall have a specification grade duplex convenience receptacle with ground fault interrupter, mounted internally within a stamped steel device box with appropriate cover. Convenience receptacle shall not be powered from a UPS and shall be protected by a dedicated fuse or circuit breaker.

14. Each panel shall be provided with an isolated copper grounding bus for all signal and shield ground connections. Shield grounding shall be in accordance with the instrumentation manufacturer's recommendations.

15. Each panel shall be provided with a separate copper power grounding bus (safety) in accordance with the requirements of the National Electrical Code.

16. Each panel shall have control, signal, and communication line surge suppression in accordance with Section 13300.

17. Microprocessor-based electronic devices in the panel that are powered by 120VAC shall be powered by the UPS.

18. Each panel shall be provided with a circuit breaker to interrupt incoming power.

19. Additional electrical components including transformers, motor starters, switches, circuit breakers, etc. shall be in compliance with the requirements of Division 16.

B. Pneumatic Tubing:

1. Refer to Section 13300.

2. Pneumatic tubing shall be a minimum of 1/4-inch O.D. Type 316 stainless steel with compression fittings. Tubing shall be rigidly supported and run in horizontal or vertical planes.

3. Pneumatic equipment shall be provided with separate shut-off valves. Flexible polyethylene tubing shall be used on all devices mounted on hinged doors, etc.

4. A screened vent shall be provided on enclosures using pneumatic instruments.

5. Pneumatic tubing shall be routed in separate bundles or wireways and shall be separated from electrical wiring by a minimum of three inches.

C. Relays not provided under Division 16 and required for properly completing the control function specified in Division 13, Division 16, or shown on the Drawings shall be provided under this Section.

D. Orientation of devices including PLC and I/O when installed shall be per the manufacturer's recommendations. No vertical orientation of PLC racks shall be allowed unless specifically indicated by the manufacturer as an acceptable mounting alternative and also approved by the Engineer.

2.06 ELECTRICAL COMPONENTS

A. Main circuit breaker shall be a thermal-magnetic molded case breaker, by Square D Company, or equal. Provide a flange mounted main power disconnect operating handle with mechanical interlock having a bypass that will allow the panel door to open only when the switch is in the OFF position.

B. Auxiliary contacts shall be provided for remote run indication and indication of each status and alarm condition. Additional controls shall be provided as specified herein and as required by the detailed mechanical equipment requirements, the P&IDs Division 13, the Control Wiring Diagrams Division 16 and as shown on the Drawings.

C. Operating control devices and instruments shall be securely mounted on the exterior door. Controls shall be clearly labeled to indicate function and shall be in accordance with the electrical area classification indicated on the Electrical Contract Drawings.

D. Control panel shall be provided with a lightning and surge protection unit on the line side of the main circuit breaker. Unit shall be 600 Volt, 3 Phase, General Electric "Tranquell" Series, or equal.

E. Specific control devices, control descriptions and other data are specified under the detailed specification for the mechanical equipment with which the control panel is supplied.

2.07 SINGLE PHASE UPS - INTERNAL TO CONTROL PANELS

A. System Description:

1. Provide an industrially rated continuous duty, on-line, solid state, line interactive, single-phase uninterruptible power system.

2. UPS shall provide power conditioning and power backup for PLC, communications hardware, and other critical electronic loads as indicated on Drawings.

3. UPS system shall consist of the following major components:

   a. Rectifier and battery charger.
   b. Inverter.
   c. Batteries.
   d. Other features as described in this Section and as indicated on Drawings.

4. UPS shall be:

   a. Phoenix Contact QUINT UPS.
   b. Or approved equal.

B. General Requirements:

1. Battery protection shall be provided an internal circuit breaker disconnect.

2. Current limiting circuitry shall protect inverter output under any load condition.

3. AC output neutral shall be electrically isolated from UPS chassis. UPS chassis shall have an equipment ground terminal. Provisions for installation of a bonding connector shall be provided.

4. UPS shall be suitable for installation in a UL508A listed panel.

5. UPS shall be DIN rail mountable.

6. UL recognized components for industrial applications in accordance with UL508 without derating.

C. Performance Requirements:

1. Ratings:

   a. Output power: 350VA – 1000VA.
   b. Battery runtime: 60 minutes at full load, 120 minutes at half-load.

2. Environment:

   a. Ambient temperature: 0 to 40 degrees C.
   b. Elevation: Up to 500 ft above mean sea level.
   c. Relative humidity: 1 to 95 percent non-condensing.

3. System Input - Primary source:

    a. Single input: Nominal Input Voltage: 120 VAC.
    b. Frequency: 45 to 65 Hz.
    c. Input Power Factor: 0.95 lag minimum, 50 to 100 percent load.
    d. Input Surge Withstandability: Per IEEE 587/ANSI C62.41. Category A and B, (6 kV).

4. System Output:

    a. Nominal Output Voltage: 120 VAC
    b. Frequency: 60 Hertz plus or minus 3 Hertz.
    c. 100 percent load with 3:1 Crest Ratio
    d. Frequency Slew Rate: 1 Hz/second. (Adjustable at startup)

5. AC to AC Efficiency (100 percent load @ rated PF): 88 percent online, 86 percent on battery.

6. Acoustical Noise: Noise generated by UPS under normal operation shall not exceed 65 dBA (60 dBA typical) at one meter from any surface, measured at 25 degrees C (77 degrees F) and full load.

7. EMI Suppression: UPS shall meet FCC Rules and Regulation 47, Part 15, Subpart J, for Class A devices.

D. Batteries:

1. Batteries shall be High Temperature sealed, maintenance-free, high-rate discharge, lead-acid cells suitable for use indoors with no off gassing, or water addition requirements. Batteries shall not require special ventilation. Battery shall consist of one or more battery banks with number of cells required to meet requirements of rest of these specifications.

2. Battery Design Life: two - four years.

E. Controls and Monitoring:

1. Remote alarm and status indication: Isolated SPDT dry contacts shall be provided to indicate UPS status for remote monitoring. Contacts shall be rated for 250VAC @ 5A or 30VDC @ 5A Individual contacts wired to the PLC for indication at OIT shall be provided for separate annunciation of the following alarm and status conditions:

    a. UPS ON battery
    b. Battery Fail.

2.08 POWER SUPPLIES (24VDC)

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:

a. Allen-Bradley.
b. Phoenix Contact.
c. SOLA HD.
d. Substitutions: Or equal

B. Type:

1. 24 VDC Power Supply to power field instruments and panel devices as shown on the drawings.

C. Function/Performance:

1. Input power: 115VAC, plus or minus 10 percent, 60 Hz.

2. Output voltage: 24VDC.

3. Output voltage adjustment: five percent.

4. Line regulation: 0.05 percent for 10V line change.

5. Load regulation: 0.15 percent no load to full load.

6. Ripple: 3 mV RMS.

7. Operating temperature: 32 to 140 degrees F.

8. Sized to accommodate the design load plus a minimum 25 percent spare capacity.

D. Physical:

1. Mounting: DIN rail. Mounted such that heat dissipation does not adversely affect other panel components.

2. Equipped with power on/off circuit breaker.

3. Provide relay contact (internal to the power supply or external if the power supply is not so equipped) to indicate on/off status of the power supply.

4. Provide relay contact to indicate power supply fault.

5. Output overvoltage and overcurrent protective devices to protect from damage due to power supply failure and external failure.

PART 3 EXECUTION

3.01 INSTALLATION

A. Panels shall be installed at locations as shown on the Contract Drawings.

B. Refer to Section 13300.

3.02 TESTS

A. Refer to Section 13300.

END OF SECTION

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SECTION 13340
INSTRUMENTS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section covers the furnishing, installation, and services for instruments.

1.02 RELATED WORK

A. Refer to Section 13300 “I & C - General Provisions.”

1.03 SUBMITTALS

A. Submit complete documentation of all field instruments using ISA-TR20.01.01-2007 data sheet formats. Submit a complete Bill of Materials (BOM) or Index that lists all instrumentation equipment. The list shall be sorted by Loop Number.

B. Submit separate data sheets for each instrument, including:

1. Plant Equipment Number and ISA tag number per the Drawings.
2. Product (item) name used herein and on the Drawings.
3. Manufacturer's complete model number.
4. Location of the device.
5. Input - output characteristics.
6. Range, size, and graduations in engineering units.
7. Physical size with dimensions, enclosure NEMA classification and mounting details in sufficient detail to determine compliance with requirements.
8. Materials of construction for enclosure and wetted parts.
9. Instrument or control device sizing calculations where applicable.
10. Certified calibration data for all flow metering devices.
11. Two-wire or four-wire device type as applicable.

C. Submit catalog cuts for all instruments. Submit descriptive literature for each hardware component, which fully describes the units being provided.

D. Submit index and data sheets in electronic format as well as hard copies on 8-1/2" x 11" formats. Electronic format shall be in Microsoft Excel or Word. Submit electronic copy on CD-ROM or DVD disk.

1.04 MAINTENANCE

A. Refer to Section 13300.

B. Test equipment:

1.05 INSTRUMENT TAGS

A. A permanent stainless steel or other non-corrosive material tag firmly attached and permanently and indelibly marked with the instrument tag number, as indicated in the Drawings, shall be provided on each piece of equipment supplied under this Section and related sections. Equipment shall be tagged before shipping to the site.

B. Provide 1/8-in by 3/8-in, Type 316 stainless steel button head machine screws.

C. All supplied instrument transmitters and instrument transmitter elements shall have a stainless steel identification tag attached to each transmitter and element prior to shipment. Tag shall be attached via stainless steel chain or stainless steel wire (24 gauge min) to a non-removable part of the device. The tag size shall be a minimum of 1.5 square inches. Tag shall include the ISA alphanumeric instrument number as indicated in the P&ID, loop, and detail drawings. The alphanumeric instrument number shall be stamped into the tag and shall have a minimum of 3/16-in high alphanumeric characters.

1.06 APPROVALS/CERTIFICATIONS

A. Instruments for hazardous locations shall have Factory Mutual (FM), Canadian Standards Association (CSA), and CENELEC approvals and certifications as specified herein and as indicated on the Drawings or in the Instrument Device Schedule. The instrument specifications in Part 2 state the Class, Division, and gas groups for FM/CSA approval, followed in parenthesis by the CENELEC certification; however, instruments provided are only required to have the approval/certification stated above. The instrument shall have a stainless steel tag identifying the relevant approval or certification.

PART 2 PRODUCTS

2.01 INSTRUMENTS

A. SUBMERSIBLE LEVEL TRANSMITTER

1. Type:

a. Submersible, hydrostatic pressure type level transmitter.

2. Function/Performance:

a. Range: Range selected shall be the manufacturer's standard range closest to the span to be measured.
b. Temperature Compensation: Temperature compensated over a range of zero to 50 degrees C.
c. Accuracy: Plus or minus 0.25 percent of range.

d. Over Pressure: Transducer shall be protected for overpressure of 1.5 times the span.
e. Output: 4-20 mA proportional to the calibrated span.

3. Physical:

a. The transmitter assembly shall have a Type 316 stainless steel or titanium body with a bottom diaphragm.
b. Sensors shall be suspended by cable. Cable shall include a vent tube for the transducer.
c. Sensor shall be suspended with a tension-relieving mounting clamp from a four-inch (100 mm) flange. Clamp and flange shall be Type 316 stainless steel.
d. Sensor shall be submersible (IP68) and shall be CSA approved or CENELEC (EEx ia IIC T4) certified intrinsically safe when intrinsically safe barriers are provided for the instrument loop.
e. 24 VDC loop powered.

4. Accessories Required:

a. Sufficient manufacturer's cable for installation between the sensor and the transmitter as indicated on the Drawings. Cable shall be reinforced to support the weight of the transducer and cable.
b. Cable clamp for suspending instrument provided by instrument supplier.
c. All fittings required for pressure calibration of the instrument.

5. Manufacturers:

a. SOR 510LT.
b. GE PTX1290.
c. Or equal.

6. Range

a. LT-2041

1) 0-4 feet

b. LT-2042

1) 0-4 feet

c. LT-2043

1) 0-4 feet

d. LT-2044

1) 0-4 feet

e. LT-2045

1) 0-4 feet

f. LT-2046

1) 0-4 feet

g. LT-2060

1) 0-96 inches

B. FLOAT SWITCHES

1. Type

a. Mercury free ball float switch.

2. Function/Performance

a. Differential: Less than 8 inches.
b. Switch Rating: 1 amp at 120 VAC or 100 VA @ 120 VAC
c. Provide NO or NC type contact for fail-safe operation per Section 13300 - I&C-General Provisions, Paragraph 2.01.F or as shown on the Drawings.

3. Physical

a. Float: Type 316 stainless steel, Teflon or non-stick coating, minimum 5-inch diameter.
b. Totally encapsulated switch.
c. Cable shall be heavy-duty, PVC or equivalent jacketed integral to float.

4. Options/Accessories Required

a. Provide stainless steel hardware.
b. Lead wire shall be a waterproof cable of sufficient length so that no splice or junction box is required in the vault.
c. Provide cast-aluminum weatherproof junction box outside the sump pit with terminals for all floats and tapped as required for conduit connections.
d. Provide mounting equipment as shown on the drawings.

5. Manufacturer(s)

a. Anchor Scientific Roto-Float SST-NM
b. Contegra FS 90
c. Flygt ENM-10
d. Evoqua Water Technologies Model 9G-EF
e. Or equal

6. Range

a. LSHH-2010

1) Elevation Alarm 25 feet

C. ULTRASONIC LEVEL METER

1. Transducer

a. Type

1) Non-contact, ultrasonic level transducer.

b. Function/Performance

1) Measuring Range: Transducer range shall be suitable for the installation indicated on the Instrumentation Drawings.
2) Temperature Range: –20° to +60°C.
3) Relative Humidity: Zero to 100%.
4) Beam Angle: 12 degrees or less.
5) Temperature Compensation: Transducers shall be provided with integral temperature sensors for temperature compensation at above temperature ranges.

c. Physical

1) Housing: NEMA 4X
2) Transducers shall be potted/encapsulated in a Kynar or other chemical and corrosion-resistant housing.
3) The surface of transducers shall be Teflon-coated where mounted on chemical tanks and exposed to vapors in the tanks that are not compatible with the transducer material.
4) Transducers shall be capable of being completely submerged without damage.
5) Transducers shall be suitable for surface, pipe, or flange mounting as indicated on the Drawings. Appropriate mounting hardwired shall be provided. Flanges shall be six inches and resistant to attack by the medium being metered or, where required, shall be protected by corrosion- resistant coatings and facings..

d. Options/Accessories Required

1) Transducers located in areas where freezing condensation may occur shall be provided with special heaters or other type of transducer protection designed to prevent sensor icing.
2) Signal cable as recommended by the manufacturer, for installation between the transducer(s) and the transmitter. Length, up to 1000 feet, shall be as required by installation indicated on the Drawings.

e. Manufacturer(s)

1) Siemens
2) Endress
3) Pulsar Process Measurements, Inc.
4) Or equal

2. Transmitter/Converter

    a. Type

        1) Microprocessor based integral with the transducer(s) provided.

    b. Functional/Performance

        1) Resolution (including transducer): +/- 0.1% of range or 0.08 inches, whichever is greater.
        2) Accuracy (including transducer): +/-0.25% of range or 0.24 inches.
        3) Range: As required by the installation indicated on the Instrumentation Drawings.
        4) Temperature Range: -20° to +50°C.
        5) Output: Minimum one isolated 4-20 mA output
        6) Temperature Compensation: Compensation over the temperature range of the sensor.
        7) Loss of Signal: Transmitter shall ignore momentary loss-of-echo signals and shall indicate loss of echo on the transmitter unit.
        8) Configuration Protection: Programmable parameters shall be protected using E2PROM. Battery backup protection is not acceptable.

    c. Physical

        1) Transmitter shall be suitable for surface or pipe stand mounting.
        2) Enclosure: NEMA 4X.

    d. Accessories Required
        1) Hand-held programmer where required for configuration and calibration of the instrument.

    e. Manufacturer(s)

        1) SITRANS Probe LU240 Endress
        2) Prosonic M FMU44
        3) Or equal

3. Range

    a. LT-2010

        1) 0-25 feet

D. MAGNETIC FLOWMETER

1. Flow Element:

a. Type:

1) Pulsed DC type.

b. Function/Performance:

1) Operating Temperature: Process liquid temperatures of 0 to 140 degrees F or greater dependent upon liner and an ambient of minus 30 to 150 degrees F.
2) Radio Frequency Interference (RFI) protection: RFI protection shall be provided as recommended by the manufacturer.
3) Pressure rating: Equal to piping system where meter is installed.
4) Additional: Meter shall be capable of running empty indefinitely without damage to any component.

c. Physical:

1) Metering Tube: Type 304 stainless steel or equivalent.
2) Flanges: Carbon Steel or Stainless Steel shall be required, plus an Isolation Kit to avoid galvanic corrosion.
3) Liner: Polyurethane or composite elastomer unless otherwise indicated on the Drawings or in the Instrument Device Schedule.
4) Electrodes: Type 316 stainless steel standard minimum requirements. All electrodes to be compatible with process fluid as indicated on the Drawings or electrodes to be supplied as listed in the Instrument Device Schedule.
5) For sludge, polymer, or any slurry application where the electrodes will be coated, a self-cleaning or a removable electrode option must be provided with that meter.
6) Finish: All external surfaces shall have a chemical and corrosion resistant finish.

d. Power Requirements:

1) Meter shall be 24 VDC powered instrument, receiving its power from transmitter.

e. Accessories/Documentation Required:

1) Factory calibration: All meters shall be factory calibrated. A copy of the calibration report shall be included in the O&M manual.
2) Grounding: Meter shall be grounded in accordance with the manufacturer's recommendation. Provide ground ring, ground wires, gaskets, etc., as required. All materials shall be suitable for the liquid being measured and must be compatible with process fluid and with the process pipe.

2. Flow Converter/Transmitter:

    a. Type:

        1) Micro-processor based, intelligent transmitter compatible with flow tube provided.
        2) Integral mount as shown on the drawings or as required by the physical location.

    b. Functional/Performance:

        1) Accuracy (including flow tube): Plus/minus 0.5 percent of flow rate or better.
        2) Operating Temperature: –20 to 140 degrees F.
        3) Output: Isolated 4-20 mA. Current output adjustable over the full range of the instrument. Provide a dry contact to indicate reverse flow.
        4) Diagnostics: Self diagnostics with on screen display of faults.
        5) Display: Digital indicator displaying flow in engineering units indicated in the Instrument Device Schedule.
        6) Totalizer: A fully configurable totalizer integral to the transmitter. Totalized flow shall be displayed.
        7) Empty Tube Zero: The transmitter shall include a feature that will lock the output at zero when no flow is detected. The empty tube zero feature shall be enabled automatically when the transmitter detects no flow or manually through a contact input.
        8) Provide electrode cleaning unit to match flow element requirements.

    c. Physical:

        1) Transmitter shall be suitable for surface or pipe stand mounting.
        2) Enclosure shall be NEMA 4X (IP65).

    d. Power Requirements:

        1) The transmitter shall be 120 VAC powered instrument.

    e. Accessories/ Required:

        1) Keypad where required for transmitter configuration.

3. Manufacturer:

    a. Proline Promag W 400 Endress+Hauser
    b. ABB Instruments WaterMaster.
    c. Krohne Optiflux 2000 or 4000 Series.
    d. Siemens Sitrans FM MAG.
    e. Rosemount Series 8732E meter/transmitter for integral mounted.
    f. Or approved equal.

4. Range

    a. FIT-2000

        1) 0-15000 gpm

b. FIT-2030

1) 0-15000 gpm

E. HANDHELD MULTI-PARAMETER ANALYZER

1. Type:

a. Microprocessor-based, intelligent analyzer compatible with multiple.

2. Function/Performance:

a. Sensor: Support a minimum of 4 sensors
b. Connectivity / Communications: Built-in micro–USB On-The-Go port for PC connection, recharging/powering and connecting directly to a USB stick
c. Connectors: MS (military spec) waterproof with quarter-turn bayonet lock (unsurpassed in regard to durability)
d. Desktop Software: Provided with compatible desktop software
e. Memory: >100,000 data sets, 400 files or minimum 4 GB
f. GPS: Coordinates are stored with measurement data and site lists
g. Graphic Display: Color, LCD graphic display, backlit keypad
h. Calibration: 1,2 or 3 points of calibrations.
i. Maximum Depth: Min 100 m

3. Physical:

a. Rating IP-67.
b. Provide Carrying Case with shoulder strap

4. Required sensors:

Parameter	Type	Range	Accuracy	Resolution
Dissolved Oxygen (% saturation)	Optical Luminescence - Lifetime Method	0 to 500%	0 to 200% (±1% of reading or 1% air saturation) 200% to 500% (±8% of reading)	0.1% or 1% air saturation
Dissolved Oxygen (mg/L, ppm) temp comp range -5 to 50°C	Optical Luminescence - Lifetime Method	0 to 50 mg/L	0 to 200% (±1% of reading or 1% air saturation) 200% to 500% (±8% of reading)	0.1 or 0.01 mg/L
Specific Conductance (µS, mS)	Calculated from Conductivity and Temperature	0 to 200 mS/cm	±0.5% of reading or 0.001 mS/cm	0.001, 0.01, 0.1 mS/cm
pH (mV, pH units)	Glass Bulb Combination Electrode; Ag/AgCl Reference Gel	0 to 14 units	±0.2 units	0.01 units
Turbidity (FNU, NTU)	Nephelometric - Optical, 90° Scatter	0 to 4000 FNU	0 to 999 (0.3 or ±2% of reading) 1000 to 4000 (±5% of reading)	0.1 FNU

5. Accessories:

    a. Cable management kit
    b. Calibration kit including calibration solution as required for each sensor provided.
    c. External battery
    d. Field mounted kits.

6. Manufacturer:

    a. YSI: ProDSS Multiparameter Digital Water Quality Meter
    b. Hydrolab: HL7 Sonde and Handheld

2.02 SPARE PARTS AND ACCESSORIES

A. General requirements for spare parts are specified in Section 13300.

B. Furnish following field Instrument related Spare Parts:

1. One flow transmitter for each type of flow element provided.

2. One level transmitter for each type of level element provided.

3. One float switch for each type of float element provided.

4. One sensor of each for multiparametric probe.

C. Furnish following Accessories:

1. All mounting hardware required for pipe stand, surface, or other mounting.

2. Each instrument shall be provided with a manufacturer installed stainless steel tag identifying the instrument tag number.

3. One year calibration solution for multiparametric sensors.

PART 3 EXECUTION

3.01 GENERAL

A. See execution requirements in Section 13300.

B. Instrumentation shall be mounted on instrument racks or stands. All instrumentation connections shall be provided with shutoff and drain valves. For differential pressure transmitters, five-valve manifolds for calibration, testing and blow down service shall also be provided. For chemical or corrosive fluids, diaphragm seals with flushing connections shall be provided.

END OF SECTION

SECTION 15072
DUCTILE IRON PIPE AND FITTINGS ABOVE GRADE

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required, install, and test ductile iron pipe and fittings for plant mechanical piping as shown on the Drawings and as specified herein.

B. Mechanical piping shall include all piping and fittings installed above grade.

C. Mechanical piping shall be installed as shown on the Drawings. Provide pipe supports, hangers and couplings as required to achieve a complete pipe system.

D. Where the word "pipe" is used, it shall refer to pipe, fittings, or appurtenances unless otherwise noted.

1.02 RELATED WORK

A. Delivery, Storage and Handling is included in Section 01600.

B. Ductile Iron Pipe and Fittings Below Grade is included in Section 02616.

C. Painting is included in Section 09901 and Section 09902.

D. Valves and Appurtenances are included in Section 15100.

E. Piping Specialties are included in Section 15120.

F. Pipe Hangers and Supports are included in Section 15140.

1.03 SUBMITTALS

A. Submit, in accordance with Section 01300, shop drawings and product data required to establish compliance with the Section. Submittals shall include the following

1. Tabulated layout drawings showing actual pipe lengths, diameters, fittings and appurtenances.

2. Prior to shipment of pipe, submit a certified affidavit of compliance from the pipe manufacturer stating that the pipe, fittings, gaskets, linings and exterior coatings for this project have been manufactured and tested in accordance AWWA and ASTM standards and requirements specified herein.

1.04 REFERENCE STANDARDS

A. ASTM International (ASTM):

1. ASTM C150 - Standard Specification for Portland Cement.

B. American National Standards Institute (ANSI):

1. ANSI B1.1 - Unified Inch Screw Threads (UN and UNR Thread Form).

2. ANSI B16.1 - Cast Iron Pipe Flanges and Flanged Fittings Classes 25, 125 and 250.

3. ANSI B18.2 - Square and Hex Bolts and Screws Inch Series Including Hex Cap Screws and Lag Screws.

C. American Water Works Association (AWWA):

1. AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.

2. AWWA C110 - Ductile-Iron and Gray-Iron Fittings. (3-in Through 48-in (80mm Through 1200mm) for Water).

3. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

4. AWWA C115 - Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.

5. AWWA C116 - Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings.

6. AWWA C150 - Thickness Design of Ductile-Iron Pipe.

7. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast.

8. AWWA C153 - Ductile-Iron Compact Fittings for Water Service.

9. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.

10. AWWA C606 - Grooved and Shouldered Joints.

11. AWWA C651 - Disinfecting Water Mains.

D. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. Each length of ductile iron pipe supplied for the project shall be hydrostatically tested at the point of manufacture to 500 psi for a duration of 10 seconds per AWWA C151. Testing may be performed prior to machining bell and spigot. Failure of ductile iron pipe shall be defined as any

rupture of the pipe wall. Certified test results shall be furnished in duplicate to the Engineer prior to time of shipment.

B. Ductile-iron pipe and fittings to be installed under this project shall be inspected and tested at the foundry as required by the standard specifications to which the material is manufactured. Furnish in duplicate to the Engineer sworn certificates of such tests and their results prior to the shipment of the pipe.

C. Pipe and fittings to be installed under this Contract may be inspected at the plant for compliance with this Section by an independent testing laboratory selected by the District, at the District's expense.

D. Inspection of the pipe and fittings will also be made by the Engineer or representative of the District after delivery. The pipe shall be subject to rejection at any time on account of failure to meet any of the specified requirements, even though sample pipes may have been accepted as satisfactory at the place of manufacture. Pipe rejected after delivery shall be marked for identification and shall be removed from the job.

E. Pipe and fittings shall be permanently marked with the following information:

1. Manufacturer, date.

2. Size, type, class, or wall thickness.

3. Standard produced to (AWWA, ASTM, etc).

1.06 DELIVERY, STORAGE AND HANDLING

A. See Section 01600 for general requirements.

B. Care shall be taken in loading, transporting and unloading to prevent injury to the pipe or coatings. Under no circumstances shall the pipe be dropped or skidded against each other. Slings, hooks, or pipe tongs shall be padded and used in such a manner as to prevent damage to the exterior surface or internal lining of the pipe.

C. Materials, if stored, shall be kept safe from damage. The interior of all piping, fittings and other appurtenances shall be kept free from dirt or foreign matter at all times.

D. Pipe ends including flange faces shall be protected from damage. All openings shall be adequately covered to prevent entrance of dirt, water and debris, and keep the pipe interior clean.

E. Pipe shall not be stacked higher than the limits recommended by its manufacturer. The bottom tier shall be kept off the ground on timbers, rails, or concrete. Stacking shall conform to manufacturer's recommendations.

F. Gaskets for mechanical and push-on joints to be stored shall be placed in a cool location out of direct sunlight. Gaskets shall not come in contact with petroleum products. Gaskets shall be used on a first-in, first-out basis.

PART 2 PRODUCTS

2.01 MATERIALS

A. Pipe:

1. Ductile iron pipe shall conform to AWWA C151 and ANSI A21.51 and shall be Special Thickness Class 53 minimum. Where threaded taps in ductile iron pipe are indicated on the Drawings, ductile iron pipe shall be Special Thickness Class 55 minimum.

2. Pipe shall be supplied in standard lengths as much as possible.

3. Ductile iron pipe shall be as manufactured by U.S. Pipe and Foundry Company, Inc.; American Cast Iron Pipe Company; Clow Water System Company, or equal. All pipe shall be made in the United States and supplied by a single manufacturer.

B. Joints:

1. Ductile iron pipe and fittings for above-grade service shall have flanged joints except where otherwise shown on the Drawings. Rubber-gasket joints shall conform to AWWA C111. Gasket shall conform to AWWA C111 and ANSI A21.1 and shall be EPDM.

2. Bolts and nuts on flange joint pipe and fittings shall be 304 stainless steel and conform to ANSI B16.1.

C. Fittings:

1. Pipe fittings shall be ductile iron with pressure rating of 350 psi for 24-in and smaller piping and 250 psi for 30-in and larger piping. Fittings shall meet the requirements of AWWA C110 or AWWA C153 as applicable. Fittings shall have the same pressure rating, as a minimum, of the connecting pipe. Fittings may be made outside the United States, but shall be supplied by one of the named pipe manufacturers or Engineer approved equal.

D. Interior Lining:

1. Interior surfaces of all ductile iron pipe shall be cleaned and lined in the shop with cement-mortar lining applied centrifugally in conformity with ANSI/AWWA C104. Ductile iron fittings shall be double cement lined. Ductile iron pipe fittings need not have the cement-mortar lining applied centrifugally. The lining machines shall be of the type that has been used successfully for similar work. At the option of the supplier, fittings may be lined in accordance with AWWA C550. Every precaution shall be taken to prevent damage to the lining. If the lining is damaged or found faulty at the delivery site, the damaged or unsatisfactory portion shall be repaired in the field in accordance the ANSI/AWWA C104.

2. All shop-applied cement mortar lining shall be given a seal coat of asphaltic material in conformance with NSI/AWWA C104.

E. Exterior Coatings:

1. Unless otherwise specified, all coatings shall be shop applied with "hold-backs" provided as required at pipe and fitting ends for satisfactory installation for joint connections in the field. Provide all necessary coating materials to perform field coating applications at joints. Unless otherwise noted, field applied coating material shall be compatible with or equal to the shop applied material. Field repair of pipe with damaged coating shall receive prior approval of the Engineer. If, in the opinion of the Engineer that the coating damage is beyond repair the pipe shall be replaced at the expense of the Contractor. All flange bearing surfaces shall be uncoated.

2. Unless otherwise specified, all exposed exterior ferrous surfaces shall be painted with an applicable paint system as specified under Division 9. Surface preparation and application thereof shall be in conformance with applicable provisions of Division 9.

3. All exterior coating and linings shall be applied to the ductile iron surface that has been mechanically cleaned or brush blasted. Chemical cleaning or wiping with solvent as a preparation method is not acceptable.

F. Pipe Hangers and Supports:

1. Pipe hangers and supports shall be provided at suitable distance along the pipeline regardless whether they are shown or not shown on the Drawings.

2. Pipe hangers and supports shall be as specified in Section 15140.

G. Harnessed Flanged Adaptor Couplings

1. Harnessed flanged adapter couplings, where shown on the Drawings, shall be Smith-Blair Type 913 with Type 907 Restraint Plates and Rods, Dresser Style 128-W with Style 441 Tie Plates and Rods. Tie rods and nuts shall be in accordance with AWWA Manual M11. Anchor studs will not be permitted.

2. All couplings shall be furnished with the pipe stop removed.

3. Couplings shall be provided with EPDM gaskets.

4. Harness rods and bolts shall be low alloy high-strength carbon steel and shall be furnished by flange adaptor coupling manufacturer. Size and number of harness rods shall be determined by manufacturer based on maximum pressure of 250 psi.

5. Interior and exterior ferrous metal surfaces shall have a factory applied epoxy coating.

PART 3 EXECUTION

3.01 PIPE INSTALLATION

A. General:

1. Piping and fittings shall be installed true to alignment and rigidly supported. Anchorage shall be provided where required. Damage to linings shall be repaired to the satisfaction of the Engineer before the pipe is installed. Each length of pipe shall be cleaned out before installation. All of manufacturer's recommendations shall be complied with.

2. Deflection at joints shall not exceed that recommended by the pipe manufacturer. Fittings, in addition to those shown on the Drawings, shall be provided, if required, in areas where conflict exists with the existing facilities.

3. When pipe cutting is acceptable to the Engineer, the cutting shall be done by abrasive saw, leaving a smooth cut at right angles to the axis of the pipe. Damage to the lining shall be repaired to the satisfaction of the Engineer. Field cut ends shall be sealed with approved epoxy coating in accordance with manufacturer's instructions.

B. Jointing:

1. Flanged joints shall be made using gaskets, bolts, bolt studs with a nut on each end, or studs with nuts where the flange is tapped. The number and size of bolts shall conform to the same ANSI Standard as the flanges.

2. Bolts in flanged joints or mechanical joints shall be tightened alternately and evenly.

3. Sleeve type couplings and grooved joints using split ring couplings shall be installed in accordance with the procedures recommended by their respective manufacturers.

C. Pipe and appurtenances connected to equipment shall be supported in such a manner as to prevent any strain being imposed on the equipment. When manufacturers have indicated requirements that piping loads shall not be transmitted to their equipment, submit a certification stating that such requirements have been complied with.

D. Sleeves of proper size shall be installed for all pipes passing through floors or walls. Sleeves shall be installed as shown on the Drawings. Where indicated on the Drawings or required for liquid or gas-tightness, the pipe shall be sealed with a mechanical seal similar to Link-Seal as manufactured by Thunderline Corporation, or equal.

3.02 TESTING

A. Piping shall be subject to acceptance tests. Provide all necessary utilities, labor and equipment for flushing and testing and dispose all waste after the test including water.

B. Pipe and fittings shall be pressure tested to 50 psi for two hours and the pipeline shall show no leakage.

C. Water required for testing will be provided by the District through pumping facilities and raw water transmission mains constructed by others under separate contracts.

D. Correct leakage and repair all damage to the pipe and pipe appurtenances or to any structures resulting from, or caused by tests. All leaks shall be repaired and lines retested.

3.03 CLEANING

A. Clean the pipe by flushing with water or other means to remove all dirt, stones, pieces of wood, or other material which may have entered during the construction period. All debris shall be removed from the pipeline. The lowest segment outlet shall be flushed last to assure debris removal.

3.04 PIPE MARKING

A. Exposed piping, exterior and interior, shall be identified by painted legend markers, directional arrow markers and number markers as required. Pipe marking colors shall contrast with pipe color for ease of visibility. Pipe marking shall match the existing markings. Letters and markers 1-1/8-in in width shall be installed on pipes under three in. in diameter. Markers 2-1/2-in in width shall be installed on pipes three in. in diameter and larger. Legend markers, directional arrow markers and number markers shall be placed as directed by the Engineer. Markers shall be located where pipes pass through walls or floors, at piping intersections and maximum 15-ft spacing on piping runs.

END OF SECTION

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SECTION 15100
VALVES AND APPURTENANCES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and install complete and ready for operation and test all valves as shown on the Drawings and as specified herein.

B. The equipment shall include, but not be limited to, the following; however not all items specified herein may be included in this project.

1. General Requirements.

2. Valve Actuators - Manual.

3. Valve Actuators - Powered.

4. Butterfly Valves.

5. Plug Valves.

6. Resilient Wedge Gate Valves.

7. Air Release Valves.

1.02 RELATED WORK

A. Shop and Finish painting is included in Sections 09901 and 09902.

B. Instrumentation, not specified herein, is included in Division 13.

C. Electrical work is included in Division 16.

D. Certain items similar to those specified in this Section may be specified to be furnished and installed with individual equipment or systems. In case of a conflict, those individual equipment or system requirements shall govern.

1.03 SUBMITTALS

A. Submit to Engineer, in accordance with Section 01300, materials required to establish compliance with this Section. First submittal shall be valve schedule described in Paragraph 1.09. Approval of valve schedule submittal is required prior to Contractor submitting any of equipment in this specification. Subsequent Equipment Submittals shall include at least the following:

1. Valve tag number.

2. Manufacturer and supplier.

3. Address at which equipment will be fabricated or assembled.

4. Drawings showing assembly details, materials of construction and dimensions.

5. Descriptive literature, bulletins and/or catalogs of the equipment.

6. Total weight of each item.

7. A complete bill of materials.

8. Additional submittal data, where noted with individual pieces of equipment.

9. Individual electrical control schematics and wiring diagrams for each valve operator with external interfaces, identified exactly as detailed on Electrical and Instrumentation Drawings. Standard catalogue cut sheets that show typical wiring diagrams only are not acceptable. Valve actuators shall be coordinated with electrical requirements shown on Drawings and valves as specified herein.

B. Test Reports:

1. Provide certified hydrostatic test data, per manufacturer's standard procedure or MSS-SP-61 for valves.

C. Certificates:

1. For each valve specified to be manufactured, tested and/or installed in accordance with AWWA and other standards, submit an affidavit of compliance with appropriate standards, including certified results of required tests and certification of proper installation.

D. Manufacturer's Installation and Application Data.

E. Operating and Maintenance Data.

1. Operating and maintenance instructions shall be furnished to Engineer as provided in Section 01730. Instructions shall be prepared specifically for this installation and shall include required cuts, drawings, equipment lists, descriptions and other information required to instruct operating and maintenance personnel unfamiliar with such equipment.

1.04 REFERENCE STANDARDS

A. ASTM International:

1. ASTM A48 - Standard Specification for Gray Iron Castings.

2. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.

3. ASTM A240 - Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels.

4. ASTM A276 - Standard Specification for Stainless Steel Bars and Shapes.

5. ASTM A436 - Standard Specification for Austenitic Gray Iron Castings.

6. ASTM A536 - Standard Specification for Ductile Iron Castings.

7. ASTM B30 - Standard Specification for Copper-Base Alloys in Ingot Form.

8. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.

B. American Water Works Association (AWWA):

1. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

2. AWWA C500 - Metal-Seated Gate Valves Supply Service.

3. AWWA C504 - Rubber-Seated Butterfly Valves.

4. AWWA C507 - Ball Valves, 6-in through 48-in (150mm through 1200mm).

5. AWWA C508 - Swing-Check Valves for Waterworks Service, 2-in (50mm through 24-in (600mm) NPS.

6. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service.

7. AWWA C511 - Reduced-Pressure Principle Backflow-Prevention Assembly.

8. AWWA C540 - Power-Actuating Devices for Valves and Sluice Gates.

9. AWWA C541 - Hydraulic and Pneumatic Cylinder and Vane Type Actuators for Valves and Slide Gates.

10. AWWA C550 - Protective Epoxy Interior Coatings for Valves and Hydrants.

11. AWWA C800 - Underground Service Line Valves and Fittings.

C. American National Standards Institute (ANSI):

1. ANSI B1.20.1 - Specifications, Dimensions, Gauging for Taper and Straight Pipe Threads (except dry seals).

2. ANSI B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.

3. ANSI B16.10 - Face-to-Face and End-to-End Dimensions of Valves.

4. ANSI B16.104 - Butterfly Valves.

D. American Iron and Steel Institute (AISI).

E. Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS):

1. MSS-SP-61 - Pressure Testing of Steel Valves.

2. MSS-SP-67 - Butterfly Valves.

3. MSS-SP-70 - Cast Iron Gate Valves, Flanged and Threaded Ends.

4. MSS-SP-71 - Cast Iron Swing Check Valves, Flanges and Threaded Ends.

5. MSS-SP-72 - Ball Valves with Flanged or Butt-Welding Ends for General Services.

6. MSS-SP-78 - Cast Iron Plug Valves, Flanged and Threaded Ends.

7. MSS-SP-80 - Bronze Gate, Globe, Angle and Check Valves.

8. MSS-SP-82 - Valve Pressure Testing Methods.

9. MSS-SP-98 - Protective Coatings for the Interior of Valves, Hydrants and Fittings.

F. National Electrical Manufacturers Association (NEMA).

G. Underwriters Laboratories (UL).

H. Factory Mutual (FM).

I. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. Qualifications:

1. Valves and appurtenances shall be products of well established firms who are fully experienced, minimum 10 years, reputable and qualified in manufacture of particular equipment to be furnished.

2. Equipment shall be designed, constructed and installed in accordance with best practices and methods and shall comply with this Section as applicable.

3. Units of the same type shall be the product of one manufacturer.

4. All 480 volt motor actuators shall be product of one manufacturer. Contractor shall coordinate this requirement with vendors who supply actuated valves as part of systems specified in Division 11 and 15. Specifically note; Process Blowers in Paragraph 1.02.

B. Certifications:

1. Manufacturers shall furnish an affidavit of compliance with Standards referred to herein as specified in Paragraph 1.03C above. Refer to PART 3 for testing required for certain items in addition to that required by referenced standards.

C. Provide services of a qualified and factory-trained service representative of manufacturer to provide operational and maintenance instruction, for a one-day, eight-hour period for each type of electric actuator.

D. Inspection of units may also be made by Engineer or other representative of District after delivery. Equipment shall be subject to rejection at any time due to failure to meet any of specified requirements, even though submittal data may have been accepted previously.

Equipment rejected after delivery shall be marked for identification and shall be removed from job site at once.

1.06 SYSTEM DESCRIPTION

A. Equipment and materials specified herein are intended to be standard for use in controlling flow of water, wastewater, sludge, air, and chemicals as noted on Drawings.

B. Valves, appurtenances and miscellaneous items shall be installed as shown on Drawings and as specified, so as to form complete workable systems.

C. Unless otherwise noted, powered valve operators shall have:

1. Valves larger than 3-in: electric operators 460 Volt, 3 Phase, 60 Hz.

2. Valves 3-inch and under: electric operators, 120 Volt, 1 Phase, 60 Hz.

3. Solenoid valves: 120 volt, single phase, 60 Hz, NEMA 4 enclosure, continuous duty Class F coils and manual operator. Solenoid valves for seal water systems shall be "fail open" design; others shall be "fail closed" unless otherwise noted on Drawings or in the Instrumentation specifications.

1.07 DELIVERY, STORAGE AND HANDLING

A. Reference is made to Section 01600 for additional information.

B. Packing and Shipping:

1. Care shall be taken in loading, transporting and unloading to prevent injury to the valves, appurtenances, or coatings. Equipment shall not be dropped. Valves and appurtenances shall be examined before installation and no piece shall be installed which is found to be defective. Damage to the coatings shall be repaired as acceptable to Engineer.

2. Prior to shipping, ends of valves shall be acceptably covered to prevent entry of foreign material. Covers shall remain in place until after installation and connecting piping is completed.

   a. Valves three in. and larger shall be shipped and stored on site until time of use with wood or plywood covers on each valve end.
   b. Valves smaller than 3 in. shall be shipped and stored as above except that heavy cardboard covers may be used on the openings.
   c. Rising stems and exposed stem valves shall be coated with a protective oil film which shall be maintained until the valve is installed and put into use.
   d. Corrosion in evidence at the time of acceptance by the District shall be removed, or the valve shall be removed and replaced.

C. Storage and Protection:

1. Special care shall be taken to prevent plastic and similar brittle items from being directly exposed to the sun, or exposed to extremes in temperature, to prevent deformation. See the individual piping sections and manufacturer's information for further requirements.

1.08 MAINTENANCE

A. Special tools and the manufacturer's standard spare parts, if required for normal operation and maintenance, shall be supplied with the equipment in accordance with Section 01730 and where noted, as specified herein. Tools shall be packaged in a steel case, clearly and indelibly marked on the exterior to indicate equipment for which tools are intended.

B. Provide one operations and maintenance manual for each type of valve and operator supplied under this specification in accordance with Section 01730.

C. Included within operations and maintenance manuals, provide a list of all spare and replacement parts with individual prices and location where they are available.

1.09 VALVE DESIGNATIONS AND SCHEDULE

A. Valves shall be identified by a unique valve tag as identified in valve schedule prepared by Contractor. Specific type of valve to be used will be identified by symbol and/or call out on Drawings. Contractor shall identify each valve by its assigned tag number on shop drawings and equipment submittals.

B. Contractor shall refer to the P&IDs and mechanical plans for type of each valve called out by abbreviation or drawing symbol. Prior to first valve submittal, Contractor shall submit a detailed valve schedule listing process valves to be furnished along with Contract Drawing P&IDs edited electronically which shall include valve tag numbers prepared by Contractor identifying each valve. Valve schedule shall include: valve tag number; valve designation; valve size; end connections and operator type.

PART 2 PRODUCTIONS
2.01

2.01 MATERIALS AND EQUIPMENT - GENERAL

A. Reference is made to Division 1 for additional requirements, including nameplates, provisions for temporary pressure gauges, protection against electrolysis and anchor bolts.

B. Use of a manufacturer's name and/or model or catalog number is for purpose of establishing standard of quality and general configuration desired.

C. Valves and appurtenances shall be of size shown on the Drawings or as noted and as far as possible equipment of same type shall be identical and from one manufacturer.

D. Valves and appurtenances shall have name of maker, nominal size, flow directional arrows, working pressure for which they are designed and standard referenced, cast in raised letters or via riveted stainless steel nameplate upon some appropriate part of the body.

E. Unless otherwise noted, items shall have a minimum working pressure of 150 psi or be of same working pressure as pipe they connect to, whichever is higher and suitable for pressures noted where they are installed.

F. Joints, size and material - unless otherwise noted or required by Engineer:

1. Except where noted, joints referred to herein shall be of same type, nominal diameter, material and with a minimum rating equal to pipe or fittings they are connected to.

2. Valves and appurtenances shall be of same nominal diameter as pipe or fittings they are connected to.

3. Valves located above ground or exposed in vaults shall have flange joints. Valves located below ground shall have mechanical joints.

G. Provide special adaptors as required to ensure compatibility between valves, appurtenances, and adjacent pipe.

H. No alternative materials will be considered for approval unless complete documentation is provided regarding their satisfactory long-term use in similar conditions; in addition, the consideration of any substitution will be considered only if superiority of proposed materials is the intent of substitution, and only if sufficient evidence is provided to document that superiority.

2.02 VALVE ACTUATORS - GENERAL/ MANUAL

A. Geared actuators shall be suitable for all weather service, with mechanical shaft seals, shall be permanently greased, or shall have provisions for greasing. Actuators for submerged duty shall be so rated, with certification by manufacturer for submerged service.

B. Valve manufacturer shall supply, mount, and test all actuators on valves at factory. Valves and their individual actuators shall be shipped as a unit.

C. Unless otherwise noted on Drawings, valves shall be manually actuated; non-buried valves shall have an operating wheel, handle or lever mounted on operator; those with operating nuts shall have a non-rising stem with an AWWA two-in. nut; At least two tee handles shall be provided for operating nuts. Unless otherwise noted, operation for valves shall be CCW open.

D. Manually actuated butterfly valves six inches and smaller for fluid service shall have a 10 position, spring retained ratcheting handle. Handle shall be fusion bonded epoxy coated steel or cast iron, hardware, spring and ratcheting plate shall be Type 316 stainless steel. Manually actuated butterfly valves for air service six inches and smaller shall have a memory stop handle with infinite throttling position capability. Memory stop plate and hardware shall be Type 316 stainless steel.

E. Except as otherwise shown on Drawings or specified herein, valves three-in. diameter or larger, with valve hand wheel center line located seven ft or more above operating floor, shall be provided with chain wheel operators complete with chain guides and hot dipped galvanized steel chain, which loop within four ft of operating floor. These requirements shall supersede positioning lever actuator requirements of manual butterfly valves six-inch and smaller.

F. Actuators shall be capable of moving valve from full open to full close position and in reverse and holding valve at any position part way between full open or closed.

G. Each operating device shall have cast on it the word "OPEN" and an arrow indicating direction of operation.

H. Floor boxes for operating nuts recessed in concrete shall be standard cast iron type, cast-in-place, with fastening top, and Type 316 stainless steel hardware.

I. Stem guides shall be of the adjustable wall bracket type, bronze bushed, with maximum spacing of 10-ft as manufactured by Clow; Rodney Hunt or equal. Extended operating nuts and/or stems shall have universal joints and pin couplings, if longer than 10-ft and a rating of at least five times the maximum operating torque. Stem adaptors shall be provided.

J. Where required by installation, or as specified, provide the following: extended stem; floor stand and handwheel; position indicator and etched or cast arrow to show direction of rotation to open the valve; resilient, moisture-resistant seal around stem penetration of slab.

K. Gear Actuators:

1. Unless otherwise noted, gear actuators shall be provided for the following: plug and ball valves larger than three-in. diameter; butterfly valves larger than six-inch diameter; where specified and/or indicated on Drawings; where manual operator effort is greater than 40 lbs rim pull.

2. Actuators shall be capable of being removed from valve without dismantling the valve or removing valve from the line.

3. Gear actuators for quarter turn valves shall be of worm or helical worm gear type with output shaft perpendicular to valve shaft, having a removable hand wheel mounted on output shaft. Where shown on Drawings, a two inch cast iron operating nut shall be provided. Actuators shall conform to AWWA C504 except where more stringent requirements are provided hereinafter. Gearing shall be machine cut steel designed for smooth operation. Bearings shall be permanently lubricated, with bronze bearing bushings provided to take thrusts and mechanical shaft seals to contain lubricants. Housings shall be sealed to exclude moisture and dirt, allow reduction mechanisms to operate in lubricant and be constructed of cast iron, ASTM A 126, Grade B, or of ductile iron, ASTM A 536. Gear housing bodies for thermoplastic valves may be cast aluminum or fabricated steel to reduce weight. Gear actuators shall indicate valve position and have adjustable stops.

4. Where indicated on Drawings, gear actuators for butterfly valves shall be of travelling nut type with output shaft perpendicular to valve shaft, having a removable hand wheel mounted on output shaft. Unless noted they shall conform to AWWA C504. Stem shaft shall be machine cut alloy steel, nut and cross head shall be bronze, lever shall be ductile iron. Nut Actuators for valves 24-in and smaller shall be slotted lever design, actuators for valves greater than 24 inch shall be link and lever design. Mechanism shall be lubricated with water resistant extreme pressure NLGI No. 2 grease. Bevel gear reduction box shall be mounted on the actuator when required to meet specified manual operating effort requirements Gear actuators shall have mechanical, external indication of valve position and have adjustable threaded stops secured to the stem with spring pins. Stop shall be capable of withstanding 450-fts-lb of input torque. Stop adjustment requiring shims are not acceptable.

5. Manual Input torque to produce required valve operating torque for worm and travelling nut gear operators shall not exceed 80 ft-lbs. In addition, hand wheel rim pull shall not exceed 20 lbs for valve sizes up to 12 inches, 40 lbs for valve size between 14 and 20 inches, 60 lbs for valve size 24 and greater. Minimum hand wheel size shall be eight inches

for up to 12 inch valve size, 12 inches for up to 16 inch valve size, 18 inches for up to 20 inch size.

6. Gear actuators for multi turn valves shall be of bevel or spiral bevel type with output shaft perpendicular to valve shaft, having a removable hand wheel mounted on output shaft. Gearing shall be machine cut steel designed for smooth operation. Bearings shall be permanently grease lubricated, with dual anti-friction ball bearings on output shaft and mechanical shaft seals to contain lubricants. Output flange of primary gear reducer shall be designed to meet an appropriate MSS or ISO standard to allow mounting to secondary gear reducer. Ring gear shall ride on ball bearings. Stem nut shall be bronze alloy, shouldered, and ride on needle bearings. Housing components shall be O-ring sealed to exclude moisture and dirt, constructed of cast iron, ASTM A 126, Grade B, or of ductile iron, ASTM A 536. Gear housing bodies for thermoplastic valves may be cast aluminum or fabricated steel to reduce weight. Manual operator input effort to the hand wheel shall be a maximum of 30 lbs for operating the valve from full open to full close, under any conditions. Maximum hand wheel size shall be 24-in diameter.

L. Additional valve actuator requirements are included with the individual valve types and as noted in Paragraph 1.02 above.

M. Position indication and direction of opening arrows shall be embossed, stamped, engraved, etched, or raised castings. Decals or painted indications shall not be allowed.

N. Unless otherwise noted, valves larger than three-in. nominal diameter shall be provided with position indicators at the point of operation.

2.03 VALVE ACTUATORS - POWERED

A. General:

1. Where buried valves are specified or shown on the Drawings to be equipped with electric actuators, valve shall be furnished with a torque tube for actuator mounting.

2. Electric actuators for 1/4 turn valves three inches and under, which do not have submergence requirements, and which exhibit a maximum torque specified below shall be operated on 120 volt single phase power as specified below. Other actuators shall be operated on 480 volt power.

3. Actuators shall conform to AWWA Standard C540, insofar as applicable and as herein specified. Actuators shall be O-ring sealed, watertight to standard NEMA 4X/6, submersion to six feet for 30 minutes. Actuators installed in vaults below grade and elsewhere subject to submergence shall be watertight to standard NEMA 6P/IP68, 15 ft for 72 hours minimum. Actuators installed in hazardous locations as noted on the Electrical Drawings and/or area classification sheets of the Architectural Drawings shall be FM certified explosion proof for Class 1 Division 1 & 2, Groups C & D and also meet the standard NEMA 4X/6 rating.

4. Valve service/operation shall be as indicated on the P&IDs and as specified in the Process Control Strategies in Section 13305.

5. 480 Volt powered actuators shall be Rotork IQ/IQM; Limitorque MX; EIM TEK 2000; AUMA SA/SAR. Actuators shall be configured as required to provide for part turn or multi-turn and be coupled with gearboxes as required to obtain the speed and operating torque as required for the valve or gate it controls.

6. Modulating actuators shall contain proportional control unit and be capable of 1200 starts per hour, open-closed valve actuators shall not require a proportional control unit, and be capable of 60 starts per hour.

7. Where shown on Instrumentation Drawings, actuators shall have a digital control module, to allow valves or gates to be positioned remotely via a two-wire non-proprietary field bus protocol. Digital control module shall be equipped with serial communication ports to allow actuation to be linked by a two wire local area network utilizing Modbus function code (report by exception) and arranged in a self-healing ring configuration, with multi-drop taps to each actuator.

B. 480 Volt Powered Actuators for Part Turn or Multi-Turn Valve Operation:

1. Operation:

   a. Capabilities shall be provided to position valve (or gate) locally via Local/Off/Remote selector switch and Open/Stop/Close push buttons.
   b. For on/off service, when in remote, actuator shall accept one remote signal to open valve or gate and a second remote signal to close valve or gate.
   c. For modulating service, when in remote actuator shall accept a 4-20mADC position control signal, and shall position valve 0-90 degrees or gate 0-100% of travel in proportion to control signal.
   d. Unless stated otherwise in valve specifications, actuator and gearing size shall be designed to operate valve at a disc speed of one foot travel per minute of operation. For quarter turn valves, valves shall rotate from stop to stop in 30 seconds per foot of throat diameter.

2. Functional:

   a. Motor operated valve controller shall include motor, operator unit gearing, limit switch gearing, limit switches, control power transformer, position transmitter (when required), torque switches, bored and key-wayed drive sleeve for non-rising stem valves, declutch lever and auxiliary handwheel as a self-contained unit. Valve contacts shall be capable of handling the current equivalent of a NEMA 1 size starter.
   b. Reversing starters shall be integral with actuator, and shall be solid-state starters for modulating service. Electro-mechanical reversing starters shall be acceptable for open-close service and shall be mechanically and electrically interlocked.
   c. Limit switches and gearing shall be an integral part of valve control. Limit switch gearing shall be made of bronze or stainless steel and shall be fully lubricated, intermittent type and totally enclosed to prevent dirt and foreign matter from entering gear train. Limit switches shall be of adjustable type capable of being adjusted to trip at any point between fully opened valve and fully closed valve. Limit and torque switches shall be provided for stopping valve in both directions. Mid-travel switches shall be provided as required. Set position shall not be lost if over travel occurs in either manual or electric modes of operation.

d. Valve position transmitter shall be a gear actuated, two-wire device, producing 4-20 mADC signal proportional to 0-90 degree valve position or to 0-100% of valve travel. Transmitter shall be provided with easily accessible zero and span adjustment potentiometers. Valve actuator shall be provided with a local digital or mechanical indicator integral with operator with a 0-100 percent scale. DC power supply shall be provided integral with operator and powered from 110 volt AC internal transformer. Positioner board shall provide repeatable accuracy to 0.25% of span. There shall be separate trim pots on positioner board for zero, span and dead band adjustment.
e. Speed of actuator shall be responsibility of system supplier with regards to hydraulic requirements and response compatibility with other components within control loop. Each valve controller shall be provided with a minimum of two limit switch functions, one for opening and one for closing. Each limit switch will have two normally open and two normally closed contacts. Gear limit switches shall be geared to driving mechanism and in step at all times whether in motor or manual operation. Provision shall be made for two extra sets of limit switches as described above, each to have two normally open and two normally closed contacts. Each valve controller shall be equipped with a double torque switch. Torque switch shall be adjustable and responsive to load encountered in either direction of travel. Limit and torque switch contacts shall be silver inlay type.
f. Each actuator shall include monitor relays to remotely indicate fault signal for indication of power failure, phase failure, thermal switch tripped, torque switch tripped between travel stops and Local-Off-Remote selector switch position.

3. Physical:

a. Operator shall be equipped with open-stop-close push-buttons, a local-off-remote selector switch and indicating lights mounted on operator. Where operator will not be situated between two-ft-0-in and seven-ft-0-in above operator platform, and where shown on Drawings provide a separate remote valve operating station.
b. Motor shall operate on 460 volt, 60 hertz, three phase power and shall be sized by actuator manufacturer to provide the required output torque for service intended. Motor shall have Class F insulation, with a duty rating of at least 15 minutes at 40 degrees C ambient temperature. Motor shall be specifically designed and built by actuator manufacturer for electric actuator service. Commercially available motors shall not be acceptable. Actuator shall include a device to ensure that motor runs with correct rotation for required direction of valve travel regardless of connection sequence of the power supply.
c. Operators utilizing multiple reduction power gearing shall consist of spur, helical, or bevel gearing and worm of hardened alloy steel, and the worm gear shall be alloy bronze. Operators utilizing single-stage reduction shall be single-stage worm gear totally enclosed in a fully lubricated gearcase, with filling and drain plugs. Non-metallic, aluminum, or cast gearing shall not be allowed. Output shaft shall incorporate thrust bearings of the ball or roller type at the base of the actuator.
d. An operating wheel shall be provided for manual and/or emergency operation, engaged when motor is declutched by a lever or similar means, the drive being restored to power automatically by starting the motor. Operating wheel drive shall be mechanically independent of motor drive, and any gearing shall be such as to permit emergency manual operation, using a 40-pound force in a reasonable time. Clockwise operation of handwheel shall give closing movement of valve unless otherwise stated.

e. Each actuator shall be supplied with a start-up kit including installation instructions, wiring diagrams, and spare cover screws and seals to provide for losses during commissioning.
f. Continuous mechanical dial indication of valve and position shall be provided. Mechanical dial position indicator shall be in step with actuator at all times in both hand wheel and motor operation. For modulating applications, mechanical dial position indicator shall include graduations of 0-100 percent scale.

4. Wiring and Terminals:

a. Internal wiring shall be of tropical grade PVC insulated stranded cable of five amp minimum rating for control circuits and of appropriate size for the motor three phase power. Each wire shall be clearly identified at each end.
b. Terminals shall be of stud type embedded in a terminal block of high tracking-resistance compound. The three-phase power terminals shall be shrouded from control terminals by means of an insulating cover.
c. Terminal compartment shall be separated from inner electrical components of actuator by means of a watertight seal. Terminal compartment of actuator shall be provided with three threaded cable entries.
d. Each actuator shall be provided with a commissioning kit consisting of a wiring diagram and installation and operation manual. A separate wiring diagram shall be provided inside the terminal cover. No special tools, devices or parts shall be required for commissioning.
e. Actuators shall have separately sealed motor and control compartments. Operators shall have space heaters in their limit switch, motor, and control compartments.

5. Performance Test:

a. Each actuator shall be shop performance tested, and individual test certificates shall be supplied without additional charge to the District. Test certificates shall be submitted prior to shipment of valve actuators. Test equipment shall simulate a typical valve load, and the following parameters shall be recorded:

1) No load current.
2) Current at maximum torque setting.
3) Stall current.
4) Torque at maximum torque setting.
5) Stall torque.
6) Test voltage and frequency.
7) Flash test voltage.
8) Actuator output speed.

2.04 BUTTERFLY VALVES

A. Butterfly valves and operators up to 72-in diameter shall conform to AWWA C504, Class B, except as specified herein. Manufacturer shall submit an affidavit of compliance stating that valves have been manufactured and tested in accordance with AWWA C504 and specifically listing all exceptions. Valves shall have a minimum 150 psi pressure rating or higher as noted on Drawings or in this Section and be manufactured by M&H; Dezurik; Val-Matic; Henry Pratt; or equal.

B. Butterfly valves for above grade service shall be flanged end with face to face dimensions in accordance with Table 2 of AWWA C504 for short-body valve. Valves for buried service shall be mechanical joint end. Valves for dead end shut off service shall be flanged type.

C. Valve seats shall be full resilient seats retained in body or on disc edge in accordance with AWWA C504. Valve discs shall be constructed of cast iron, ASTM A 48, Class 40; Ni-resist, ASTM A 436, Type 1; or ductile iron, ASTM A 536, Grade 65-45-12.

1. When resilient seats are attached to body, discs shall have Type 316 stainless steel seating edges. When resilient seat is attached to disc, it shall be fastened with a one piece Type 316 stainless steel retaining ring, Type 316 stainless steel Nylock set screws and a mating Type 316 stainless steel ring shall be installed in valve body. Resilient seats shall be EPDM. Seats shall be fully adjustable and replaceable with valves in place using no special tools.

D. Valve body shall be constructed of close grain cast iron per ASTM A 126, Class B with integrally cast hubs for shaft bearing housings of through boss-type. Permanently self-lubricating body bushings shall be provided and shall be sized to withstand bearing loads. Stuffing box of liberal dimensions shall be provided at operator end of vane shaft.

1. Packing shall be of self-compensating V-type. A sealing element utilizing O-rings shall also be acceptable for up to and including 24-in valves. Over 24-in, pull down seals using a square braid of graphite fiber is an acceptable alternate.

2. Packing shall be held in place by a bolted corrosion resistant retainer plate or gland; retainer clips are not acceptable. Valves 30-in or larger shall use a stuffing box with follower gland.

3. Replacement of seals, for all size butterfly valves, shall not require removal of valve from the line. In addition adjustment or replacement of seals on valves of 30-in or larger shall not require disturbing any part of valve or operator assembly, except any packing follower gland.

E. Valve shaft shall be of Type 316 stainless steel and designed for both torsional and shearing stresses when valve is operated under its greatest dynamic or seating torque. No reductions of shaft diameter will be allowed except at operator connection. Any reduction shall have a full radius fillet.

F. Butterfly valve actuator shall conform to requirements of AWWA C504, insofar as applicable and as specified herein. Gearing for actuators where required shall be totally enclosed in a gear case in accordance with AWWA C504. Actuators shall have permanent indicators with raised or engraved marks to show position of valve disc.

2.05

2.05 PLUG VALVES

A. Plug valves shall be of offset disc type, 1/4 turn, non-lubricated, serviceable (able to be repacked) under full line pressure and capable of sealing in both directions at rated pressure. Disc shall be completely out of flow path when open. Plug valves specified herein shall be manufactured by DeZurik; M&H Valve; or approved equal. Manufacturers named or otherwise, shall comply completely with this Section.

1. Minimum port area shall be 80 percent when measured by percent cross-sectional area of equivalent size (nominal same diameter) pipe.

2. Plug valves shall be capable of passing "pigging" cleaning equipment (using a Girard or similar cleaning pig of full nominal pipeline diameter) in either direction and manufacturer shall so certify that this may be done without use of special equipment.

B. Valves shall be rated at minimum 175 psi WOG (Water, Oil and Gas) working pressure for sizes four-in. to 12-in. inclusive and at minimum 150 psi WOG working pressure for sizes 14-in. and larger and shall be capable of providing drop tight shut-off to full valve rating with pressure on either side of plug.

1. Plug valves under this Paragraph shall be performance, leakage and hydrostatically tested in accordance with AWWA C517, except as modified herein.

2. At above rated minimum working pressures, valves shall be certified by manufacturer as permitting zero leakage for a five-minute duration with full pressure applied in either direction.

3. At direction of Engineer, valve manufacturer may be requested to perform a valve seat leakage test, witnessed by Engineer to prove compliance with this Section.

C. Valve bodies shall be of cast iron, 30,000 psi tensile strength, ASTM A 126, Grade B, or of ductile iron, ASTM A 536 and of top entry, bolted bonnet design, cast with integral flanges conforming to connecting piping. Exposed bolts, nuts, and washers shall be zinc or cadmium-plated, except for submerged valves, which shall have Type 316 stainless steel hardware.

1. Valve bodies shall be glass lined for plug valves installed in glass lined ductile iron pipelines. Glass lining shall be as specified in piping specification.

D. Valve Plug:

1. Shall be Buna N coated, cast iron ASTM A 126, Grade B, or ductile iron, ASTM A 536, Grade 65-45-12.

2. Shall be removable without removing valve from the line.

3. Shall have an integral upper and lower shaft which shall have seals on upper and lower journals to prevent entrance of solids into journals.

4. Shall be one piece for all valves.

E. Shaft bearings shall be permanently lubricated stainless steel or bronze at both upper and lower stem journals. Operator shaft shall have easily replaceable seals, which shall be externally adjustable and repackable without removing bonnet from valve, or shall have self-adjusting packing.

F. Valve seating surface shall provide full 360 degree seating by contact of a resilient seating material on plug mating with welded-in high nickel content overlay seating surface in body.

1. Seating design shall be resilient and of continuous interface type having consistent opening and closing torques and shall be non-jamming in closed position. Screw-in seats shall not be acceptable.

2. Plugs shall have a full resilient facing of neoprene or Buna-N.

G. Valves 6 inch and larger shall be actuated via gearbox and hand wheel, unless mechanized, which shall require gearbox and actuator. A suitably sized steel actuator mounting bracket shall be provided to provide an air gap between actuator and valve stem seal. Under no circumstance shall gear box be mounted directly to top body flange such that leakage could directly enter gear box.

H. Unless otherwise required due to location or mechanized operation, each valve four-in. and smaller shall be provided with its own securely attached lever. Provide adjustable limit stops for both opening and closing and a clearly marked position indicator.

I. Plug valves shall be installed so that direction of flow through valve and shaft orientation is in accordance with manufacturer's recommendations. Unless otherwise noted, shaft shall be horizontal, with plug opening up.

2.06 RESILIENT WEDGE GATE VALVES

A. Resilient wedge gate valves shall comply with AWWA C509. Body shall be ductile iron and shall have mechanical joint ends in compliance with AWWA C111. Valve body shall be rated for 250 psi. Bonnet and gland bolts and nuts shall be Type 316 stainless steel. The hot-dip process in accordance with ASTM A153 is not acceptable. Allen-wrench type bonnet and gland fastening shall not be acceptable and will be rejected. Wedges shall be ductile iron and totally encapsulated in nitrile rubber (four-inch–12-inch size) or SBR rubber (14-inch–24-inch size).

B. Stem:

1. Non-rising.

2. Material: Bronze.

3. Triple O-ring stem seals.

4. Two upper O-ring seals shall be replaceable while valve is in service without significant leakage.

5. Thrust collars and stems shall integrally cast.

C. Operation:

1. 2-inch square operating nut with direction of opening indicated.

2. Open counterclockwise unless otherwise indicated.

D. Linings and Coatings – See Paragraph 2.1.

E. Units shall be, in addition, UL and FM approved.

F. Manufacturers: Mueller, Clow, or equal.

G. All gate and valves shall be provided with extension shafts, operating nuts and valve boxes as follows:

1. Extension shafts shall be Type 304 stainless steel and the operating nut shall be two-in. square. Shafts shall be designed to provide a factor of safety of not less than four. Operating nuts shall be pinned to the shafts.

2. Top of the operating nut shall be located two inches below the rim of the valve box.

3. Valve boxes shall be a heavy-pattern cast iron, three-piece, telescoping type box with dome base suitable for installation on the buried valves. Inside diameter shall be at least 4-1/2-in. Barrel length shall be adapted to the depth of cover, with a lap of at least six-in. when in the most extended position. Covers shall be cast iron with integrally-cast direction-to- open arrow, and the word ["WATER"] shall also be integrally cast. Aluminum or plastic are not acceptable. A means of lateral support for the valve extension shafts shall be provided in the top portion of the valve box.

4. The upper section of each box shall have a top flange of sufficient bearing area to prevent settling. The bottom of the lower section shall enclose the stuffing box and operating nut of the valve and shall be oval.

5. All fasteners shall be Type 316 stainless steel.

2.07 AIR RELEASE AND VACUUM RELIEF VALVES: TAG TYPE NOTED BELOW

A. Pipeline air and vacuum valves shall be supplied with shutoff gate or ball valves with operator handle or lever removed. Valves shall be properly vented and piped to drain.

B. Valve pressure rating shall be at least equal to attached pipe's rating and suitable for 200 psi test pressure.

C. Valves for raw water/sewage service shall have connections for draining and flushing with isolation ball valves for connection size up to three inch, and solid wedge gate valves for size four inch and larger.

D. Air Release Valves: Tag Type ARV.

1. Small orifice assembly air release valves shall automatically release air accumulations from pipe while under positive pressure. When valve body fills with air, float mechanism shall fall to open small orifice and exhaust air to atmosphere. When air has been exhausted, float mechanism shall be buoyed up and shall tightly close small orifice. Small orifice assembly shall be furnished with Type 304 stainless steel body and cover, and shall use Type 316 stainless steel hardware. Float mechanism shall be constructed of polypropylene or Type 316 stainless steel. Wetted components shall be polypropylene, Buna-N or Type 316 stainless steel. A resilient, Buna-N seat shall provide drop-tight closure.

2. Separate air release valves shall be, equal as manufactured by APCO 450; Val-Matic; GA; Crispin or equal of the special type for use with non-clean water.

2.08 SURFACE PREPARATION AND SHOP COATINGS

A. Notwithstanding any of these specified requirements, coatings and lubricants in contact with potable water shall be certified as acceptable for use with that fluid.

B. If not specified herein, coatings shall comply with the requirements of Section 09901 and 09902. In case of a conflict, requirements of this Section govern.

C. If manufacturer's requirement is not to require finished coating on interior surfaces, then manufacturer shall so state and no interior finish coating will be required, if acceptable to Engineer.

D. Exterior surface of various parts of valves, operators, floor-stands and miscellaneous piping shall be thoroughly cleaned of all scale, dirt, grease or other foreign matter and thereafter one shop coat of an approved rust-inhibitive primer such as Inertol Primer No. 621 shall be applied in accordance with instructions of paint manufacturer or other primer compatible with finish coat provided.

E. Unless otherwise noted, interior ferrous surfaces of valves shall be given a shop finish of an asphalt varnish conforming to AWWA C509, (except mounting faces/surfaces) or epoxy conforming to AWWA C550 with a minimum thickness of 6 mils.

F. Ferrous surfaces obviously not to be painted shall be given a shop coat of grease or other suitable rust-resistant coating. Mounting surfaces shall be especially coated with a rust preventative.

G. Special care shall be taken to protect uncoated items and plastic items, especially from environmental damage.

2.09 FACTORY INSPECTION AND TESTING

A. Factory inspection, testing and correction of deficiencies shall be done in accordance with the referenced standards and as noted herein.

B. See Division 1 for additional requirements. Also refer to PART 1, especially for required submission of test data to Engineer.

C. In addition to tests required by referenced standards, the following shall also be factory tested:

1. Pressure regulating valves shall be factory tested at specified pressures and flows.

2. Butterfly valves shall be factory tested to demonstrate drop tight closure at specified conditions.

3. All types of air and vacuum valves.

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

A. Valves and appurtenances shall be installed per manufacturer's instructions in locations shown, true to alignment and rigidly supported. Damage to above items shall be repaired to satisfaction of Engineer before they are installed.

B. Install brackets, extension rods, guides, various types of operators and appurtenances as shown on Drawings, or otherwise required. Before setting these items, check Drawings and figures which have a direct bearing on their location. Contractor shall be responsible for proper location of valves and appurtenances during construction of the work.

C. Materials shall be carefully inspected for defects in construction and materials. Debris and foreign material shall be cleaned out of openings, etc. Valve flange covers shall remain in place until connected piping is in place. Operating mechanisms shall be operated to check their proper functioning and nuts and bolts checked for tightness. Valves and other equipment which do not operate easily, or are otherwise defective, shall be repaired or replaced at no additional cost to District.

D. Where installation is covered by a referenced standard, installation shall be in accordance with that standard, except as herein modified, and Contractor shall certify such. Also note additional requirements in other parts of this Section.

E. Unless otherwise noted, joints for valves and appurtenances shall be made up utilizing same procedures as specified under applicable type connecting pipe joint and valves and other items shall be installed in proper position as recommended by manufacturer. Contractor shall be responsible for verifying manufacturers' torqueing requirements for all valves.

3.02 INSTALLATION OF MANUAL OPERATIONAL DEVICES

A. Unless otherwise noted, operational devices shall be installed with units of factory, as shown on Drawings or as acceptable to Engineer to allow accessibility to operate and maintain item and to prevent interference with other piping, valves, and appurtenances.

B. For manually operated valves three-in. in diameter and smaller, valve operators and indicators shall be rotated to display toward normal operation locations.

C. Floor boxes, valve boxes, extension stems and low floor stands shall be installed vertically centered over operating nut, with couplings as required and elevation of box top shall be adjusted to conform to elevation of finished floor surface or grade at completion of Contract. Boxes and stem guides shall be adequately supported during concrete placement to maintain vertical alignment.

3.03 INSPECTION, TESTING AND CORRECTION OF DEFICIENCIES

A. See also Division 1. Take care not to over pressure valves or appurtenances during pipe testing. If unit proves to be defective, it shall be replaced or repaired to satisfaction of Engineer.

B. Functional Test: Prior to plant startup, items shall be inspected for proper alignment, quiet operation, proper connection and satisfactory performance. After installation, manual valves

shall be opened and closed in presence of Engineer to show valve operates smoothly from full open to full close and without leakage. Valves equipped with electric, pneumatic or hydraulic actuators shall by cycled five times from full open to full closed in presence of Engineer without vibration, jamming, leakage, or overheating. Pressure control and pressure relief valves shall be operated in presence of Engineer to show they perform their specified function at some time prior to placing piping system in operation and as agreed during construction coordination meetings

C. Various pipe lines in which valves and appurtenances are to be installed are specified to be field tested. During these tests any defective valve or appurtenance shall be adjusted, removed, and replaced, or otherwise made acceptable to Engineer.

D. Various regulating valves, strainers, or other appurtenances shall be tested to demonstrate their conformance with specified operational capabilities and deficiencies shall be corrected or device replaced or otherwise made acceptable to Engineer.

3.04 CLEANING

A. Items including valve interiors shall be inspected before line closure, for presence of debris. At option of Engineer, internal inspection of valve and appurtenances may be required any time that likelihood of debris is a possibility. Pipes and valves shall be cleaned prior to installation, testing disinfection and final acceptance.

END OF SECTION

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SECTION 15120
PIPING SPECIALTIES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and install complete test, and make ready for operation all piping specialties required by the work of this Contract. Specific piping materials, systems and related installation and testing requirements shall be coordinated with the related sections in Divisions 2, 13 and 15. The items shall include the following:

1. Mechanical Sleeve Seals.

2. Pressure Gauges.

3. Diaphragm Seals for Gauges.

4. Color Coding and Labeling.

1.02 RELATED WORK

A. Piping materials and systems are included in other Sections of Division 15.

B. Specialties and apparatus furnished with equipment and systems are included in individual Sections in Divisions 11.

C. Valves are included in Section 15100.

1.03 SUBMITTALS

A. Submit, in accordance with Section 01300, general submittals for piping, piping systems and pipeline appurtenances are listed below. It is not intended that all submittals listed below be provided for all piping materials and systems. Refer to individual System or Piping Sections for specific submittals.

B. Shop Drawings and Product Data:

1. Large scale details of wall penetrations..

2. Catalog cuts of specialties, appurtenances, and other accessories specified herein.

3. Brochures and technical data on coatings and linings and proposed method for application and repair.

C. Samples.

D. Design Data.

E. Test Reports.

F. Manufacturers Installation (or application) instructions.

G. Warranties.

1.04 REFERENCE STANDARDS

A. ASTM International (ASTM):

1. ASTM A36 - Standard Specification for Carbon Structural Steel.

2. ASTM A126 - Standard Specification for Gray Iron Casting for Valves, Flanges and Pipe Fittings.

3. ASTM A183 - Standard Specification for Carbon Steel Track Bolts and Nuts.

4. ASTM A278 - Standard Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures up to 650 Degrees F.

5. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.

6. ASTM A325 - Standard Specification for Strength Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.

7. ASTM A536 - Standard Specification for Ductile Iron Castings.

8. ASTM A575 - Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades.

9. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.

10. ASTM B88 - Standard Specification for Seamless Copper Water Tube.

B. American National Standards Institute (ANSI)

1. ANSI A13.1 - Scheme for the Identification of Piping Systems.

2. ANSI B1.1 - Unified Inch Screw Threads (UN and UNR Thread Form).

3. ANSI B18.2 - Square and Hex Bolts and Screws Inch Series Including Hex Cap Screws and Lag Screws.

4. ANSI B31 - Code for Pressure Piping.

5. ANSI B31.1 - Power Piping.

C. American Society of Mechanical Engineers (ASME):

1. ASME B2.1 - Specifications, Dimensions, Gauging for Taper and Straight Pipe Threads (except dry seals).

2. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.

3. ASME B16.5 - Pipe Flanges and Flange Fittings.

D. American Welding Society (AWS):

1. AWS B3.0 - Welding Procedure and Performance Qualifications.

E. American Water Works Association (AWWA):

1. AWWA C110 - Ductile-Iron and Gray-Iron Fittings, 3-in Through 48-in (75mm Through 1200mm), for Water and Other Liquids.

2. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

3. AWWA C219 - Bolted Sleeve-Type Couplings for Plain-End Pipe.

4. AWWA C606 - Grooved and Shouldered Joints.

5. AWWA Manual M11 - Steel Pipe - A Guide for Design and Installation.

F. Plumbing and Drainage Institute (PDI):

1. WH 201 - Water Hammer Arrestors.

G. Underwriters Laboratories (UL).

H. Factory Mutual (FM).

I. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. All materials shall be new and unused.

B. Provide manufacturer's certification that materials meet or exceed minimum requirements as specified.

C. Reject materials contaminated with gasoline, lubricating oil, liquid or gaseous fuel, aromatic compounds, paint solvent, paint thinner and acid solder.

D. Unless otherwise specified, pressures referred to in all piping specifications sections are expressed in pounds per square inch, gauge above atmospheric pressure, psig and all temperature are expressed in degrees Fahrenheit (F).

1.06 DELIVERY, STORAGE AND HANDLING

A. During loading, transportation and unloading, take care to prevent damage to products furnished under this section.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Equipment shall be of the size shown on the Drawings or as noted and as far as possible equipment of the same type shall be identical and from one manufacturer.

B. Equipment shall have the name of the maker, nominal size, flow directional arrows (if applicable), working pressure for which they are designed and standard referenced specifications cast in raised letters or indelibly marked upon some appropriate part of the body.

C. Unless otherwise noted, items shall have a minimum working pressure of 150 psi or be of the same working pressure as the pipe they connect to, whichever is higher and suitable for the pressures noted where they are installed.

D. All the piping system components shall be suitable to withstand the rated system pressure. The rated pressure shall be not less than the operating pressure and the test pressure of the piping system in which it is installed.

2.02 MECHANICAL SLEEVE SEALS

A. Mechanical sleeve seals shall be used to secure and seal the annular space around all new sleeved and core-drilled wall penetrations.

B. A single seal shall be provided for all sleeve and cores in walls up to 14-in thick; dual sleeves shall be provided in larger walls.

C. Galvanized steel wall sleeves and concrete core diameter shall be sized sufficiently larger to accommodate the modular elements, per the manufacturer's recommendations.

D. Bolts and hardware shall be carbon steel, zinc-plated. Pressure plates shall be corrosion-resistant acetal resin.

E. Mechanical sleeve seals shall consist of modular bolted, synthetic rubber sealing elements, Link Seal by Thunderline Corp., Pipeseal by Flexicraft Industries or equal.

2.03 PRESSURE GAUGES

A. Bosses, connections, or nipples for gauges shall be provided as acceptable to the Engineer. Unbossed tappings shall not be acceptable. Where gauge tappings are not available in the suction or discharge nozzle, the necessary tapping in the adjacent piping shall be made.

B. In addition to the locations shown on the Drawings, pressure gauges shall be furnished and installed on the upstream and downstream sides of pressure reducing stations and in the suction and discharge nozzle of all pumps, compressors and similar equipment. Additional pressure gauges shall be furnished and installed as specified with individual equipment.

C. Gauges shall be furnished as part of a complete factory assembly, including gauge, snubber, liquid fill, bar stock ball valve isolation valve and threaded red brass connecting piping.

D. Unless otherwise noted, gauge rating shall be from 0 to at least 2.5 percent higher than the rating of the pipe it is connected to.

E. For Liquid Service:

1. Pressure gauges shall have a 300 series stainless steel/ABS or FRP/Aluminum case and shall be 4-1/2-in nominal diameter with a full-sized Type 316 stainless steel Bourdon tube and a 300 series stainless steel movement. The gauges shall be liquid filled with glycerin and shall be provided with a filler/breather cap. The socket shall be 1/4-in NPT Type 316 stainless steel with a bottom connection and the dial shall be a white background with black markings. Gauges shall be ANSI Grade A plus or minus one percent of scale and shall have a blow-out back design.

2. Gauges for the above services shall be liquid filled as manufactured by U.S. Gauge; Ashcroft; Trerice or equal.

F. Air Service:

1. Unless otherwise noted, pressure gauges for pressure air pipelines shall have a range of 0 to 200 psig.

2. Pressure gauges shall have a 300 series stainless steel/aluminum case and shall be 4-1/2-in nominal diameter with a Type 316 stainless steel Bourdon tube and a 300 series stainless steel movement. The socket shall be 1/2-in NPT Type 316 stainless steel with a bottom connection. Gauges shall have an accuracy of at least plus or minus 0.25 percent of scale. Gauges shall be furnished with needle valve isolation.

3. Gauges for air service shall be Model 5840 as manufactured by Marsh Instrument Co., Skokie, IL or equal.

G. Gauges shall be furnished from standard ranges of the manufacturer, with dual range (ft and psi) scales, per the following schedule:

2.04 DIAPHRAGM SEALS FOR GAUGES

A. Diaphragm seals shall be installed for all pressure gauges and pressure switches, to protect pressure gauges and pressure switches from contact with the fluid in the pipeline. Gauges shall be furnished as part of a complete factory assembly, including gauge, snubber, diaphragm seal, liquid fill, bar stock isolation valve and threaded red brass interconnecting piping. Furnish also a 1/4-in backflushing connection and ball valve.

B. Diaphragm seals shall be minimum 2-1/2-in diameter, or as required for the connected pressure gauges. The diaphragm shall be "thread attached" to both piping and pressure switches or gauges. Furnish mineral oil fill between the diaphragm seal and the gauge.

1. Diaphragm seals shall have an upper housing of cadmium plated carbon steel, with the lower housing of Type 316 stainless steel with Type 304 stainless steel bolts. Diaphragms shall be Teflon.

2. Each diaphragm seal shall be connected to its respective piping or equipment with threaded red brass pipe and fittings. Pipe size and diaphragm tap size shall match the size of the

gauge tap on the equipment, but shall not be less than 3/4-in, except for connections to plant water piping which shall be minimum 1/2-in. Furnish a ball valve shut-off valve between the pipeline or equipment and the diaphragm seal.

3. Each diaphragm seal shall have a minimum 1/4-in NPT flush connection with ball valve and gauge tap to match the size of the gauge.

4. Furnish pulsation dampeners adequate to prevent pulsation and/or vibration of the gauge indicator under all system operating conditions.

5. Pump gauges shall connect to the diaphragm seal by a flexible Type 304 stainless steel capillary tube. Gauges shall be mounted on a support stand independent of the pump and piping, to minimize vibration of the gauges caused by vibration of the equipment or piping. Mount both the suction and discharge gauges at the same elevation. Furnish supports as specified in Section 15140, or attach gauges to the seal water assembly support (where applicable).

6. Diaphragm seals shall be Type SG by Mansfield and Green; Ashcroft or equal.

C. Where installed on chlorine lines, or lines leading to chlorine ejectors, seals shall be special chlorine-resistant type. All other materials shall be certified corrosion resistant for seal location and fluid.

2.05 COLOR CODING AND LABELING

A. General:

1. Provide a complete color coding system consisting of preprinted labels and banding by Brady; Seton or equal. Field painting shall be specified in Section 09902. Painting and coding shall comply with the requirements of the PROCESS PIPING SCHEDULE.

2. Piping system identification shall comply with the requirements of ANSI A13.1.

3. Colors listed are general. Actual colors will be selected based on a comparison to the existing plant color codes, except as otherwise indicated; samples shall be furnished for all pipe paint colors; with chips from existing piping where new service lines are connecting.

4. Banding:

   a. Unless special spacing is listed in schedule, apply banding to pipe at connections to equipment, valves, branch fittings, at wall, floor, or ceiling boundaries and at intervals not greater than 36-ft.

5. Labels and Directional Arrows:

   a. Apply labels with directional arrows at connections to equipment, valves, branch fittings, at least one wall, floor, or ceiling boundary within a room and at intervals not greater than 36-ft.
   b. At each label, arrows indicating direction of flow shall point away from label. If flow may be in both directions, use double headed arrows.
   c. Lettering shall bear the full pipe system name as scheduled.

d. Lettering height shall be as follows:

Outside Pipe Diameter	Minimum Letter Height
3/4-in to 1-1/4-in	1/2-in
1-1/2-in to 2-in	3/4-in
2-1/2-in to 6-in	1-1/4-in
8-in to 10-in	2-1/2-in
Over 10-in	3-1/2-in

e. Two labels minimum each room, crawl space or compartment, unless otherwise approved.

PART 3 EXECUTION

3.01 GENERAL

A. All dirt, scale, weld splatter, water and other foreign matter shall be removed from the inside and outside of all pipe and sub-assemblies prior to installing.

B. All pipe joints and connections to equipment shall be made in such a manner as to produce a minimum of strain at the joint.

C. Installation of Pipeline Appurtenances:

1. All pipeline appurtenances shall be installed as required and in accordance with the manufacturer's recommendations, as acceptable to the Engineer.

2. Gauges, meters and similar in-line items shall be isolated from testing pressures in excess of the rated pressure of the assembly.

3. Use Teflon tape on all screwed fittings.

END OF SECTION

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SECTION 15140
PIPE HANGERS AND SUPPORTS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals and install a complete system of pipe hangers, supports, concrete inserts and anchor bolts including all metallic hanging and supporting devices for supporting non-buried piping as shown on the Drawings and as specified herein.

B. The absence of pipe supports and details on the Drawings shall not relieve the Contractor of the responsibility for providing them. Pipe supports indicated on the Drawings are shown only to convey the intent of the design for a particular location and are not intended to represent a complete system.

1.02 RELATED WORK

A. Concrete is included in Division 3.

B. Miscellaneous metal is included in Section 05500.

C. Field painting is included in Division 9.

D. Pipe and fittings are included in Division 15.

E. Valves and appurtenances are included in Section 15100.

1.03 SUBMITTALS

A. Submit, in accordance with Section 01300, complete sets of shop drawings of all items to be furnished under this Section. Submittals shall include complete layouts, schedules, location plans and complete total bill of materials for all pipe support systems.

B. Submittals shall include a representative catalog cut for each different type of pipe hanger or support indicating the materials of construction, important dimensions and range of pipe sizes for which that hanger is suitable. Where standard hangers and/or supports are not suitable, submit detailed drawings showing materials and details of construction for each type of special hanger and/or support. Provide detailed information on anti-seize compound.

C. Submittals shall include complete piping drawings as submitted for each piping submittal indicating type of hanger and/or support, location, magnitude of load transmitted to the structure and type of anchor, guide and other pipe supporting appurtenances including structural fasteners.

D. Types and locations of pipe hangers and/or supports shall also be shown on the piping layouts for each piping submittal as specified in Division 15 pipe sections.

E. Submit complete design data for pipe support systems to show conformance with this Section.

1.04 REFERENCE STANDARDS

A. Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS):

1. MSS SP-58 - Pipe Hangers and Supports - Materials, Design and Manufacture.

2. MSS SP-69 - Pipe Hangers and Supports - Selection and Application.

B. ASTM International:

1. ASTM A36 - Standard Specification for Carbon Structural Steel.

2. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.

C. American National Standards Institute (ANSI):

1. ANSI B31.1 - Power Piping.

D. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. All hangers, supports and appurtenances shall conform to the latest applicable requirements of ANSI B31.1, except as supplemented or modified by the requirements of this Section.

B. All hangers, supports and appurtenances shall be of approved standard design where possible and shall be adequate to maintain the supported load in proper position under all operating conditions. The minimum working factor of safety for all supporting equipment, with the exception of springs, shall be five times the ultimate tensile strength of the material, assuming 10-ft of water-filled pipe being supported.

C. All pipe and appurtenances connected to equipment shall be supported in such a manner as to prevent any strain being imposed on the equipment. When manufacturers have indicated requirements that piping loads shall not be transmitted to their equipment, submit certification stating that such requirements have been complied with.

1.06 DELIVERY, STORAGE AND HANDLING

A. All supports and hangers shall be crated, delivered and uncrated so as to protect against any damage.

B. All parts shall be properly protected so that no damage or deterioration shall occur during a prolonged delay from the time of shipment until installation is completed.

C. Finished metal surfaces not galvanized, that are not of stainless steel construction, or that are not coated, shall be grease coated, to prevent rust and corrosion.

PART 2 PRODUCTS

2.01 GENERAL

A. All of the equipment specified herein is intended to support the various types of pipe and piping systems shown on the Drawings. It shall be the responsibility of the Contractor to develop final details.

B. All pipe and tubing shall be supported as required to prevent significant stresses in the pipe or tubing material, valves, fittings and other pipe appurtenances and to support and secure the pipe in the intended position and alignment. All supports shall be designed to adequately secure the pipe against excessive dislocation due to thermal expansion and contraction, internal flow forces and all probable external forces such as equipment, pipe and personnel contact. Structural steel members required to brace any piping from excessive dislocation shall conform to the applicable requirements of Section 05500 and shall be furnished and installed under this Section.

C. The Contractor may propose minor adjustments to the piping arrangements in order to simplify the supports, or in order to resolve minor conflicts in the work. Such an adjustment might involve minor change to a pipe centerline elevation so that a single trapeze support may be used.

D. Where flexible couplings are required at equipment, tanks, etc., the end opposite to the piece of equipment, tank, etc., shall be rigidly supported, to prevent transfer of force systems to the equipment. No fixed or restraining supports shall be installed between a flexible coupling and the piece of equipment.

E. All pipe and appurtenances connected to the equipment shall be supported in a manner to prevent any strain from being imposed on the equipment or piping system.

F. All rods, clamps, hangers, inserts, anchor bolts, brackets and components for interior pipe supports shall be furnished with galvanized finish, hot dipped or electro-galvanized coated, except where field welding is required, where cold-applied galvanizing may be used. Interior clamps on plastic pipe shall be plastic coated. Supports for copper pipe shall be copper plated or shall have a 1/16-in plastic coating. All rods, clamps, hangers, inserts, anchor bolts, brackets and components for exterior pipe, submerged pipe and pipe within outdoor structures shall be of Type 316 stainless steel.

G. Supports shall be sufficiently close together such that the sag of the pipe is within limits that will permit drainage and avoid excessive bending stresses from concentrated loads between supports.

H. All non-metallic piping such as PVC, CPVC, etc., shall be protected from local stress concentrations at each support point. Protection shall be provided by galvanized steel protection shields or other method as approved by the Engineer. Where pipes are bottom supported 180 degrees, arc shields shall be furnished. Where 360 degree arc support is required, such as U bolts, protection shields shall be provided for the entire pipe circumference. Protection shields shall have an 18 gauge minimum thickness, not be less than 12-in in length and be securely fastened to pipe with stainless steel or galvanized metal straps not less than 1/2-in wide.

I. Where pipe hangers and supports come in contact with copper piping provide protection from galvanic corrosion by; wrapping pipe with 1/16-in thick neoprene sheet material and galvanized protection shield; isolators similar to Elcen, Figure No. 228; or copper plated or PVC coated hangers and supports. All stainless steel piping shall be isolated from all ferrous materials, including galvanized steel by use of neoprene sheet material and protection shields, similar to above methods.

J. Pipe supports shall be provided as follows:

1. Except where otherwise shown on the Drawings, ductile iron, steel and stainless steel piping shall be supported at a maximum support spacing of 10-ft with a minimum of one support per pipe section at the joints.

2. Insofar as is possible, floor supports shall be given preference. Typical concrete supports are shown on the structural drawings. Base elbow and base tees shall be used where possible.

3. Support spacing for steel and stainless steel piping two-in. and smaller diameter and copper tubing shall not exceed five ft.

4. For all stainless steel piping, provide neoprene isolators between the pipe and support components.

5. Pipe supports shall not induce point loadings but shall distribute pipe loads evenly along the pipe circumference.

6. Supports shall be provided at changes in direction and elsewhere as shown in the Drawings or as specified herein. No piping shall be supported from other piping or from metal stairs, ladders and walkways, unless specifically directed or authorized by the Engineer.

7. Pipe supports shall be provided to minimize lateral forces through valves, both sides of split type couplings and sleeve type couplings and to minimize all pipe forces on pump housings. Pump housings shall not be utilized to support connecting pipes.

8. Effects of thermal expansion and contraction of the pipe shall be accounted for in the pipe support selection and installation.

K. Unless otherwise specified herein, pipe hangers and supports shall be standard catalogued components, conforming to the requirements of MSS-SP-58 and -69; and shall be as manufactured by Grinnell Co., Inc., Providence, RI; Carpenter & Patterson, Inc., Woburn, MA; F&S Central, Brooklyn NY; Elcen Metal Products Co., Franklin Park, IL and Unistrut Northeast, Cambridge, MA or equal. Reference to a specific figure number of a specific manufacturer is for the purpose of establishing a type and quality of product and shall not be considered as proprietary.

L. Required pipe supports for which the supports specified in this Section are not applicable shall be fabricated or constructed from standard structural steel shapes, concrete and anchor hardware similar to items previously specified herein and shall be subject to the approval of the Engineer.

M. Expansion anchors shall be equal to Kwik-Bolt as manufactured by the McCullock Industries, Minneapolis, MN or Wej-it by Wej-it Expansion Products, Inc., Bloomfield, CO. The length of expansion bolts shall be sufficient to place the wedge portion of the bolt a minimum of one-in. behind the steel reinforcement.

N. Hanger rods shall be hot rolled steel, machine threaded and galvanized after fabrication. The strength of the rod shall be based on its root diameter. Hanger rods shall be attached to concrete structures using concrete inserts similar to F&S, Figures 180, 571 or 150; or continuous concrete inserts per F&S. Inserts shall be malleable iron, or steel with galvanized finish. Beam clamps, C clamps or welded beam attachments shall be used for attaching hanger rods to structural steel members. Where necessary and approved by the Engineer, expansion anchors shall be used for attaching to concrete structures.

2.02 SINGLE PIPE HANGERS

A. Single pipes shall be supported by hangers suspended by hanger rods from structural steel members, concrete ceilings, bottom of trapeze hangers and wall mounted steel angle brackets.

B. Except as otherwise specified herein, pipe hangers shall be steel, of the adjustable clevis type similar to Grinnell, Figure No. 65, 260 and 590 as required.

C. Where pipes are near walls, beams, columns, etc., and located an excessive distance from ceilings or underside of beams, welded steel wall brackets similar to Carpenter and Patterson, Figure No. 69-68, 84 or 139 shall be used for hanging pipe. Where single pipes rest on top of bracket pipe supports, attachments shall meet requirements as specified under multiple pipe hangers.

2.03 MULTIPLE PIPE HANGERS

A. Suspended multiple pipes, running parallel in the same horizontal plane, which are adjacent to each other shall be suspended by trapeze type hangers or wall brackets. Trapeze hangers shall consist of galvanized structural steel channel supported from galvanized threaded rod or attached to concrete walls, columns or structural steel support members as required to meet the intent of this Section. Channel shall be similar to F&S, Figure 710, rods, concrete inserts, "C" clamps, beam clamps, welded beam attachments and expansion shields shall be as specified in Paragraph 2.02 above.

B. Except as otherwise specified herein pipe anchors used for attaching pipe to trapeze or multiple pipe wall brackets shall be anchor or pipe chairs similar to F&S, Figures 158, 419, 160A, 160B as required. Material of construction shall be galvanized steel. Chair "U" bolts shall be tightened to allow freedom of movement for normal expansion and contraction except where pipe must be anchored to control direction of movement or act as a thrust anchor.

2.04 SINGLE AND MULTIPLE PIPE SUPPORTS

A. Single pipes located in a horizontal plane close to the floor shall be supported by one of the methods as shown on the Drawings and as specified herein.

B. Pipes three-in. in diameter and larger shall be supported by adjustable stanchions similar to F&S, Figure 427. Stanchions shall provide at least four-in adjustment and be flange mounted to floor.

C. Pipes less than three-in in diameter shall be held in position by supports fabricated from steel "C" channel, welded post base similar to Unistrut, Figure P2072A and pipe clamps similar to Unistrut, Figures P1109 thru P1126. Where required to assure adequate support, fabricate supports using two vertical members and post bases connected together by horizontal member of sufficient load capacity to support pipe. Wherever possible supports shall be fastened to nearby walls or other structural member to provide horizontal rigidity. More than one pipe may be supported from a common fabricated support.

D. Where shown on the Drawings, ductile iron pipe shall be supported using cast-in-place concrete supports.

2.05 BASE ANCHOR SUPPORT

A. Where pipes change direction from horizontal to vertical via a bend, a welded or cast base bend support shall be installed at the bend to carry the load. The base bend shall be fastened to the floor, pipe stanchion, or concrete pedestal using expansion anchors or other method as approved by the Engineer.

B. Where shown on the Drawings, pipe bends shall be supported using concrete anchor posts. Pipes shall be securely fastened to the concrete supports with suitable metal bands as required and approved by the Engineer. A felt insert shall be used to isolate the piping from the poured concrete.

2.06 VERTICAL PIPE SUPPORTS

A. Where vertical pipes are not supported by a Unistrut system as specified in Paragraph 2.08 below, they shall be supported in one of the following methods.

1. For pipes 1/4-in to two-in in diameter, an extension hanger ring shall be provided with an extension rod and hanger flange. The rod diameter shall be as recommended by the manufacturer for the type of pipe to be supported. The hanger ring shall be steel or PVC clad depending on the supported pipe. The hanger ring shall be equal to Carpenter & Paterson, Figure No. 81 or 81CT. The anchor flange shall be galvanized malleable iron similar to Carpenter and Patterson, Figure No. 85.

2. For pipes equal to or greater than two-in in diameter extended pipe clamps similar to Carpenter and Patterson, Figure No. 267 may be used. The hanger shall be attached to concrete structures using double expansion shields, or to steel support members using welding lugs similar to Carpenter and Patterson, Figure No. 220.

3. Pipe riser clamps shall be used to support all vertical pipes extending through floor slabs. Riser clamps shall be steel similar to Carpenter and Patterson, Figure No. 126. Copper clad or PVC coated clamps shall be used on copper pipes. Insulation shall be removed from insulated pipes prior to installing riser clamps. Insulation shall not be damaged by clamp installation.

4. Unless otherwise specified, shown, or specifically approved by the Engineer, vertical runs exceeding 12-ft shall be supported by base elbows/tees, clamps, brackets, wall rests and pipe collars, all located as required to ensure a rigid installation.

2.07 SPECIAL SUPPORTS

A. Pipe supports shall be provided for closely spaced vertical piping systems required to provide a rigid installation. The interval of vertical support spacing shall be as specified, but in no case shall vertical interval exceed 10-ft. The support system shall consist of a framework suitably anchored to floors, ceilings or roofs.

B. Vertical and horizontal supporting members shall be U shaped channels similar to Unistrut, Series P1000. Vertical piping shall be secured to the horizontal members by pipe clamps or pipe straps. All components shall be of steel.

C. For piping three-in and smaller, the framework shall be as manufactured by the Unistrut Corporation; Globe-Strut as manufactured by the Metal Products Division of U.S. Gypsum or equal. For piping larger than three-in, the support frame shall be fabricated from structural steel shapes and secured through the use of expansion anchors.

D. The assemblies shall be furnished complete with all nuts, bolts and fittings required for a complete assembly including end caps for all unistruts members.

E. The design of each individual framing system shall be the responsibility of the Contractor. Shop drawings, as specified above shall be submitted and shall show all details of the installation, including dimensions and types of supports. In all instances the completed frame shall be adequately braced to provide a complete rigid structure when all the piping has been attached.

F. Supports not otherwise described in this Section shall be fabricated or constructed from standard structural steel shapes in accordance with applicable provisions of Section 05500, or unistrut-type frame; have anchor hardware similar to items previously specified herein, shall meet the minimum requirements listed below and be subject to the approval of the Engineer.

1. Pipe support systems shall meet all requirements of this Section and all related Sections.

2. Complete design details of the pipe support system and system components shall be submitted for review and approval as specified in PART 1. No hanger or support shall be installed without the written approval of the Engineer.

3. The pipe support system shall not impose loads on the supporting structures in excess of the loads for which the supporting structure is designed.

2.08 SURFACE PREPARATION AND SHOP PRIME PAINTING

A. All surfaces shall be prepared and shop painted as part of the work of this Section. Surface preparation and shop painting shall be as specified in Section 09901.

PART 3 EXECUTION

3.01 INSTALLATION

A. Proceed with the installation of piping and supports only after any building structural work has been completed and new concrete has reached its 28-day compressive strength.

B. The installation of pipe support systems shall in no way interfere with the operation of the overhead bridge cranes, monorails, access hatches, etc.

C. The installed systems shall not interfere with maintenance and operational access to any equipment installed under this Section, or any other related Section.

D. All pipes horizontal and vertical, requiring rigid support shall be supported from the building structure by approved methods. Supports shall be provided at changes in direction and elsewhere as shown in the Drawings or as specified herein. No piping shall be supported from metal stairs, ladders and walkways unless specifically directed or authorized by the Engineer.

E. All pipe supports shall be designed with liberal strength and stiffness to support the respective pipes under the maximum combination of peak loading conditions to include pipe weight, liquid weight, liquid movement and pressure forces, thermal expansion and contraction, vibrations and all probable externally applied forces. Prior to installation, all pipe supports shall be approved by the Engineer.

F. Pipe supports shall be provided to minimize lateral forces through valves, both sides of split type couplings and sleeve type couplings (within four pipe diameters) and to minimize all pipe forces on pump housings. Pump housings shall not be utilized to support connecting pipes.

G. Inserts for pipe hangers and supports shall be installed on forms before concrete is placed. Before setting these items, all Drawings and figures shall be checked which have a direct bearing on the pipe location. Responsibility for the proper location of pipe supports is included under this Section.

H. Continuous metal inserts shall be embedded flush with the concrete surface.

I. Apply anti-seize compound to all nuts and bolts. Supports installed without the approved compound shall be dismantled and correctly installed, at no additional cost to the District.

3.02 TESTING

A. All pipe support systems shall be tested for compliance with this Section. After installation, each pipe support system shall be tested in conjunction with the respective piping pressure tests. If any part of the pipe support system proves to be defective or inadequate, it shall be repaired or augmented under this Section to the satisfaction of the Engineer.

END OF SECTION

SECTION 16000
ELECTRICAL - GENERAL PROVISIONS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and install complete and make operational, electrical and process instrumentation systems at the Black Creek Water Resource Development Project Aquifer Recharge Area as shown on the Drawings and as specified herein.

B. The work shall include furnishing, installing and testing the equipment and materials specified in other Sections of the Division 16 Specifications and shown on the Drawings.

C. The work shall include furnishing and installing the following:

1. Electrical service from the Power Company.

2. Conduit, wire and field connections for all motors, motor controllers, control devices, control panels and electrical equipment furnished under other Divisions of these specifications.

3. Conduit, wiring and terminations for all field-mounted instruments furnished under other Divisions of these specifications, including process instrumentation primary elements, transmitters, local indicators and control panels. Lightning and surge protection equipment wiring at process instrumentation transmitters. Install vendor furnished cables specified under other Divisions of these specifications.

4. A complete raceway system for the Data Highway Cables and specialty cable systems. Install the Data Highway Cables and other specialty cable systems furnished under Division 13 in accordance with the system manufacturers' installation instructions. Review the raceway layout, prior to installation, with the computer system supplier and the cable manufacturer to ensure raceway compatibility with the systems and materials being furnished. Where redundant cables are furnished, install cables in separate raceways.

5. Furnish and install precast manholes, precast handholes and light pole bases.

6. Furnish and install manhole and handhole frames and covers.

7. It is the intent of these Specifications that the electrical system shall be suitable in every way for the service required. All material and all work which may be reasonably implied as being incidental to the work of this Section shall be furnished at no extra cost.

8. Provide Power System Study.

D. The Contractor shall prepare and furnish electrical and instrumentation conduit layout shop drawings for yard electrical, within and under all roads, buildings and structures to the

Engineer for approval prior to commencing work. Layouts shall include but not be limited to equipment, pull boxes, manholes, conduit routing, dimensioning, methods and locations of supports, reinforcing, encasement, materials, conduit sizing, equipment access, potential conflicts, building and yard lighting, and all other pertinent technical specifications for all electrical and instrumentation conduits and equipment to be furnished. All layouts shall be drawn to scale on 24” x 36” sheets. Refer to Division 16000, 1.03, I for additional requirements.

E. The work shall include complete testing of all equipment and wiring at the completion of work and making any minor correction changes or adjustments necessary for the proper functioning of the system and equipment. All workmanship shall be of the highest quality; substandard work will be rejected.

F. A single manufacturer shall provide panelboards, transformers, disconnect switches, etc. This manufacturer shall also provide a short circuit/coordination study as specified herein.

G. Contractor shall provide their own temporary power for miscellaneous power (drills, pumps, etc.). No facility circuits shall be used unless approved in writing by the Engineer. Any temporary added shall be removed at job completion.

H. Complete coordination with other contractors. Contractor shall coordinate with all other contractors’ equipment submittals and obtain all relevant submittals.

I. Mount control panels, transmitters, process instruments, operator stations, etc. furnished under other Divisions of these specifications.

J. Concrete electrical duct encasement, including but not limited to excavation, concrete, conduit, reinforcement, backfilling, grading and seeding is included in Division 16. All work shall be done in accordance with Divisions 2 and 3 of these specifications.

K. Excavation, bedding material, forms, concrete and backfill for underground raceways; forms and concrete for electrical equipment furnished herein is included in Division 16. All work shall be done in accordance with Divisions 2 and 3 of these specifications.

1.02 RELATED WORK

A. Excavation and backfilling, including gravel or sand bedding for underground electrical work is specified in Division 2.

B. Cast in place concrete work, including concrete encasements for electrical duct banks, equipment pads, light pole bases and reinforcing steel, is specified in Division 3.

1.03 SUBMITTALS

A. Submit to the Engineer, in accordance with Section 01300, shop drawings for equipment, materials and other items furnished under Division 16.

B. Shop drawings shall be submitted for the following equipment:

1. Raceways, Boxes, Fittings and Hangers
2. Wires and Cables
3. Miscellaneous Equipment (as specified in Section 16191)
4. Panelboards
5. Lighting Fixtures and Lamps
6. Switches, Receptacles and Covers
7. Precast Manholes and Handholes, Frames and Covers
8. Grounding Hardware and Connections
9. Surge Protection Devices
10. Lightning Protection System

C. Submittals shall be required for the following items:

1. Concealed and Buried Conduit Layouts
2. Preliminary Short Circuit and Coordination Study Report
3. Final Power System Study

D. The manufacturers name and product designation or catalog numbers shall be submitted for the following material utilized:

1. Testing Equipment
2. Ground System Resistance Test Equipment

E. Check shop drawings for accuracy and contract requirements prior to submittal. Shop drawings shall be stamped with the date checked and a statement indicating that the shop drawings conform to the Specifications and the Drawings. This statement shall also list all exceptions to the Specifications and the Drawings. Shop drawings not so checked and noted shall be returned.

F. The Engineer's check shall be for conformance with the design concept of the project and compliance with the Specifications and the Drawings. Errors and omissions on approved shop drawings shall not relieve the Contractor from the responsibility of providing materials and workmanship required by the Specifications and the Drawings.

G. All dimensions shall be field verified at the job site and coordinated with the work of all other trades.

H. Material shall not be ordered or shipped until the shop drawings have been approved. No material shall be ordered or shop work started if shop drawings are marked "APPROVED AS NOTED - CONFIRM", "APPROVED AS NOTED - RESUBMIT" or "NOT APPROVED".

I. In addition to manufacturer's equipment shop drawings, submit electrical installation working drawings containing the following:

1. Concealed and buried conduit layouts, shown on floor plans drawn at not less than 1/4-in = 1-ft-0-in scale. The layouts shall include locations of process equipment, switchboards, variable frequency drives, transformers, panelboards, control panels and equipment, motors, switches, motor starters, large junction or pull boxes, instruments and any other electrical devices connected to concealed or buried conduits.

2. Plans shall be drawn on high quality reproducible, paper size 36-inch by 24-inch and shall be presented in a neat, professional manner or electronic PDF file.

3. Concrete floors and/or walls containing concealed conduits shall not be poured until conduit layouts are approved.

J. Operation and Maintenance Data

1. Submit operations and maintenance data for equipment furnished under this Division, in accordance with Section 01730. The manuals shall be prepared specifically for this installation and shall include catalog data sheets, drawings, equipment lists, descriptions, parts lists, etc, to instruct operating and maintenance personnel unfamiliar with such equipment.

2. Manuals shall include the following as a minimum:

a. A comprehensive index.

b. A complete "As-Built" set of approved shop drawings.

c. A complete list of the equipment supplied, including serial numbers, ranges and pertinent data.

d. A table listing of the "as left" settings for all timing relays and alarm and trip setpoints.

e. System schematic drawings "As-Built", illustrating all components, piping and electric connections of the systems supplied under this Section.

f. Detailed service, maintenance and operation instructions for each item supplied.

g. Special maintenance requirements particular to this system shall be clearly defined, along with special calibration and test procedures.

h. The operating instructions shall also incorporate a functional description of the entire system, with references to the systems schematic drawings and instructions.

i. Complete parts list with stock numbers, including spare parts.

1.04 REFERENCE STANDARDS

A. Electric equipment, materials and installation shall comply with the latest edition of National Electrical Code (NEC) and with the latest edition of the following codes and standards:

1. National Electrical Safety Code (NESC)

2. Occupational Safety and Health Administration (OSHA)

3. National Fire Protection Association (NFPA)

4. National Electrical Manufacturers Association (NEMA)

5. American National Standards Institute (ANSI)

6. Insulated Cable Engineers Association (ICEA)

7. Instrument Society of America (ISA)

8. Underwriters Laboratories (UL)

9. Factory Mutual (FM)

10. International Electrical Testing Association (NETA)

11. Institute of Electrical and Electronic Engineers (IEEE)

B. All electrical equipment and materials shall be listed by Underwriter's Laboratories, Inc., and shall bear the appropriate UL listing mark or classification marking. Equipment, materials, etc. utilized not bearing a UL certification shall be field or factory UL certified prior to equipment acceptance and use.

C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 PRIORITY OF THE CONTRACT DOCUMENTS

A. If, during the performance of the work, the Contractor finds a conflict, error or discrepancy between or among one or more of the Sections or between or among one or more Sections and the Drawings, furnish the higher performance requirements. The higher performance requirement shall be considered the equipment, material, device or installation method which represents the most stringent option, the highest quality or the largest quantity.

B. In all cases, figured dimensions shall govern over scaled dimensions, but work not dimensioned shall be as directed by the Engineer and work not particularly shown, identified, sized, or located shall be the same as similar work that is shown or specified.

C. Detailed Drawings shall govern over general drawings, larger scale Drawings take precedence over smaller scale Drawings, Change Order Drawings shall govern over Contract Drawings and Contract Drawings shall govern over Shop Drawings.

D. If the issue of priority is due to a conflict or discrepancy between the provisions of the Contract Documents and any referenced standard, or code of any technical society, organization or association, the provisions of the Contract Documents will take precedence if they are more stringent or presumptively cause a higher level of performance. If there is any conflict or discrepancy between standard specifications, or codes of any technical society, organization or association, or between Laws and Regulations, the higher performance requirement shall be binding on the Contractor, unless otherwise directed by the Engineer.

E. In accordance with the intent of the Contract Documents, the Contractor accepts the fact that compliance with the priority order specified shall not justify an increase in Contract Price or an extension in Contract Time nor limit in any way, the Contractor's responsibility to comply with all Laws and Regulations at all times.

1.06 ENCLOSURE TYPES

A. Unless otherwise specified herein or shown on the Drawings, electrical enclosures shall have the following ratings:

1. NEMA 1 for dry, non-process indoor locations.

2. NEMA 12 for "DUST" locations.

3. NEMA 4X for outdoor locations, rooms below grade (including basements and buried vaults), "DAMP" and "WET" locations. Enclosures shall be Type 316 stainless steel.

4. NEMA 4X for "CORROSIVE" locations. Enclosures shall be Type 316 stainless steel.

1.07 SERVICE AND METERING

A. The power company serving this project is Clay Electric Cooperative. Service will be obtained at 480 Volts, Three Phase, Four Wire, 60 Hz wye grounded to the service entrance equipment as shown on the drawings. Pay all fees and charges as required to obtain temporary and permanent service. Coordinate with Clay Electric Cooperative to provide and meet requirements for these services.

B. The power company will be responsible for the following work:

1. Furnishing and installing primary conduits and cables.

2. Furnishing and installing transformer.

3. Furnishing and installing the transformer pad and grounding.

4. Termination of underground primary cables at the transformer.

5. Termination of underground secondary cables at the transformer.

6. Furnishing metering current transformers (C.T.s), meter and meter wiring.

7. Furnishing meter base and enclosure.

C. The Contractor shall be responsible for the following work:

1. Obtain an estimate from the power company for the work described in Paragraph 1.07B above and include the cost of the power company work in the Bid Price.

2. Make all arrangements with the power company for obtaining electrical service, pay all power company charges and furnish all labor and material required for the electrical service.

3. Furnishing and installing secondary conduits and cables from transformer to service entrance equipment.

4. Furnishing and installing a power company approved metering current transformer enclosure.

5. Installing meter base and enclosure.

6. Furnishing and installing an empty conduit with pull line from the metering C.T. enclosure to the meter enclosure. Conduit size and type shall be approved by the power company.

7. Steel bollards.

1.08 CODES, INSPECTION AND FEES

A. Equipment, materials and installation shall comply with the requirements of the local authority having jurisdiction.

B. Obtain all necessary permits and pay all fees required for permits and inspections.

1.09 TESTS AND SETTINGS

A. Test systems and equipment furnished under Division 16 and repair or replace all defective work and equipment. Refer to the individual equipment sections for additional specific testing requirements.

B. Make adjustments to the systems and instruct the District's personnel in the proper operation of the systems.

C. In addition to the specific testing requirements listed in the individual Sections, the following minimum tests and settings shall be performed. Submit test reports upon completion of testing in accordance with Section 01300.

1. Mechanical inspection, testing and settings of circuit breakers, disconnect switches, motor starters, overload relays, control circuits and equipment for proper operation.

2. Check the full load current draw of each motor. Where power factor correction capacitors are provided the capacitor shall be in the circuit at the time of the measurement. Check ampere rating of thermal overloads for motors and submit a typed record to the Engineer of the same, including MCC cubicle location and driven load designation, motor service factor, horsepower, and Code letter. If incorrect thermal overloads are installed replace same with the correct size overload.

3. Check power and control power fuse ratings. Replace fuses if they are found to be of the incorrect size.

4. Check settings of the motor circuit protectors. Adjust settings to lowest setting that will allow the motor to be started when under load conditions.

5. Check motor nameplates for correct phase and voltage. Check bearings for proper lubrication.

6. Check rotation of motors prior to testing the driven load. Disconnect the driven equipment if damage could occur due to wrong rotation. If the rotation is incorrect for the driven equipment correct motor connections at the motor terminal box.

7. Check interlocking, control and instrument wiring for each system and/or part of a system to prove that the system will function properly as indicated by control schematic and wiring diagrams.

8. Inspect each piece of equipment in areas designated as HAZARDOUS to ensure that equipment of proper rating is installed.

9. Verify all terminations at transformers, equipment, panels and enclosures by producing a one, two, three clockwise rotation on a phase sequenced motor when connected to "A", "B" and "C" phases.

10. Verify correct wire termination positions across tie circuits, transfer switches, or other devices that normally have two sources of three-phase power present by performing a hot phase test. That is, in addition to verifying clockwise rotation, a voltage reading across both incoming circuits should measure 0 volts when phase “A” of one side is compared to phase “A” of the other side.

11. Check all wire and cable terminations. Verify to the Engineer connections meet the equipments torque requirements.

12. Field set all transformer taps as required to obtain the proper secondary voltage.

13. Infra-red hot spot inspection shall be made of all electrical equipment including but not limited to switchboard, variable frequency drives, transformers, switches, power and control panels, etc. This shall be done under representative load conditions before the equipment is used by the District and again three months before expiration of the one-year warranty period.

D. Testing shall be scheduled and coordinated in writing with the Engineer at least two weeks in advance. Provide qualified test personnel, instruments and test equipment. Provide certified calibration sheets including dates for all equipment to be used for testing with notice of scheduled testing. Calibration sheets shall also indicate that the units have been calibrated within six months of the testing date. The Contractor shall have qualified personnel present during the testing.

1.10 POWER SYSTEM STUDY

A. General:

1. The major electrical equipment manufacturer shall provide a computerized Power System Study for the electrical power distribution and motor control equipment. The study shall verify adequacy of all of the existing equipment as well as new additions being implemented under these Specifications.

2. The study shall also include the utility company's protective devices, the main switchboard, all feeders, and distribution and all associated equipment. Graphic indication of coordination shall be furnished in the form of a clearly labeled and identified composite drawing showing time-current curves of system protective devices. Time-current curves of each device shall also be furnished.

3. The Contractor/Manufacturer shall be responsible for obtaining and verifying with the Power Company in writing all information needed to conduct this study. Provide this correspondence and information including contacts and phone numbers with the study submittal.

4. The Contractor shall set all protective devices and relays based on this coordination study to provide coordinated, selective protection for all equipment supplied or affected by the installation under this Contract.

5. The Contractor/Manufacturer shall provide data necessary to perform the study. This includes feeder cable sizes, approximate feeder length, motor data, switchboard data, existing protective relay settings and any other information relevant to the study.

6. A summary of the short circuit analysis shall be provided to the Contractor at the time shop drawings for all of the new equipment is submitted for approval. This preliminary short circuit submittal shall be required in order to approve the equipment submittal.

7. The Contractor shall provide and install equipment specific arc flash warning labels per the arc flash study performed herein.

8. Acceptable Software:

    a. SKM System Analysis, Inc.: Power*Tools
    b. Operation Technology, Inc.: ETAP (Electrical Transient Analyzer Program)
    c. EasyPower, Inc.: EasyPower
    d. Or equal

9. Except for one-line diagrams, standard 8 ½-in by 11-in pages, with total pages numbered.

10. Electronic PDF format copy with electronic bookmarks for each section.

11. Signed and sealed by a professional engineer registered in the state in which the project is located.

12. Organized in the following order:

    a. Executive Summary
    b. Short Circuit Analysis
    c. Short Circuit Computer Printout
    d. Protective Device Coordination
    e. Motor Starting
    f. Arc Flash Hazard Analysis
    g. Harmonic Analysis
    h. Utility Data
    i. Modeled One Line Diagrams

13. Information on one-line diagrams, legible when printed at 11-in x 17-in. Show the following:

    a. Protective device designations and ampere ratings.
    b. Conductor types, sizes, and lengths.
    c. Transformer kilovolt ampere (kVA), impedance, and voltage ratings.
    d. Motor and generator designations and kVA ratings.
    e. Switchgear, switchboard, motor-control center, and panelboard designations and ratings.
    f. Derating factors and environmental conditions.
    g. Any revisions to electrical equipment required by the study.

14. Identifiers between the one-line diagram, short circuit study, coordination study, and arc flash study to be the same.

15. Include copies of correspondence with electric utility under utility data section of report. Correspondence to include names and contact information.

B. Scope:

1. The power system study consists of four major parts. The first part is the preliminary short circuit study. The preliminary short circuit study shall verify new equipment is being applied with design ratings. Shop drawings for new equipment will not be reviewed until the preliminary short circuit study is approved by the Engineer.

2. The second and third parts of the power system study include the final short circuit and protective device coordination study. New equipment will not be energized until this study is approved by the Engineer and devices are set in the field in accordance with the study.

3. The fourth and final part of the power system study is the arc flash study. The arc flash study labels will be added after the equipment is energized and all changes, upgrades or modifications have been made, to ensure field labeling will be accurate.

4. The short circuit study shall be in accordance with ANSI Standard C37.010 and C37.13, shall be performed to check the adequacy, and to verify the correct application of circuit protective devices and other system components specified. The study shall address the case when the system is being powered from the normal source as well as from the on-site generating facilities. Minimum as well as maximum possible fault conditions shall be adequately covered in the study.

5. Fault contribution of all motors shall be considered. The Contractor shall be responsible for obtaining all required data of equipment. All back-up calculations shall become part of the final report. The Calculations shall be in sufficient detail to allow easy review.

C. Contents:

1. The study shall include representation of the power company's systems, the base quantities selected, impedance source-data, calculation methods and tabulations, one-line and impedance diagrams, conclusions and recommendations. Short circuit momentary duties, shall be calculated on the basis of an assumed bolted three-phase short circuit at each medium voltage bus, low voltage switchboard bus, switchboards, variable frequency drives, distribution panelboards, pertinent branch circuit panelboards, and other significant locations through the systems. The short-circuit tabulations shall include significant X to R ratios, asymmetry factors, KVA, and symmetrical fault current.

2. A protective device time current coordination study shall be included with coordination plots of key and/or limiting devices, tabulated data, rating, and/or settings selected. The study shall present an engineering balance between the competing objectives of protection and continuity of service for the system specified, taking into account the basic factors of sensitivity, selectivity and speed.

3. Separate plots shall be provided for each mode of "normal" and "stand-by" operation. Maximum fault values shall be shown in each case. Both power sources shown in one plot will not be accepted.

4. Existing protective device settings shall be reviewed to ensure selectivity under the new conditions. Recommended changes shall be indicated in the report. The Contractor shall be made aware of required changes immediately.

5. Transformer damage curves in accordance with ANSI C57.109.

6. Feeder cable damage curves.

7. Required settings for breakers and relays shall be maximized to provide the most effective protection possible whether the system is fed from the normal or emergency source.

8. Tabulations indicating recommended set points for all protective devices shall be provided. This shall include the normal as well as the emergency source.

9. An executive summary outlining the distribution system, the information received from the utility company, assumptions made to complete the study, statement of the adequacy of the distribution equipment to safely clear or close on any fault, and identification of any problem areas with recommendations for resolving the problem.

10. Tabulation of arc flash information.

D. General Information for Time-Current Curves Presentations:

1. The coordination plots shall include complete titles, representative one-line diagrams, legends, associated power company's relay or system characteristics, significant motor starting characteristics, complete parameters for power, and substation transformers, and complete operating bands for low-voltage circuit breaker trip devices.

2. The coordination plots shall define the types of protective devices selected, together with the proposed coil taps, time-dial settings and pick-up settings required.

3. The short-time region shall indicate the medium voltage relay instantaneous elements, the magnetizing in-rush, and ANSI withstand transformer parameters, the low-voltage circuit breaker instantaneous trip devices, fuse manufacturing to tolerance bands, and significant symmetrical and asymmetrical fault currents.

4. Each primary protective device required for a delta-to-wye connected transformer shall be selected so that the characteristic or operating band is within the transformer parameters; which, where feasible, shall include a parameter equivalent to 58 percent of the ANSI withstand point to afford protection for secondary line-to-ground faults.

5. Low-voltage power circuit breakers shall be separated from each other and the associated primary protective device, where feasible, by a 16 percent current margin for coordination and protection in the event of secondary line-to-line faults.

6. Protective relays shall be separated, where feasible, by a 0.3 second time margin when the maximum three-phase fault flows, to assure proper selectivity.

E. Arc Flash Study:

1. The study shall utilize the fault current values calculated in the short circuit study and the clearing time of the upstream protective device in the coordination study to calculate the incident energy at each fault location.

2. Study shall be in accordance with IEEE Standard 1584 and NFPA 70E, latest versions.

3. Study shall calculate the incident energy and flash protection boundary at all significant locations in the electrical distribution where work could be performed on energized parts. Include any 208 volt or 240 volt equipment that is fed from transformers greater than 125 kVA.

4. Incident energy calculations shall include maximum and minimum fault contribution scenarios, since protective device clearing times can vary greatly depending upon the fault current.

5. Tabulations shall be provided showing each fault location, the arcing fault magnitude, protective device clearing time, duration of the arc, arc flash boundary, working distance, incident energy and hazard risk category.

F. The power system study shall be bound in a standard 8-1/2" x 11" size report and submitted in accordance with Section 01300. The completed short circuit and coordination study shall be submitted to and approved by the Engineer before any of the equipment is shipped. All protective devices shall be adjusted, tested, and calibrated in the field, prior to energizing the equipment, per the settings listed in the study. This work shall be performed by the manufacturer as described in this section and prior to final acceptance by the District.

G. All protective devices, existing and new shall be calibrated and tested as recommended by and under the supervision of the distribution gear manufacturer's representative as specified in this section.

H. The coordination study shall be stamped and signed by a professional engineer registered in the state in which the equipment is to be installed.

I. Arc Flash Warning Labels:

1. Provide a machine printed thermal transfer type label of high adhesion polyester for each location identified in the arc flash study.

2. Labels shall include the following machine printed information (hand lettering is not acceptable): equipment name, flash hazard boundary, incident energy, boundaries for shock hazard, limited approach, restricted approach, PPE (personal protective equipment) and date.

3. All equipment 50 volts and higher shall have arc flash labels. The switchboard shall include both LINE and LOAD side labels on applicable sections.

1.11 INTERPRETATION OF DRAWINGS

A. The Drawings are not intended to show exact locations of conduit runs. Coordinate the conduit installation with other trades and the actual supplied equipment.

B. Install each three-phase circuit in a separate conduit unless otherwise shown on the Drawings.

C. Unless otherwise approved by the Engineer, conduit shown exposed shall be installed exposed; conduit shown concealed shall be installed concealed.

D. Where circuits are shown as "home-runs" all necessary fittings and boxes shall be provided for a complete raceway installation.

E. Verify the exact locations and mounting heights of lighting fixtures, switches and receptacles prior to installation. Any adjustments required in the field shall be provided at no additional cost to the District and coordinated and approved by the Engineer.

F. Except where dimensions are shown, the locations of equipment, fixtures, outlets and similar devices shown on the Drawings are approximate only. Exact locations shall be determined by the Contractor and approved by the Engineer during construction. Obtain information relevant to the placing of electrical work and in case of any interference with other work, proceed as directed by the Engineer and furnish all labor and materials necessary to complete the work in an approved manner.

G. Circuit layouts are not intended to show the number of fittings, or other installation details. Furnish all labor and materials necessary to install and place in satisfactory operation all power, lighting and other electrical systems shown. Additional circuits shall be installed wherever needed to conform to the specific requirements of the approved equipment at no additional cost to the District.

H. Redesign of electrical or mechanical work, which is required due to the Contractor's use of an alternate item, arrangement of equipment and/or layout other than specified herein, shall be done by the Contractor at his/her own expense. Redesign and detailed plans shall be submitted to the Engineer for approval. No additional compensation will be provided for changes in the work, either his/her own or others, caused by such redesign.

I. Surface mounted panel boxes, junction boxes, conduit, etc., shall be supported by ½-inch spacers to provide a clearance between wall and equipment.

J. All floor mounted electrical equipment shall be placed on four-inch thick (3/4-inch, 45 degree chamfer at all exposed edges) concrete pads, provide reinforcement, anchors, etc.

K. The Contractor shall harmonize the work of the different trades so that interferences between conduits, piping, equipment, architectural and structural work will be avoided. All necessary offsets shall be furnished so as to take up a minimum space and all such offsets, fittings, etc, required to accomplish this shall be furnished and installed by the Contractor without additional expense to the District. In case interference develops, the Engineer is to decide which equipment, piping, etc., must be relocated, regardless of which was installed first.

L. Raceways and conductors for the lightning protection system is not shown on the Drawings. Provide raceways and conductors as required by the system manufacturer for a complete and operating system. Raceways shall be installed concealed in all finished spaces and may be installed exposed or conducted in process spaces.

M. Raceways and conductors for all electrical equipment, lighting, switches, receptacles and other miscellaneous low voltage power and signal systems as specified are not shown on the

Drawings. Raceways and conductors shall be provided as required for a complete and operating system. Homeruns, as shown on the Drawings, are to assist the Contractor in identifying raceways to be run exposed and raceways to be run concealed. Raceways shall be installed concealed in all finished spaces and may be installed exposed or concealed in all process spaces. Raceways installed exposed shall be near the ceiling or along walls of the areas through which they pass and shall be routed to avoid conflicts with HVAC ducts, cranes hoists, monorails, equipment hatches, doors, windows, etc. Raceways installed concealed shall be run in the center of concrete floor slabs, above suspended ceilings, or in partitions as required.

1.12 PHASE BALANCING

A. The Drawings do not attempt to balance the electrical loads across the phases. Circuits on switchboards and panelboards shall be field connected to result in evenly balanced loads across all phases.

B. Field balancing of circuits shall not alter the conductor color coding requirements as specified in Section 16120.

1.13 SIZE OF EQUIPMENT

A. Investigate each space in the structure through which equipment must pass to reach its final location. Coordinate shipping splits with the manufacturer to permit safe handling and passage through restricted areas in the structure.

B. The equipment shall be kept upright at all times during storage and handling. When equipment must be tilted for passage through restricted areas, brace the equipment to ensure that the tilting does not impair the functional integrity of the equipment.

1.14 RECORD DRAWINGS

A. As the work progresses, legibly record all field changes on a set of Project Contract Drawings, hereinafter called the "Record Drawings".

B. Record Drawings shall accurately show the installed condition of the following items:

1. One-line Power Diagram(s).

2. Equipment elevations (front views).

3. Raceways and pullboxes.

4. Conductor sizes and conduit fills.

5. Panel Schedule(s).

6. Control Wiring Diagram(s).

7. Lighting Fixture Schedule(s).

8. Lighting fixture, receptacle and switch outlet locations.

9. Underground raceway and duct bank routing.

10. Plan view, sizes and locations of switchboard, distribution transformers, variable frequency drives, and panelboards.

C. Submit a schedule of control wiring raceways and wire numbers, including the following information:

1. Circuit origin, destination and wire numbers.

2. Field wiring terminal strip names and numbers.

D. In addition to the schedule, provide point-to-point connection diagrams showing the same information submitted in the schedule of control wiring raceways including all designations and wire numbers.

E. Submit the record drawings, schedule of control wiring raceways and wire numbers and the point-to-point connection diagrams to the Engineer. The schedule of control wiring raceways and wire numbers and the point-to-point connection diagrams shall be computer generated (i.e. no hand-written or drawn schedules, drawings, or diagrams will be accepted).

1.15 EQUIPMENT INTERCONNECTIONS

A. Review shop drawings of equipment furnished under other Divisions and prepare coordinated wiring interconnection diagrams or wiring tables. Submit copies of wiring diagrams or tables with the Record Drawings.

B. Furnish and install all equipment interconnections.

1.16 MATERIALS AND EQUIPMENT

A. Materials and equipment shall be new, except where specifically identified on the Drawings to be re-used.

B. Material and equipment of the same type shall be the product of one manufacturer and shall be UL listed.

C. Warrant all equipment furnished under Division 16 in accordance with Section 01740. Refer to individual equipment sections for additional warranty items.

1.17 EQUIPMENT IDENTIFICATION

A. Identify equipment (disconnect switches, separately mounted motor starters, control stations, etc) furnished under Division 16 with the name of the equipment it serves. Control panels, panelboards, switchboards, variable frequency drives, junction or terminal boxes, transfer switches, etc, shall have nameplate designations as shown on the Drawings.

B. Nameplates shall be engraved, laminated plastic, not less than 1/16-in thick by 3/4-in by 2-1/2-in with 3/16-in high white letters on a black background.

C. Nameplates shall be screw mounted to NEMA 1 enclosures. Nameplates shall be bonded to all other enclosure types using an epoxy or similar permanent waterproof adhesive. Two sided foam adhesive tape is not acceptable. Where the equipment size does not have space for mounting a nameplate, the nameplate shall be permanently fastened to the adjacent mounting surface. Cemented nameplates shall not be drilled.

D. All voltages (480 volts, etc.) within pull boxes, junction boxes etc. shall be identified on the front exterior cover. Signs shall be red background with white engraved lettering, lettering shall be a minimum of 1" high.

E. All receptacles, wall switches, lighting fixtures, photocells, emergency lights, exit lights, etc. shall be identified with the panel and circuit to which it is connected. Identification shall be with machine generated labels with ¼” high letters.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 SLEEVES AND FORMS FOR OPENINGS

A. Provide and place all sleeves for conduits penetrating floors, walls, partitions, etc. Locate all necessary slots for electrical work and form before concrete is poured.

B. Exact locations are required for stubbing-up and terminating concealed conduit. Obtain shop drawings and templates from equipment vendors or other subcontractors and locate the concealed conduit before the floor slab is poured.

C. Where setting drawings are not available in time to avoid delay in scheduled floor slab pours, the Engineer may allow the installations of such conduit to be exposed. Requests for this deviation must be submitted in writing. No additional compensation for such change will be allowed.

D. Seal all openings, sleeves, penetration and slots as specified in Section 16110.

3.02 CUTTING AND PATCHING

A. Cutting and patching shall be done in a thoroughly workmanlike manner and be in compliance with modifications and repair to concrete as specified in Section 01045. Sawcut concrete and masonry prior to breaking out sections.

B. Core drill holes in existing concrete floors and walls as required.

C. Install work at such time as to require the minimum amount of cutting and patching.

D. Do not cut joists, beams, girders, columns or any other structural members.

E. Cut opening only large enough to allow easy installation of the conduit.

F. Patching to be of the same kind and quality of material as was removed.

G. The completed patching work shall restore the surface to its original appearance or better.

H. Patching of waterproofed surfaces shall render the area of the patching completely waterproofed.

I. Remove rubble and excess patching materials from the premises.

J. When existing conduits are cut at the floor line or wall line, they shall be filled with grout of suitable patching material.

3.03 INSTALLATION

A. Any work not installed according to the Drawings and this Division or without approval by the Engineer shall be subject to change as directed by the Engineer. No extra compensation will be allowed for making these changes.

B. Electrical equipment shall at all times during construction be adequately protected against mechanical injury or damage by water. Electrical equipment shall not be stored out-of-doors. Electrical equipment shall be stored in dry permanent shelters. If an apparatus has been damaged, such damage shall be repaired at no additional cost. If any apparatus has been subject to possible injury by water, it shall be replaced at no additional cost to the District, the damaged unit(s) or systems shall remain on site and returned to the manufacturer after the replacement unit(s) or systems have been delivered to the site. Under no circumstances will electrical equipment damaged by water be rehabilitated or repaired, new equipment shall be supplied, and all cost associated with replacement shall be borne by the Contractor.

C. Equipment that has been damaged

D. shall be replaced or repaired by the equipment manufacturer, at the Engineer's discretion.

E. Repaint any damage to factory applied paint finish using touch-up paint furnished by the equipment manufacturer. The entire damaged panel or section shall be repainted per the field painting requirements Section 09902, at no additional cost to the District.

3.04 POWER SYSTEM STUDY

A. Provide a complete system Power System Study including preliminary short circuit, final short circuit, protective device coordination and arc flash study as specified herein.

B. Provide and install arc flash warning labels at equipment identified with the arc flash study.

END OF SECTION

SECTION 16110
RACEWAYS, BOXES, FITTINGS AND SUPPORTS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish and install complete raceway systems as shown on the Drawings and as specified herein.

1.02 RELATED WORK

A. Refer to Section 16600 for additional requirements.

1.03 SUBMITTALS

A. Submit to the Engineer, in accordance with Section 01300, the manufacturers' names and product designation or catalog numbers with cut-sheets of all materials specified. Indicate in the submittal, the areas where specific materials are used.

PART 2 PRODUCTS

2.01 MATERIALS

A. Rigid Aluminum Conduit

1. Rigid aluminum conduit shall be 6063 alloy and shall be as manufactured by New Jersey Aluminum Corp.; Reynolds Aluminum International Services Inc.; Alumax Extrusions, Inc; VAW of America, Inc. or equal.

2. Rigid aluminum conduit shall be for use under the provisions of NEC Article 344.

B. Electrical Metallic Tubing

1. Electrical metallic tubing shall be hot-dipped galvanized steel as manufactured by the Allied Tube and Conduit Corp.; Triangle PWC Inc.; Wheatland Tube Co.; Bridgeport or equal.

2. Electrical metallic tubing shall be for use under the provisions of NEC Article 358.

C. Rigid Nonmetallic Conduit

1. PVC conduit shall be rigid polyvinyl chloride Schedule 80 as manufactured by Carlon; An Indian Head Co.; Cantex; Queen City Plastics or equal.

2. PVC conduit used in underground concrete encased duct banks shall be rigid polyvinyl chloride Schedule 40 as manufactured by Carlon; An Indian Head Co.; Cantex; Queen City Plastics or equal.

3. PVC conduit shall be for use under the provisions of NEC Article 352.

D. Liquidtight Flexible Metal Conduit, Couplings and Fittings

1. Liquidtight flexible metal conduit shall be Sealtite, Type UA, manufactured by the Anaconda Metal Hose Div.; Anaconda American Brass Co.; American Flexible Conduit Co., Inc.; Universal Metal Hose Co. or equal.

2. Fittings used with liquidtight flexible metal conduit shall be of the three-piece screw-in type malleable iron as manufactured by the O.Z. Gedney Co. or equal.

3. Liquidtight flexible metal conduit shall be for use under the provisions of NEC Article 350.

E. Flexible Metallic Tubing

1. Flexible metallic tubing shall be for use under the provisions of NEC Article 360.

2. Flexible metallic tubing shall be hot-dipped galvanized steel strips shaped into interlocking convolutions firmly joined to one another assuring a complete lock similar to Tristeel as manufactured by Triangle - PWC, Inc. or equal.

3. Flexible metallic tubing shall be used only indoors for connection to lighting fixtures in NEMA 1 administration and office areas.

4. Furnish and install insulated bushings at terminations for conductor protection.

F. Flexible Couplings

1. Flexible couplings shall be type ECGJH as manufactured by the Crouse-Hinds Co.; Appleton Electric Co.; Killark Electric Manufacturing Co. or equal.

G. Boxes and Fittings

1. Pressed steel switch and outlet boxes shall be hot-dipped galvanized with hot-dipped galvanized tile rings as manufactured by the Raco Manufacturing Co.; Adalet Co.; O.Z. Manufacturing Co. or equal.

2. NEMA 1 and NEMA 12, junction boxes, pull boxes etc., shall be sheet steel unless otherwise shown on the Drawings. Boxes shall be galvanized and have continuously welded seams. Welds shall be ground smooth and galvanized. Box bodies shall be flanged and shall not have holes or knockouts. Box bodies shall not be less than 14 gauge metal and covers shall not be less than 12 gauge metal. Covers shall be gasketed and fastened with stainless steel screws. Terminal boxes shall be furnished with hinged doors, terminal mounting straps and brackets (refer to Section 16191 for additional requirements). Boxes shall be as manufactured by Hoffman Engineering Co.; Lee Products Co.; ASCO Electrical Products Co., Inc., or equal. All boxes shall be shop primed and painted by the box manufacturer.

3. NEMA 4X stainless steel, junction boxes and pull boxes shall be 316 stainless steel with 316 stainless steel hardware and gasketed covers. Boxes shall have continuously welded seams and welds shall be ground smooth. Box bodies shall be flanged and shall not have holes or knockouts. Box bodies shall not be less than 14 gauge metal and covers shall not be less than 12 gauge metal. Covers shall be gasketed and fastened with stainless steel screws. Terminal boxes shall be furnished with hinged doors, terminal mounting straps and brackets (refer to Section 16191 for additional requirements.) Boxes shall be as manufactured by Hoffman Engineering Co.; Lee Products Co.; ASCO Electrical Products Co., Inc., or equal.

4. Explosion-proof boxes shall be designed for Class 1, Group D, Division 1 hazardous locations. They shall be cast aluminum, with stainless steel hinged covers and stainless steel hardware and bolts; Type EJB-N4 as manufactured by the Crouse-Hinds Co.; Appleton Electric Co.; Adalet-PLM or equal.

5. Cast aluminum boxes and fittings shall be copper free aluminum with cast aluminum covers and stainless steel screws as manufactured by the Killark Electric Co..; Crouse-Hinds Co.; Appleton Electric Co.; or equal.

6. Cast aluminum device boxes shall be Type FD. All cast aluminum boxes and fittings shall be copper-free aluminum with cast aluminum covers and stainless steel screws as manufactured by the Killark Electric Co.; Crouse-Hinds Co.; L. E. Mason Co. or equal.

7. Cast aluminum fittings (Cs, Ts, LBs, etc.) shall be of the mogul design (with rollers) as manufactured by Appleton Electric Co.

8. Floor boxes shall be of the adjustable single gang, concrete tight type for installation in concrete fill, Walker 800 Series, similar by Hubbell; Thomas & Betts Co. or equal.

9. Conduit hubs shall be of the grounding type as manufactured by Myers Electric Products, Inc. or equal.

10. Conduit wall seals for new concrete walls below grade shall be O.Z./Gedney Co., Type WSK; Spring City Electrical Manufacturing Co., Type WDP or equal.

11. Conduit wall seals for cored holes shall be Type CSML as manufactured by the O.Z./Gedney Co. or equal.

12. Conduit wall and floor seals for sleeved openings shall be Type CSMI as manufactured by the O.Z./Gedney Co. or equal.

13. Combination expansion-deflection fittings embedded in concrete shall be Type XD as manufactured by the Crouse-Hinds Co.; O.Z./Gedney Co.; Spring City Electrical Mfg. Co. or equal.

14. Combination expansion-deflection fittings installed exposed shall be Type XJ as manufactured by Crouse-Hinds Co.; O.Z. Gedney Co.; Spring City Electrical Mfg. Co. or equal.

15. Explosion proof fittings shall be as manufactured by the Crouse-Hinds Co.; Appleton Electric Co.; O.Z./Gedney Co. or equal.

16. Conduit sealing bushings shall be O.Z./Gedney, Type CSB or equal.

17. Elbows and couplings shall be aluminum.

18. Electrical metallic tubing fittings shall be of the steel, raintight, concrete-tight, insulated throat (connectors), compression type as manufactured by the Appleton Electric Co.; Crouse-Hinds Co. or equal.

H. Conduit Mounting Equipment

1. In dry indoor non-process areas, hangers, rods, backplates, beam clamps, channel, fasteners, anchors, nuts, washers, etc., shall be hot-dipped galvanized steel.

2. 316 Stainless steel channel with 316 stainless steel hardware (hangers, rods, backplates, beam clamps, fasteners, anchors, nuts, washers, etc.) shall be used in process areas, as shown on the drawings, in areas designated "WET", "DAMP" and "CORROSIVE" on the Drawings and in outdoor locations. All channel and hardware shall be resistant to the chemicals present in the area in which it is used.

3. Expansion anchors (minimum 3/8" diameter) shall be equal to Kwik-Bolt as manufactured by the McCullock Industries, Minneapolis, MI; Wej-it by Wej-it Expansion Products, Inc., Bloomfield, CO; or Kwik-Bolt II as manufactured by the Hilti Fastening Systems, Inc, Tulsa, OK. The length of expansion bolts shall be sufficient to place the wedge portion of the bolt a minimum of one in. behind the steel reinforcement. Apply anti-seize compound to all nuts and bolts. Supports installed without the approved compound shall be dismantled and correctly installed, at no cost to the District.

I. Wall and Floor Slab Opening Seals

1. Wall and floor slab openings shall be sealed with "FLAME-SAFE" as manufactured by the Thomas & Betts Corp.; Pro Set Systems; Neer Mfg. Co.; Specified Technologies, Inc. or equal.

J. Cold Galvanizing Compound

1. Cold galvanizing compound shall be 95% zinc rich paint as manufactured by ZRC Products Company, a Division of Norfolk Corp. or equal.

PART 3 EXECUTION

3.01 RACEWAY APPLICATIONS

A. Except where otherwise shown on the Drawings, or specified, all wiring shall be in rigid aluminum conduit.

B. Rigid aluminum conduit shall be used at all locations (underground and within structures) as raceways for shielded process instrumentation wiring, shielded control wiring, data highway wiring and I/O wiring.

C. Schedule 80 PVC conduit shall be used where shown on the Drawings and in chemical rooms, chlorinator rooms and chlorine storage areas or areas designated "CORROSIVE" on the Drawings.

D. Rigid aluminum conduit or Schedule 80 PVC shall be used underground where concrete encasement is not called for or as specified in Paragraph 3.01B above. Where schedule 80 PVC is used all elbows shall be rigid aluminum.

E. PVC conduit shall be used for concrete encased underground duct banks except as specified in Paragraph 3.01B above and except as specified in Section 16600.

F. Electrical metallic tubing and fittings may be used only in NEMA 1 administration and office areas. Electrical metallic tubing and fittings shall not be embedded in concrete, installed outdoors, in process areas, shops, maintenance areas, electrical rooms, etc.

G. All conduit of a given type shall be the product of one manufacturer.

3.02 BOX APPLICATIONS

A. Unless otherwise specified herein or shown on the Drawings, all boxes shall be metal.

B. Exposed switch, receptacle and lighting outlet boxes and condulet fittings shall be cast aluminum.

C. Concealed switch, receptacle and lighting outlet boxes shall be pressed steel. Welded seamed boxes will not be permitted.

D. Terminal boxes, junction boxes and pull boxes shall have NEMA ratings suitable for the location in which they are installed, as specified in Section 16000.

3.03 FITTINGS APPLICATIONS

A. Combination expansion-deflection fittings shall be used where conduits cross structure expansion joints. Refer to Structural Drawings for expansion joint locations. Provide bonding jumpers around fittings.

B. Conduit wall seals shall be used where underground conduits penetrate walls or at other locations shown on the Drawings.

C. Conduit sealing bushings shall be used to seal conduit ends exposed to the weather and at other locations shown on the Drawings.

3.04 INSTALLATION

A. No conduit smaller than 3/4 inch electrical trade size shall be used, nor shall any have more than the equivalent of three 90 degree bends in any one run. Pull boxes shall be provided as required or directed.

B. No wire shall be pulled until the conduit system is complete in all details; in the case of concealed work, until all rough plastering or masonry has been completed; in the case of exposed work, until the conduit system has been completed in every detail.

C. The ends of all conduits shall be tightly plugged to exclude dust and moisture during construction.

D. Conduit supports, other than for underground raceways, shall be spaced at intervals of eight ft or less, as required to obtain rigid construction.

E. Single conduits shall be supported by means of aluminum one-hole pipe clamps in combination with aluminum one-screw back plates, to raise conduits from the surface. Multiple runs of conduits shall be supported on trapeze type hangers with steel horizontal members and threaded hanger rods. The rods shall be not less than 3/8-in diameter. Surface mounted panel boxes, junction boxes, conduit, etc, shall be supported by spacers to provide a minimum of 1/2-in clearance between wall and equipment.

F. Conduit hangers shall be attached to structural steel by means of beam or channel clamps. Where attached to concrete surfaces, concrete expansion anchors shall be provided.

G. All conduits on exposed work, within partitions and above suspended ceilings, shall be run at right angles to and parallel with the surrounding wall and shall conform to the form of the ceiling. No diagonal runs will be allowed. Bends in parallel conduit runs shall be concentric. All conduit shall be run perfectly straight and true.

H. Conduit terminating in pressed steel boxes shall have double locknuts (aluminum) and insulated grounding bushings.

I. Conduit terminating in gasketed enclosures shall be terminated with Meyers grounding type conduit hubs.

J. Conduits containing equipment grounding conductors and terminating in sheet steel boxes shall have insulated throat grounding bushings with lay-in type lugs.

K. Conduits shall be installed using threaded fittings unless otherwise specified herein.

L. Liquidtight flexible metal conduit shall be used for all motor terminations, the primary and secondary of transformers, generator terminations and other equipment where vibration is present.

M. Flexible couplings shall be used in hazardous locations for all motor terminations and other equipment where vibration is present.

N. Aluminum fittings and boxes shall be used with aluminum conduit. Aluminum conduit shall not be imbedded in concrete containing chlorides, unwashed beach sand, sea water, or coral bearing aggregates. Aluminum conduit shall be isolated from other metals with heat shrink tubing (Raychem or equal) or plastic-coated hangers. Strap wrenches shall be used for tightening aluminum conduit. Pipe wrenches, channel locks, chain wrenches, pliers, etc. shall not be used.

O. All threads on aluminum conduit and fittings shall be cleaned and coated with ”No-Oxide” compound before installing.

P. Aluminum conduit installed in concrete or below grade shall be completely covered with two coats of bitumastic paint or with heat shrink tubing (Raychem or equal).

Q. Where conduits pass through openings in walls or floor slabs, the remaining openings shall be sealed against the passage of flame and smoke.

R. PVC conduit to non-metallic and metallic box connections shall be made with sealing rings, with a stainless steel retainer as manufactured by Thomas & Betts Co.

S. Conduit ends exposed to the weather shall be sealed with conduit sealing bushings.

T. Expansion fittings shall be used on exposed runs of PVC conduit where required for thermal expansion. Installation and number of fittings shall be as provided per the NEC and approved by the PVC conduit manufacturer.

U. All conduit entering or leaving a motor control center, switchboard or other multiple compartment enclosure shall be stubbed up into the bottom horizontal wireway or other manufacturer designated area, directly below the vertical section in which the conductors are to be terminated.

V. Spare conduits and conduit stubouts for future construction shall be provided with threaded PVC end caps at each end.

W. No unbroken run shall exceed 300 feet in length. This length shall be reduced by 75 feet for each 90 degree elbow.

X. Aluminum conduit entering manholes and below grade pull boxes shall be terminated with grounding type bushings and connected to a 3/4" x 10' rod with a #6 bare copper wire.

Y. Underground circuits shall be installed directly to the respective motor control centers, lighting panels, etc., except stainless steel pull boxes shall be wall mounted on structures to eliminate excessive bends. With prior written approval, below grade pull boxes may be used. Splices shall not be made in above or below grade pull boxes unless otherwise indicated on the plans and approved in writing by the Engineer.

Z. All conduits shall have a 4-inch concrete housekeeping pad at all slab and grade penetrations. The housekeeping pad shall have 45 degree, 3/4-inch chamfer at all exposed edges.

AA. All risers from underground, concrete pads, floors, etc. shall be provided with heat shrink tubing (Raychem Co. or equal) from a point one foot-0-inch below bottom of slab or grade to a point not less than six inches above grade or surface of slab.

BB. Existing conduits are to be reused only where specifically noted on the drawings. Mandrels shall be pulled through all existing conduits which will be reused and through all new conduits two-in. in diameter and larger prior to installing conductors.

CC. 3/16-in polypropylene pull lines shall be installed in all new conduits noted as spares or designated for future equipment.

DD. Where no size is indicated for junction boxes, pull boxes or terminal cabinets, they shall be sized in accordance with the requirements of NEC Article 314.

EE. Conduits shall not cross pipe shafts, access hatches or vent duct openings. They shall be routed to avoid such present or future openings in floor or ceiling construction.

FF. The use of running threads is prohibited. Where such threads are necessary, a three-piece cast aluminum union shall be used.

GG. Conduits passing from heated to unheated spaces, exterior spaces, refrigerated spaces, cold air plenums, etc, shall be sealed with "Duxseal" as manufactured by Manville or seal fitting to prevent the accumulation of condensation.

HH. All field cut ends of hot dipped galvanized mounting channel shall be cleaned and painted with cold galvanizing compound before installation.

II. All underground control and instrumentation conduits shall be separated from power conduits by a minimum of 12 inches unless specifically noted otherwise. Crossing of control and instrumentation conduits with power conduits shall be kept to a minimum and where they must cross they shall cross at 90-degree angles.

END OF SECTION

SECTION 16120
WIRES AND CABLES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish, install and test all wire, cable and appurtenances as shown on the Drawings and as specified herein.

B. Install data highway, fiberoptic, coaxial and I/O cables furnished under Division 13.

1.02 SUBMITTALS

A. Submit to the Engineer, in accordance with Section 01300, samples of proposed wire. Each sample shall have the size, type of insulation and voltage stenciled on the jacket.

B. Approved samples will be sent to the project location for comparison by the Resident Engineer with the wire actually installed.

C. Installed unapproved wire shall be removed and replaced at no additional cost to the District.

1.03 DELIVERY, STORAGE AND HANDLING

A. Carefully handle all conductors to avoid kinks and damage to insulation.

PART 2 PRODUCTS

2.01 GENERAL

A. Wires and cables shall be of annealed, 98 percent conductivity, soft drawn copper.

B. All conductors shall be stranded, except that lighting and receptacle wiring may be solid.

C. Except for control, signal and instrumentation circuits, wire smaller than No. 12 AWG shall not be used.

D. All wire of a given type shall be the product of a single manufacturer.

2.02 MATERIALS

A. 600 Volt or Less Wire and Cable

1. Wire for lighting, receptacles, and other circuits not exceeding 150 volts to ground shall be NEC type XHHW-2. Below grade and underground the wire shall be type XHHW-2.

2. Wire for circuits over 150 volts to ground shall be NEC type XHHW-2 for sizes 4/0 AWG and smaller, and shall be NEC type RHW-2 for sizes 250 MCM (kcmil) and larger.

3. Wire for control circuits shall be #14 AWG minimum NEC type XHHW-2 stranded.

4. Equipment grounding conductors shall be installed in all raceways. Equipment grounding conductors shall be the same NEC type as the phase conductor, green and sized per NEC Table 250.122. Ground grid conductors shall be uninsulated unless shown otherwise on the Drawings.

5. Types XHHW-2 and RHW-2 wire shall be as manufactured by the Southwire Co., Pirelli Cable Corp., Okonite Co., or equal.

6. Multi-conductor control cable shall be stranded, #14 AWG, 600 V, cross-linked polyethylene insulated w/PVC jacket. Type "XLP" as manufactured by the Southwire Co., American Insulated Wire Corp., or equal.

2.03 INSTRUMENTATION WIRE

A. Process instrumentation wire shall be twisted pair, 600 V, cross linked polyethylene insulated, aluminum tape shielded, polyvinyl chloride jacketed type "XLP" as manufactured by the Rockbestos Co., or equal.

B. Cable for 4-20 mA instrumentation, potentiometer, RTD and similar analog circuits shall be multi-conductor twisted and shielded.

1. Single pair cable:

   a. Conductors: Two No. 16 AWG stranded and twisted
   b. Insulation: XLP
   c. Shield: 100 percent tape with drain wire
   d. Jacket: PVC with UL and manufacturers identification

2. Three conductor (triad) cable:

   a. Conductors: Three No. 16 AWG stranded and twisted
   b. Insulation: XLP
   c. Shield: 100 percent tape with drain wire
   d. Jacket: PVC with UL and manufacturers identification

3. Multiple pair cables (where shown on the Drawings):

   a. Conductor: Multiple Two No. 16 AWG stranded and twisted
   b. Insulation: XLP
   c. Shield: Individual pairs and overall shielded with 100 percent tape and drain wire
   d. Jacket: PVC with UL manufacturers identification

2.04 TERMINATIONS AND SPLICES (POWER CONDUCTORS)

A. Unless otherwise indicated on the plans, no splices may be made in the cables without prior written approval of the Engineer. Where splicing is approved, then splicing material shall be approved by the Engineer and cable manufacturer. Splicing materials for all 600 volt splices shall be made with long barrel tin plated copper compression (hydraulically pressed) connectors and insulated with heavy wall heat shrinkable tubing. The conductivity of all completed connections shall be not less than that of the uncut conductor. The insulation

resistance of all completed connections of insulated conductors shall be not less than that of the uncut conductor.

B. 600 volt wire lugs shall be tin plated copper, long barrel compression type (hydraulically pressed) for wire sizes No. 8 AWG and larger. Lugs for No. 10 AWG and smaller wire shall be locking spade type with insulated sleeve. Lugs shall be as manufactured by the Thomas and Betts Co., or equal.

2.05 TERMINATION AND SPLICES (CONTROL CONDUCTORS)

A. Unless otherwise indicated on the plans, no splices may be made in the cables without prior written approval of the Engineer. Where splicing is approved, then splicing material shall be approved by the Engineer and cable manufacturer. Splicing materials and installation shall be as required by the Engineer. The conductivity of all completed connections shall be not less than that of the uncut conductor. The insulation resistance of all completed connections of insulated conductors shall be not less than that of the uncut conductor.

B. Termination connectors shall be of the expanded vinyl insulated locking fork-end (upturned leg ends) type as manufactured by Ideal Industries; 3M Co.; Panduit Corp. or equal.

2.06 TERMINATIONS (INSTRUMENTATION CABLES)

A. Termination connectors shall be of the expanded vinyl insulated locking fork-end (upturned leg ends) type as manufactured by 3M Co.; Panduit Corp. or equal.

2.07 MOTOR CONNECTIONS

A. For wire sizes #8 AWG and larger, long barrel tin plated copper compression (hydraulically pressed) type connections (Burndy Co., or equal) shall be installed on the branch circuit wires and the motor leads. Bolted connections shall utilize products which are rated for vibration applications (bolt, nut and spring washer). All connections shall be insulated with heavy duty heat shrinkable material (Raychem Corp. or equal).

2.08 WIRE AND CABLE MARKERS

A. Wire and cable markers shall be type written, heat shrinkable type as manufactured by the W.H. Brady Co., Thomas & Betts Co., 3M Co., or equal.

B. Wire and cables with diameters exceeding the capacity of the heat shrinkable markers shall be marked with pre-printed, self-adhesive vinyl tapes as manufactured by the W.H. Brady Co., Panduit Corp., or equal.

2.09 WALL AND FLOOR SLAB OPENING SEALS

A. Wall and floor slab openings shall be sealed with "FLAME-SAFE" as manufactured by the Thomas & Betts Corp. or equal.

PART 3 EXECUTION

3.01 INSTALLATION

A. Uniquely identify all wires, cables and each conductor of multi-conductor cables (except lighting and receptacle wiring) at each end with wire and cable markers.

B. Use lubrications to facilitate wire pulling. Pulling compound shall be nontoxic, nonflammable, noncombustible and noncorrosive. The material shall be UL listed and compatible with the cable insulation and jacket.

C. All wire and cable shall be continuous and without splices between points of connection to equipment terminals, except a splice will be permitted by the Engineer if the length required between the points of connection exceeds the greatest standard shipping length available from the manufacturer specified or approved by the Engineer as the manufacturer of the particular item or wire and cable.

D. Seal openings in slabs and walls through which wires and cables pass.

E. Steel fish tapes and/or steel pulling cables shall not be used in PVC conduit runs.

F. Pull cable from direction that requires the least tension.

G. Feed cable into raceway with zero tension and without cable crossover at raceway entrance.

H. Use a feed-in tube and sheave designed for cable installation. Use sheaves with radii that exceed the cable manufacturer's recommended minimum bending radius.

I. Use a dynamometer and constant velocity power pulling. Velocity should not be less than 15-ft./min or more than 50-ft/min. Do not exceed the cable manufacturer's maximum recommended tension.

J. If cable cannot be terminated immediately after installation install heat shrinkable end caps.

K. Fireproof exposed cables in manholes, vaults, pullboxes, switchgear and other areas not protected by conduit where medium voltage cables are present. Use fire-proofing tape and glass tape in accordance with the manufacturer's instructions. Fire-proofing tape shall be with one half-lapped layer of Scotch Brand 77 Electric Arc and Fireproofing Tape by 3M Corp. or equal. Tape shall be secured with a two-layer band of Scotch Brand 69 Glass Electrical Tape by 3M Corp. or equal over the last wrap.

L. Uniquely identify all cable at supply and receiving ends and in all manholes, handholes or pullboxes. Use embossed brass tags and tywrap fasteners.

M. Hydraulically or manually operated cable benders shall not be used unless approved in writing by the Engineer.

N. Instrumentation cables shall be installed in rigid steel conduits as specified. All circuits shall be installed as twisted pairs or triads. In no case shall a circuit be made up using conductors from different pairs or triads. Triads shall be used wherever three wire circuits are required.

O. Install shielded instrumentation wire from terminal to terminal with no splicing at any intermediate point. Shielded instrumentation wire, coaxial, data highway, I/O and fiberoptic cables shall be run without splices between instruments, terminal boxes, or panels.

P. Terminal blocks shall be provided at all instrument cable junctions, and all circuits shall be identified at such junctions.

Q. Ground shielding on instrumentation wire at one end only as recommended by the instrument manufacturer and isolated at all other locations. Terminal blocks shall be provided for inter-connecting shield drain wires at all junction boxes. Where individual circuit shielding is required, each shield circuit shall be provided with its own terminal block.

R. Install shielded instrumentation wire in conduit and pull boxes that contain only shielded instrumentation wire. Instrumentation cables shall be separated from all other (i.e. power, control, etc.) cables in manholes.

S. All shielded cable terminations at each end shall be provided with heat shrinkable tubing placed over the exposed shield and conductors. The tubing shall extend one-in. minimum over the jacket end and extend ½" minimum from the jacket end over the exposed conductors.

3.02 WIRE COLOR CODE

A. All wire shall be color coded or coded using electrical tape in sizes where colored insulation is not available. Where tape is used as the identification system, it shall be applied in all junction boxes, manholes and other accessible intermediate locations as well as at each termination.

B. The following coding shall be used:

System	Wire	Color
240/120 Volts	Neutral	White
Single-Phase, 3 Wire	Line 1	Black
	Line 2	Red
208Y/120, Volts	Neutral	White
3 Phase, 4 Wire	Phase A	Black
	Phase B	Red
	Phase C	Blue
240/120 Volts	Neutral	White
3 Phase, 4 Wire	Phase A	Black
delta, center tap	Phase B (High)	Orange
ground on phase	Phase C	Blue
coil A-C		

480Y/277 Volts 3 Phase, 4 Wire	Neutral Phase A Phase B Phase C	White Brown Orange Yellow
Control (Individual Conductors)	AC DC	Red Blue

3.03 FIELD TESTING

A. Test all 600 volt wire insulation with a megohm meter after installation and prior to termination. Make tests at not less than 1000 volts DC. Submit a written test report of the results to the Engineer. Notify Engineer in writing 48 hours prior to testing.

B. Field testing and commissioning shall be done in accordance with the latest revision of the "Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems" published by the InterNational Electrical Testing Association (NETA Standard ATS) unless otherwise modified by this Section. Minimum wire insulation resistance shall not be less than 250 Megohms.

C. All service conductors shall be tested as in paragraph A above with the Engineer present.

END OF SECTION

SECTION 16191
MISCELLANEOUS EQUIPMENT

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish and install all miscellaneous equipment as shown on the Drawings and as specified herein.

1.02 EQUIPMENT LIST

A. This Section provides the requirements for miscellaneous equipment typically employed in a facility, however, not all components specified in this Section are necessarily utilized on this project.

1.03 SUBMITTALS

A. Submit, in accordance with Section 01300, detailed catalog information or drawings describing electrical and physical characteristics of all equipment specified in sufficient detail to show compliance with the Drawings and Specifications.

1.04 REFERENCE STANDARDS

A. Equipment enclosures shall have NEMA ratings suitable for the location in which they are installed, as specified in Section 16000.

PART 2 PRODUCTS

2.01 MATERIALS

A. Disconnect Switches

1. Disconnect switches shall be heavy-duty, quick-make, quick-break, visible blades, 600 Volt, 3 Pole with full cover interlock, interlock defeat and flange mounted operating handle. All current carrying parts shall be copper

2. NEMA 4X enclosures shall be stainless steel.

3. Switches shall be as manufactured by the Square D Co.; General Electric; Eaton, or equal.

B. Combination Magnetic Motor Starters

1. Motor starters shall be a combination motor circuit protector and contactor, 2 or 3 Pole, single or 3 Phase as required, 60 Hz, 600 Volt, magnetically operated, full voltage non-reversing unless otherwise shown on the Drawings. NEMA sizes shall be as required for the horsepowers shown on the Drawings. Minimum size shall be NEMA size 1. Motor circuit protectors (MCP) shall be molded case with adjustable magnetic trip only. They shall be specifically designed for use with magnetic motor starters. Motor circuit protectors shall be current limiting type, with additional current limiters if required. Combination motor starters shall be fully rated for 65,000 Amps RMS symmetrical.

2. Each motor starter shall have a 120 Volt operating coil and control power transformer. Transformer primaries and secondaries shall be equipped with time-delay fuses. Three phase starters shall have three overload relays. One normally open and one normally closed auxiliary contact shall be provided as spares in addition to contacts shown on the Drawings.

3. Overload relays shall be adjustable, ambient compensated and manually reset.

4. Furnish built-in control stations and indicating lights where shown on the Drawings.

5. NEMA 4X enclosures shall be stainless steel.

6. Combination magnetic motor starters shall be as manufactured by the Square D Co.; General Electric; Eaton, or equal.

C. Control Stations

1. Control stations shall be heavy-duty type, with full size (30mm) operators. Stop buttons shall have a lockout latch that can be padlocked in the open position.

2. NEMA 4X enclosures shall be stainless steel.

3. Control stations shall be Square D Class 9001, similar by Eaton; General Electric Co., or equal.

D. General Purpose Dry Type Transformers

1. Transformers shall be dry type, two-winding with kVA and voltage ratings as shown on the Drawings. Transformer shall incorporate a 220 degree C insulation system and be designed not to exceed 80 degrees C temperature rise above a 40 degree C ambient full load

2. Four full capacity taps shall be furnished, two 2-1/2 percent above and two 2-1/2 percent below rated primary voltage.

3. Windings shall be copper.

4. Transformers shall be built in accordance with ANSI C89.2 and shall be UL.

5. Transformers shall be energy efficient type, meeting the efficiency levels specified in NEMA Standard TP1. Efficiency shall be tested in accordance with TP1.

6. Transformers shall be furnished in NEMA 2 enclosures unless otherwise noted on the Drawings or as required by Section 16000. Areas where a NEMA 4X and/or stainless steel enclosure is required, the transformer shall be of the TENV type.

7. Transformers shall be furnished with hot-dipped galvanized mounting hardware. In NEMA 4X areas or where stainless steel enclosures are required, hardware shall be Type 316 stainless steel.

8. Transformers shall have common core construction with low hysteresis and eddy current losses. The core flux density shall be below the saturation point to prevent overheating caused by harmonic distortion.

9. Transformer impedance shall be a minimum of three percent and a maximum of five percent.

10. Provide vibration isolators for transformers rated 112.5 kVA and higher.

11. Provide ground lug on frame and strap ground core assembly to frame of enclosure.

12. Transformers shall be manufactured by Square D Co.; General Electric Co.; Eaton, or equal.

E. Transformer-Panel Assembly

1. Each Transformer-Panel Assembly (TPA) shall include a main primary breaker, a dry-type transformer and a secondary panelboard with main breaker.

2. Enclosures shall be type NEMA 1 enclosures unless otherwise noted on the Drawings or as required by Section 16000. Main primary, secondary, and feeder breakers shall be enclosed with a padlockable hinged door. Where NEMA 3RX stainless steel enclosure is required, the hardware shall be 316 stainless steel.

3. Transformers shall be dry type, two winding with kVA and voltage ratings as shown on the Drawings.

4. Transformer windings shall be copper, 115 degree C rise, epoxy-resin encapsulated with two full capacity taps rated 5 percent below rated primary voltage.

5. Interconnecting wiring between the primary breaker and transformer, transformer and secondary main breaker, and secondary main breaker and distribution section shall be factory installed.

6. Panelboard bus shall be copper.

7. TPA main primary breaker shall have a minimum interrupting rating of 18 kA at 480 volts and shall be sized per manufacturer’s standard for the kVA size.

8. TPA secondary main breaker shall have a minimum interrupting rating of 10 kA at 240 volts and shall be sized per manufacturer’s standard for the kVA size.

9. TPA feeder breakers shall be bolt-on type with a minimum interrupting rating of 10 kA.

10. Panelboard section shall include copper equipment ground bar.

11. TPA shall be Mini Power-Zone as manufactured by Schneider Electric/Square D, Mini-Power Center as manufactured by Eaton, Servicenter as manufactured by ABB/General Electric, or Sentron Power Center as manufactured by Siemens.

F. Detectable Warning Tape

1. Each ductbank section shall be marked by means of a detectable warning tape (tracer tape) as shown on the Drawings. The detectable warning tape shall be capable of being detected or located by either conductive or inductive location techniques.

2. The detectable warning tape shall consist of five mil (.005-in) overall thickness; five-ply composition; ultra-high molecular weight; virgin polyethylene; acid; alkaline and corrosion resistant; with 150 pounds of tensile break strength minimum per six-in. width.

3. The top side of the tracer tape shall be color banded red for electrical and high voltage lines, and orange for signal, communication, telephone and fire alarm lines. Tracer tape shall be four-in. wide with four color bands. The tape shall be inscribed with the warning message for the utility such as "CAUTION – ELECTRICAL LINED BURIED BELOW". Tape shall be as manufactured by Mutual Industries, Inc.; Terra Tape, Div. of Reef Industries Inc., or equal.

G. Terminal Blocks

1. Terminal blocks shall be NEMA type rated at 20 amperes minimum, 600 Volt, channel mounted, with tubular screw and pressure plate.

2. Terminal blocks shall be Bulletin 1492 as manufactured by the Allen-Bradley Co.; ABB; Kukla, or equal.

H. Break-Glass Emergency Station

1. Break-Glass Emergency Station shall be of the break glass design with a cast metal outer case finished in fire red and have an attached chain hung "Hammer". A weatherproof glass panel shall be mounted in front of the push button operator. Switch contacts shall be 1-open, 1-closed, rated 10 Amp, 600 Volts.

I. Equipment Mounting Stands

1. Equipment mounting stands shall be custom fabricated from 1/4-in steel plate and 4-in steel channel, as shown on the Drawings. For NEMA 4X areas or where stainless steel enclosures are required mounting stands and channels shall be Type 316 stainless steel.

J. Rubber Floor Mats

1. Furnish and install a non-conductive elastomer compound rubber floor mat extending the full length and placed in front of and in back of each switchboard, transformer, and variable frequency drive.

2. Mats shall be in accordance with ASTM D178, Type II, Class 2, 1/4-in thick minimum, 36-in wide with corrugated surface and shall be branded continuously on the back.

3. Mats shall have the following ratings:

   a. Voltage phase to phase 17,000 V RMS
   b. AC Proof Test Voltage 20,000 V RMS
   c. DC Proof Test Voltage 50,000 V Average

4. Type II mats shall be ozone, flame and oil resistant.

5. Install mats in one continuous piece. Where equipment faces each other and is less than six-ft apart, provide one width of mat.

6. Mats shall be stored without distortion, free from direct sun light or sources of ozone and at a temperature not to exceed 95 degrees F (35 degrees C).

K. Arc Flash Protection Warning Signs

1. Provide field-affixed arc flash warning labels on all switchboards, panelboards, industrial control panels, and motor control centers in accordance with National Electrical Code Article 110.16.

2. As a minimum, warning signs shall state "WARNING: Arc Flash and Shock Hazard, Appropriate PPE required", and shall be designed in accordance with ANSI Z535.4-1998. Where available from the equipment manufacturer, additional information including Flash Hazard boundary, incident energy, voltage shock hazard, PPE required, etc. shall be provided.

L. Electric Warning Sign

1. Provide and install using stainless steel fasteners a total of two restrictive signs that conform with OSHA regulations for accident prevention. Size of sign: 10-in high by 14-in wide. Sign shall state "DANGER HIGH VOLTAGE". Sign shall be constructed of High Performance Plastic (HPP) by the Seton Name Plate Corp.; Global Equipment Co.; World-wide Sign Co., or equal.

M. Terminal Cabinets

1. Interiors shall be so designed that control relays and terminal blocks can be replaced or added without disturbing adjacent units. Each cabinet shall be furnished with a minimum of 50 spare terminals.

2. All interiors shall be completely factory assembled with control relays, terminal blocks, insulating barriers, etc. All 120-volt AC and DC terminal blocks shall be isolated from each other by insulating barriers or separate enclosures.

3. All wiring within the cabinets shall be grouped together in harnesses and secured to the structure.

4. All shielded cables shall terminate in separate cabinets. A third terminal shall be provided for each twisted shielded pair and the shield for each connected thereto, unless otherwise noted on manufacturer's shop drawings.

5. Terminal blocks shall be tubular screw type with pressure plates and shall be rated 600 volts. Terminal blocks shall be Allen Bradley Catalog Number 1492-CA1 or equal.

6. Boxes shall be made from 14-gauge galvanized steel and shall be of sufficient size to provide a minimum of four inches of wiring space on all sides and between adjacent terminal blocks. A minimum two-inch spare shall be provided between control relays. A minimum of four mounting studs shall be provided on each cabinet. Cabinets shall be furnished without knockouts. Holes for raceways shall be drilled on the job.

7. A single or double hinged door shall cover the front of each terminal cabinet. Doors shall have a neoprene gasket, vault type handle, three-point catch and lock. Two keys shall be supplied for each lock. All locks shall be keyed alike. A terminal block schedule shall be provided with each terminal point numbered and identified (typewritten) as to function.

8. All exterior and interior steel surfaces of the cabinets shall be properly cleaned and finished with ANSI 61 grey over a rust-inhibiting phosphatized coating conforming to ANSI A55.1. The finish paint shall be of a type to which field applied paint will adhere.

9. Cabinets in wet, damp, corrosive and all outdoor locations shall be NEMA 4X 316 stainless steel.

10. Cabinets shall be Schaefer with latch kit hardware, or equal.

2.02 CONTROL SYSTEM

A. The Manufacturer shall provide a complete and fully functional control system to manually or automatically operate the control system as specified herein and in other applicable sections of these specifications. All Manufacturers recommended safety devices shall be furnished to protect operators. All control devices, unless specified otherwise, shall be mounted in the Control Panel.

B. Control Panel Construction

1. The control panel shall consist of a main circuit breaker, a motor circuit protector (MCP) and magnetic starter for each motor, and a 120-volt control power transformer (fused on primary and secondary). All control components shall be mounted in one common enclosure. Control switches shall provide means to operate each motor manually or automatically.

2. Unless specifically noted otherwise, the electrical control equipment shall be mounted within a NEMA 4X enclosure, constructed of not less than 14 gauge 316 stainless steel. Latches shall be quarter turn quick release type and all hardware shall be 316 stainless steel. Where NEMA 3R or 12 enclosures are specifically required, the door shall be provided with a pad-lockable vault type three-point latch. The enclosure shall be equipped with a door and shall incorporate a removable back panel on which control components shall be mounted. Back panel shall be secured to enclosure with collar studs. Door(s) shall be interlocked with main circuit breaker and provided with pad-locking provision.

3. All motor branch circuit breakers, motor starters and control relays shall be of highest industrial quality, securely fastened to the removable back panels with screws and lock

washers. Back panels shall be tapped to accept all mounting screws. Self-tapping screws shall not be used to mount any component.

4. A thermal-magnetic air circuit breaker, Type FH (65KAIC) as manufactured by the Square D Company, or equal, shall be furnished for the main breaker. All circuit breakers shall be sealed by the manufacturer after calibration to prevent tampering. Each circuit breaker shall be adequately sized to meet the equipment operating conditions. Motor Circuit Protectors (MCP) shall be molded case with adjustable magnetic trip only, "Mag-Gard" as manufactured by the Square D or equal.

5. An open frame, across-the-line, NEMA-rated magnetic motor/starter, Class 8536 as manufactured by the Square D Company, or equal, shall be furnished for each motor. All motor starters shall be provided with motor circuit protectors and equipped to provide under-voltage release and overload protection on all three phases. Motor starter contacts shall be easily replaceable without removing the motor starter from its mounted position. Overloads shall be of the melting alloy or bi-metallic type, adjustable overloads are not acceptable, Class 10 quick trip overloads shall be provided for all submersible motors. Overload reset push-buttons shall be located on the exterior of the door. Normally open and normally closed auxiliary motor overload contacts wired to terminal blocks shall be provided for each motor starter within the control panel

6. Auxiliary contacts shall be provided for remote run indication and indication of each status and alarm condition. Additional controls shall be provided as specified herein and as required by Divisions 13, 16 and as shown on the drawings.

7. All operating control and instruments shall be securely mounted on the exterior door. All controls and instruments shall be clearly labeled to indicate function. All exterior mounted equipment shall be NEMA 4X.

8. Mode selector switches shall be Hand-Off-Auto type to permit override of automatic control and manual actuation of shutdown. Switches shall be NEMA 4X (800H) as manufactured by Allen-Bradley, or equal, providing three switch positions, each of which shall be clearly labeled according to function.

9. Indicator lamps shall be LED (indoors) or Incandescent (outdoors) full voltage type and mounted in NEMA 4X (800H) modules, as manufactured by Allen-Bradley. Lamp modules shall be equipped to operate at 120-volt input. Lamps shall be easily replaceable from the front of the control compartment door without removing lamp module from its mounted position. Indicators shall be provided for individual motor run and an indicator for each failure condition.

10. A six digit, non-reset elapsed time meter shall be connected to each motor starter to indicate the total running time of each motor in "hours" and "tenth of hours". The elapsed time meters shall be Series T50 as manufactured by the ENM Company or equal.

11. A failure alarm with horn and beacon light shall be provided. Silence and reset pushbuttons shall also be furnished. A common failure reset pushbutton shall be provided to reset the alarm conditions (reset shall occur only if fault condition has been cleared). The alarm horn shall be weatherproof rated with gasket (Federal Signal Corporation, Cat. #350 or equal). The alarm beacon shall be NEMA 4X rated, red lens and solid-state flasher (Ingam Products Inc. LRX-40).

12. The control panel shall operate on a power supply of 480 volts, 3-phase, 60 Hertz unless otherwise noted.

13. The control diagrams and overload tables shall be laminated to the inside of the door except where door space is limited the laminated documents shall be in the print storage pocket.

14. Print storage pockets shall be provided on the inside of each panel. Pocket shall be of sufficient size as required to hold all prints necessary to service the equipment. A set of reduced drawings shall be provided for each panel, fixed to fit in the storage pocket.

15. A duplex GFCI utility receptacle (circuit breaker protected) providing 120 volts, 60 Hertz, single phase current shall be mounted on the side of the enclosure.

16. The control panel shall include an adjustable time delay relay to prevent any two motors from starting simultaneously. All timing relays shall be solid state, with pin (octal) and bases, relays shall be T-series as manufactured by Diversified Electronics Inc. or equal.

17. Alternators shall be provided to sequence motors, alternators shall be 008-120-13SP or 009-120-23AP as manufactured by Sta-con, or equal.

18. A phase monitor shall be provided for the control panel, monitors shall be model SUA-440-ASA as manufactured by Diversified Electronics Inc., or equal.

19. All exterior mounted equipment shall be rated NEMA 4X. Hinged NEMA 4X 316 stainless steel viewing windows will be permitted where such equipment is not available with a NEMA 4X rating.

20. The control panel shall be provided with surge protection device (SPD). The SPD shall be mounted within the control panel enclosure. Lead lengths shall not be longer than 12 inches from the main circuit breaker and as straight as possible. The SPD shall have a minimum surge current rating of 200kA per phase. Refer to Section 16192 for additional requirements.

21. All control panel wiring shall be numbered at both ends with type written heat shrinkable wire markers.

22. Wiring shall be stranded copper, minimum size #14 AWG (except for shielded instrumentation cable), with 600 volt, 90 degree C, flame retardant, Type MTW thermoplastic insulation.

23. The control panel shall be provided with nameplates identifying each component, selector switches, pilot lights, etc. Nameplates shall be permanently affixed using an epoxy process (inner door nameplates shall be fastened with stainless steel screws). Nameplates shall be laminated plastic, engraved white letters with a black background.

24. All control panels shall be provided with a master nameplate located on the exterior door.

25. Where applicable provide a nameplate which reads as follows "CAUTION - THIS PANEL CONTAINS A VOLTAGE FROM AN EXTERNAL SOURCE." Letters shall be black on a high visibility yellow background.

26. Corrosion Inhibitor Emitter: Inclusion of an industrial corrosion inhibitor emitter that shall protect internal components of control panel from corrosion for up to one year. One spare emitter shall be provided for each control panel.

27. All control relays shall have 10 amp rated contacts (minimum), 11 pin with mounting base, 3PDT (minimum), with LED indicators to show relay status, relays shall be manufactured by Potter Brumfield or equal.

28. Terminal blocks shall be 600 volt heavy duty rated, tubular clamp type. Terminal strips shall be Allen Bradley catalog #1492-CA-1 or equal. Each terminal shall be individually labeled.

29. The completed control panel assembly shall be U.L. certified. The minimum overall short-circuit withstand rating of the control panel and devices shall be 65,000 Amperes RMS symmetrical at 480 volts.

30. Intrinsically safe relays shall be solid state type with five Amp output contacts, suitable for use on 120 volt, 60 hertz power supply and shall be Factory Mutual approved for devices in Class 1, Division 1 hazardous atmospheres. Intrinsically safe relays shall be Gems Solid State Safe-Pak as manufactured by Gems Sensors, Division of Transamerica Delaval, Inc. or equal.

31. All electronic control equipment (i.e. controllers, isolators, signal boosters, transmitters, PLC's, etc.) shall be as specified in Division 13.

32. A copper ground bar with sufficient terminals for all field and panel ground connections shall be provided.

33. All signal wiring entering and exiting the control panel shall be provided with surge protection. Surge protection shall be as specified in Division 13.

34. An eight-inch (minimum) clear space within the enclosure shall be provided horizontally along the entire top and bottom of the control panel. A four-inch (minimum) clear space within the enclosure shall be provided vertically along the entire sides of the control panel. No devices, terminals, etc. shall be installed within this space, the space shall be provided for field conduit and wiring access only.

35. Incoming phase conductor terminals shall be clearly identified. All wiring within the control panel shall be color coded or coded using electrical tape in sizes where colored insulation is not available. The following coding shall be used.

System	Wire	Color
Incoming line voltage	Phase conductors	Black
	Ground	Green
	Neutral (As Required)	White
Less than line voltage (individual conductors)	AC	Red
	24VDC	Blue
	0VDC	White/Blue Stripes
	Foreign	Yellow

C. Spare Parts

1. The following number of spare parts shall be furnished for each control panel.

a. One Indicator light assembly.
b. Two control relays for each type furnished.
c. Five fuses for each type/size furnished.
d. One set thermal overloads for each size furnished.
e. One selector switch for each type furnished.
f. One starter coil for each size furnished.

PART 3 EXECUTION

3.01 INSTALLATION

A. Mounting Stands

1. Field mounted disconnects, pushbutton control stations, alarm panels, enclosed starters and circuit breakers, transformers, automatic transfer switches, wireways, contactors, terminal boxes, junction and pull boxes shall be mounted on galvanized or stainless steel stands as specified. Where clearance requirements for stands may not be maintained, the Engineer may direct electric control equipment to be wall-mounted adjacent to the driven equipment, but in no case shall the distance from the drive motor to the control station exceed three ft, all at no additional cost to the District.

2. All floor mounting stands, bracing, anchor bolts and appurtenances furnished to support equipment loads, dynamic loads, wind loads shall conform to the latest applicable requirements of the Florida Building Code in effect at the time of Bid. Refer to Structural Drawing S-1 for the wind design requirements.

3. All wall mounted brackets, bracing, bolts and appurtenances to support equipment loads dynamic loads, wind loads and seismic forces shall conform to the latest applicable requirements of the Florida Building Code in effect at the time of Bid. Refer to Structural Drawing S-1 for the wind design requirements.

4. Channel supports shall be ground smooth and fitted with plastic end caps.

B. All panelboards located in pedestal cabinets or outdoors and panelboards that have branch circuits feeding exterior to the building shall be equipped with lightning arresters and surge capacitors.

3.02 FIELD TESTING

A. Before supplying power to the alarm panels, the following tests shall be done: Verify that all wiring connection interfaces that are required are present. Check for secure connections. Using a continuity device, verify that all discrete inputs and output to and from the control panel are wired in correct polarity and are operating in the correct state of operation (normally open or closed state). Check for any direct short circuits across all voltage supply sources. As each of the above tests are performed, the Electrical Contractor shall highlight and initial each circuit that is tested. This set of prints shall be signed and left inside the enclosure.

B. Check mechanical interlocks for intended operation. Make any adjustments required.

C. In the event of an equipment fault in the panel, notify the Engineer immediately. After the cause of the fault has been identified and corrected, a joint inspection of the equipment shall be conducted by the Contractor and Engineer. Repair or replace the equipment as directed by the Engineer prior to placing the equipment back into service at no additional cost to the District.

END OF SECTION

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SECTION 16192
SURGE PROTECTIVE DEVICES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish and install all surge protective devices (SPDs), formerly referred to as transient voltage surge suppressors (TVSSs), for power systems as shown on the Drawings and as specified herein.

1.02 RELATED WORK

A. Refer to Division 13 for SPDs for instruments, telecommunication systems, antenna systems, or computer systems.

1.03 SUBMITTALS

A. Submit to the Engineer, in accordance with Section 01300, the following:

1. Detailed catalog information with sufficient detail to determine compliance with the specifications including the electrical and physical characteristics.

    a. Minimum electrical ratings shall include operating voltage, voltage protection rating (VPR), frequency and phasing.
    b. Minimum performance ratings for Type 1 and Type 2 SPDs shall include nominal discharge current *(I_n)* rating, maximum continuous operating voltage (MCOV), and short circuit current rating (SCCR).
    c. UL 1449, Fifth Edition (minimum) listing compliance certification.

2. Warranty statement.

1.04 REFERENCE STANDARDS

A. The materials and installation shall comply with the codes and standards of the following organizations:

1. American National Standards Institute (ANSI)

2. Institute of Electrical and Electronic Engineers (IEEE)

3. National Electrical Manufacturers Association (NEMA)

4. National Fire Protection Association (NFPA)

5. Underwriters Laboratories (UL)

B. Specific codes and standards that apply include the following:

1. ANSI/IEEE C62.41 – Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits

2. ANSI/IEEE C62.45 – Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits

3. NFPA 70 – National Electrical Code, Article 285

4. NFPA 780 – Standard for the Installation of Lightning Protection Systems

5. UL 1283 – Electromagnetic Interference Filters

6. UL 1449 – Surge Protective Devices

C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 WARRANTY

A. All SPD panel units shall be guaranteed by the installing contractor and surge suppression manufacturer to be free of defects in materials and workmanship for a period of not less than 10 years from the date of substantial completion of the system to which the suppressor is installed.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance, the following manufacturers are acceptable:

1. Advanced Protection Technologies

2. Current Technology

3. Surge Suppression Inc.

4. Joslyn (Total Protection Solutions)

5. Eaton/Cutler-Hammer

6. Square D

7. LEA International

2.02 PRODUCTS

A. The SPD supplied shall be selected to match the voltage, phasing, and frequency of the power system.

B. The SCCR rating of the SPD shall have at least the same rating of the electrical equipment being protected.

C. The SPD enclosure shall be rated NEMA 12 for indoor dry locations and NEMA 4X for outdoor, wet, damp, chemical, or corrosive areas.

D. The SPD shall protect against surges produced by a 1.2 / 50 µs and 8 / 20 µs combination waveform generator.

E. SPDs at switchgear, switchboards, and motor control centers shall have a nominal discharge current *(I_n)* of at least 20 kA 8 / 20 µs per phase.

F. SPDs shall include EMI/RFI noise filtration and comply with UL 1283.

G. The SPD shall be of a parallel design using fast-acting energy protection that will divert and dissipate the surge energy for 480-volt distribution panels, switchgear, switchboards, substations and motor control centers.

H. The SPD shall provide LED indicator lights to provide continuous positive operational status of each individual MOV in each mode in each protected phase. Indicator lights shall be visible without the need to open any compartments.

I. The SPD shall provide all modes of protection based on the system voltage.

J. The voltage protection ratings (VPRs) shall not exceed the following:

System Voltage	Line-Neutral	Line-Ground	N-Ground	Line-Line
120 (2W+G)	700	700	700	n/a
240 (2W+G)	1200	1200	1200	n/a
120/240 (3W+G)	700	700	700	1200
120/208Y (4W+G)	700	700	700	1200
277/480Y (4W+G)	1200	1200	1200	2000
240Δ (3W+G)	n/a	1200	n/a	1200

K. SPD shall have a one nanosecond or less response time for any individual component and shall be self restoring and fully automatic.

L. Minimum surge current ratings per mode shall be as follows:

1. Service entrance equipment, switchgear, and switchboards (480V): 300 kA

2. Distribution panels and Motor control centers (480V): 200 kA

3. Branch panels and control panels (480V): 200 kA

4. Branch panels (120/208/240 – single or three phase): 100 kA

PART 3 EXECUTION

3.01 INSTALLATION

A. Install surge protective devices as shown on the Drawings and in accordance with manufacturer's instructions.

B. SPDs shall be installed with lead conductors as short as possible (not to exceed 24-inches), gently twisted together, and routed to avoid sharp bends or kinks.

C. SPDs may be mounted internally in motor control centers, switchgear or switchboards provided they are in an individual compartment.

D. SPDs may be mounted internally in variable frequency drives and control panels.

E. SPDs may be mounted internally at panelboards.

F. SPD's shall be externally mounted at transformer panel assemblies.

END OF SECTION

SECTION 16470
PANELBOARDS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and install all panelboards as shown on the Drawings and as specified herein.

B. All panelboard wiring shall include wiring numbers and terminal point numbers cross referenced to shop drawing and subsequent record drawing submittals.

1.02 SUBMITTALS

A. Submit to the Engineer, in accordance with Section 01300, shop drawings and product data, for the following as a minimum:

1. Equipment outline drawings showing elevation and plan views, dimensions and weight. Indicate all options, special features, ratings and deviations from this Section.

2. Bus arrangement drawings.

3. Product data sheets and catalog numbers for circuit breakers, etc. List all options, trip adjustments and accessories furnished specifically for this project.

4. Instruction and renewal parts books.

5. Test and inspection reports.

6. Complete bill of materials list.

7. The equipment drawings, summary tables, and bill of materials list shall be computer generated (i.e., no hand-drawn drawings, sketches, lists will be accepted).

1.03 REFERENCE STANDARDS

A. Panelboards shall be in accordance with the Underwriter Laboratories (UL) "Standard for Panelboards" and "Standard for Cabinets and Boxes" and shall be so labeled where procedures exist. Panelboards shall also comply with NEMA Standard for Panelboards and the National Electrical Code (NEC).

B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.04 MANUFACTURERS

A. 120/240 Volt, single phase, 3 Wire and 120/208 Volt, 3 Phase, 4 Wire panelboards shall be Type NQOD as manufactured by Square D; Type Pow-R-Line by Eaton; Type AQ by General Electric; or P Series by Siemens.

B. 277/480 Volt, 3 Phase, 4 Wire panelboards shall be; Type NF as manufactured by Square D; Type Pow-R-Line by Eaton; Type AE by General Electric; or P Series by Siemens.

C. 480 Volt, 3 Phase, 3 Wire panelboards shall be; I-Line series as manufactured by Square D; Type Pow-R-Line by Eaton; Type Spectra by General Electric; or P Series by Siemens.

D. NEMA 3R and 4X panelboards shall be as specified herein, provided in 316 stainless steel enclosures as manufactured by the Hoffman or equal and completely assembled by the panelboard manufacturer.

E. Refer to additional requirements for manufacturers in Section 16000. Alternate suppliers must be submitted for approval to the Engineer in writing four weeks prior to the original bid date with supporting documentation to confirm all aspects of the specifications.

PART 2 PRODUCTS

2.01 GENERAL

A. Rating

1. Panelboard ratings shall be as shown on the Drawings. All panelboards shall be rated for the intended voltage.

2. Circuit breaker panelboards shall be fully rated for the specified circuit breaker fault current interrupting capacity. Series connected short circuit ratings will not be acceptable.

2.02 MATERIALS (NEMA 1)

A. Interiors

1. All interiors shall be completely factory assembled with circuit breakers, wire connectors, etc. All wire connectors, except screw terminals, shall be of the anti-turn solderless type and all shall be suitable for copper wire of the sizes indicated.

2. Interiors shall be so designed that circuit breakers can be replaced without disturbing adjacent units and without removing the main bus connectors and shall be so designed that circuits may be changed without machining, drilling or tapping.

3. Branch circuits shall be arranged using double row construction except when narrow column panels are indicated. Branch circuits shall be numbered by the manufacturer.

4. A nameplate shall be provided listing manufacturer's name, panel type and rating.

B. Buses

1. Bus bars for the mains shall be of tin-plated copper. Full size tin-plated copper neutral bars shall be included. Bus bar taps for panels with single pole branches shall be arranged for sequence phasing of the branch circuit devices. Bussing shall be braced throughout to conform to industry standard practice governing short circuit stresses in panelboards. Phase bussing shall be full height without reduction. Cross connectors shall be tin plated copper. Each panel shall be provided with a ground bus bar, with removable link/jumper between neutral and ground bus. The ground bus shall be sized to the maximum number of circuit breakers that can be installed in the panelboard.

2. Neutral bussing shall have a suitable lug for each outgoing feeder requiring a neutral connection.

3. Spaces for future circuit breakers shall be bussed for the maximum device that can be fitted into them.

4. Tin plated copper equipment ground bars shall be furnished.

C. Boxes

1. Recessed or flush mounted boxes shall be made from galvanized code gauge steel having multiple knockouts, unless otherwise noted. Boxes shall be of sufficient size to provide a minimum gutter space of four-in. on all sides.

2. Surface mounted boxes and trims shall have an internal and external finish as specified in Paragraph 2.04D4 below.

3. At least four studs for mounting the panelboard interior shall be furnished.

4. All conduit entrances shall be field punched.

D. Trim

1. Hinged doors covering all circuit breaker handles shall be included in all panel trims.

2. Doors shall have semi flush type cylinder lock and catch, except that doors over 48-in. in height shall have a vault handle and three-point catch, complete with lock, arranged to fasten door at top, bottom and center. Door hinges shall be concealed. Furnish two keys for each lock. All locks shall be keyed alike; directory frame and card having a transparent cover shall be furnished on each door. All trims shall be door-in-door type construction.

3. The trims shall be fabricated from code gauge sheet steel.

4. All exterior and interior steel surfaces of the panelboard shall be properly cleaned and finished with ANSI Z55.1, No. 49 or 61 light gray paint over a rust-inhibiting phosphatized coating. The finish paint shall be of a type to which field applied paint will adhere.

5. Trims for flush panels shall overlap the box by at least 3/4-in all around. Surface mounted panel trims shall have the same width and height as the box. Trims shall be fastened with quarter turn clamps.

2.03 MATERIALS (NEMA 3R and 4X)

A. Interiors and Buses

1. Interiors and buses shall be as hereinbefore specified for NEMA 1 construction.

B. Boxes and Covers

1. Boxes, covers and hardware shall be made from 316 stainless steel with natural finish.

2. Boxes and covers shall have continuous welded seams and shall be hinged (piano type) together and gasketed.

3. Conduit openings shall be tapped.

2.04 CIRCUIT BREAKERS

A. Panelboards shall be equipped with circuit breakers with frame size and trip settings as shown on the Drawings.

B. Circuit breakers shall be molded case, bolt-on type. Refer to Drawings for interrupting capacity.

C. GFCI (ground fault circuit interrupter) shall be provided for circuits as required and where indicated the Drawings. GFCI units shall be 1 Pole, 120 Volt, molded case, bolt-on breakers, incorporating a solid-state ground fault interrupter circuit insulated and isolated from the breaker mechanism. The unit shall be UL listed Class A Group I device (5 milliamp sensitivity, 25 millisecond trip time) and an interrupting capacity of 10,000 Amps, RMS.

D. Circuit breakers shall be manufactured by the panelboard manufacturer.

PART 3 EXECUTION

3.01 INSTALLATION

A. Mount boxes for surface mounted panelboards so there is at least 1/2-in air space between the box and the wall.

B. Connect panelboard branch circuit loads so that the load is distributed as equally as possible between the phase busses. Record normal base load phase voltages and currents for each phase and the total neutral current and submit to the Engineer for review.

C. Install markers on the front cover of all panelboards which identify the voltage rating. Markers shall be made of self-sticking B-500 vinyl cloth printed with black characters on an Alert Orange background, 2-1/4-in high by nine-in. wide, Style A as manufactured by W.H. Brady Co. or equal.

D. Install a one-in. by three-in. nominal laminated plastic nameplate with 1/2-in white letters on a black background on each panelboard. Nameplate lettering shall be as shown on the Drawings. Nameplates shall be stainless steel screw mounted.

E. Unless otherwise noted on the Drawings, top of cabinets shall be mounted six feet-0-inch

above the floor, properly aligned and adequately supported independently of the connecting raceways.

F. All wiring in panelboards shall be neatly formed, grouped, and identified to provide a neat and orderly appearance. A typewritten directory card identifying all circuits shall be placed in the card holder inside the front cover.

G. All panelboards shall be protected from physical damage, water damage, moisture, corrosion, dirt and dust during construction. Any panelboard judged to be unacceptable by the Engineer shall be replaced by the Contractor at no additional cost to the District.

H. Standard factory testing shall be performed for the equipment furnished under this section and these tests shall be in accordance with the latest version of NEMA and UL standards. Certified copies of these tests shall be provided to the Engineer upon request.

I. Field testing and commissioning shall be done in accordance with the latest revision of the "Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems" published by the International Electrical Testing Association (NETA Standard ATS) unless otherwise modified by this Section.

3.02 CLEANING

A. Remove all rubbish and debris from inside and around the equipment. Remove dirt, dust or concrete spatter from the interior and exterior of the equipment using brushes, vacuum cleaner or clean lint-free rags. Do not use compressed air.

END OF SECTION

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SECTION 16502
LIGHTNING PROTECTION SYSTEM

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Provide a complete lightning protection system for the following buildings and structures at Black Creek Treatment Cells Project: Ground Storage Tank and Canopy for Electrical Equipment Pad. The system shall be UL Master Labeled and shall be designed and installed in compliance with provisions of UL 96A and NFPA 780.

B. The Contractor shall employ the services of a licensed lightning protective systems engineering company to design and install the lightning protection system and prepare detailed installation drawings and material specifications. These drawings and specifications shall be submitted for review in accordance with Section 01300.

C. The lightning protection system shall be checked by a UL field inspector upon completion of the installation. The Contractor shall assume full responsibility for the correctness of the installation and shall make any and all corrections and additions deemed necessary by the UL inspector. The Contractor shall pay for all costs of the UL inspection and any subsequent re-inspections as required.

D. The lightning protection system for the buildings shall consist of conductors, air terminals and accessories which shall be grounded to the building structural steel or ground grid at regular intervals. The Contractor may submit alternate methods of lightning protection with his proposal, provided the alternate provides equal or greater lightning protection than specified.

E. The lightning protection system contractor shall coordinate his work with the electrical contractor.

F. Each bidder or his authorized representatives shall, before preparing his proposal, visit all area of the existing buildings and structures in which work under this section is to be performed and inspect carefully the present installation. The submission of the proposal by this bidder shall be considered evidence that he or his representative has visited the buildings and noted the locations and conditions under which the work will be performed and that he takes full responsibility for a complete knowledge of all factors governing his work.

1.02 RELATED WORK

A. Refer to Section 16660 for Grounding Systems.

1.03 SUBMITTALS

A. Contractor shall submit to the Engineer/District for review the facility lightning protection system. The submittal data shall contain the following minimum information.

1. Plan view of site showing buildings and structures, locations of air terminals, and associated zone of protection for each air terminal; show all equipment on roofs which require protection.

2. Schematic diagram of lightning protection system showing air terminals, conductors, and other connectors or fittings required for the complete system. Provide details showing bonding requirements to structural steel, water piping, etc.

3. Locations of connection points of lightning protection system to facility grounding system.

4. Bill-of-materials.

1.04 REFERENCE STANDARDS

A. Underwriters Laboratories (UL)

1. UL 96 – Standard for Lightning Protection Components

2. UL 96A – Standard for Installation Requirements for Lightning Protection Systems

B. National Fire Protection Association (NFPA)

1. NFPA 780 – Standard for the Installation of Lightning Protection Systems

C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

PART 2 PRODUCTS

2.01 MATERIALS

A. All materials shall be new and shall comply in weight, size, and composition with the requirements of UL and NFPA.

B. Grounding materials and methods shall be equal to those specified under Section 16660.

C. The following is a brief description of the various items of material.

1. Air Terminals

a. Buildings 75 feet and less in height shall use Class I air terminals. Aluminum air terminals shall be solid aluminum, ½" minimum diameter. Copper air terminals shall be nickel plated solid copper, 3/8" minimum diameter. Length 18".
b. Buildings over 75 feet tall shall use Class II air terminals. Aluminum air terminals shall be solid aluminum, 5/8" minimum diameter. Copper air terminals shall be nickel plated solid copper, ½" minimum diameter. Length 18".
c. Air terminal type shall be copper unless the following applies. Copper lightning protection materials shall not be installed on aluminum roofing, siding or other aluminum surfaces.
d. Air terminal base supports shall be specifically designed for the surface where used. All air terminal bases shall be cast bronze with stainless steel bolt pressure cable connectors. Air terminal bases for flat roof areas shall be of the adhesive type.

2. Conductors

    a. Buildings 75 feet and less in height shall use Class I conductors. Main conductors shall be either aluminum 14 AWG, 28 strand (weighing 105 lbs. per 1,000 feet) or tinned copper 17 AWG, 32 strand (weighing 220 lbs. per 1,000 feet).
    b. Buildings over 75 feet tall shall use Class II conductors. Main conductors shall be either aluminum 13 AWG, 37 strand (weighing 200 lbs. per 1,000 feet) or tinned copper 14 AWG, 28 strand (weighing 380 lbs. per 1,000 feet).
    c. Conductor type shall be copper unless the following applies. Copper lightning protection materials shall not be installed on aluminum roofing, siding or other aluminum surfaces. Aluminum lightning protection materials shall not be embedded in concrete, masonry, or on or below copper surfaces.

3. Fasteners

    a. Conductor fasteners shall be an approved type of non-corrosive metal and have ample strength to support conductors.

4. Cable Connectors

    a. All cable connectors shall be per NFPA standards, cast bronze with screw pressure type stainless steel bolts and nuts. For buried and non-accessible connections, exothermic weld process shall be used.

PART 3 EXECUTION

3.01 INSTALLATION

A. All materials shall be installed by a UL listed lightning protection contractor. The lightning protection system shall be installed per approved shop drawings and UL and NFPA recommended practices.

B. The lightning protection system engineering company shall provide jobsite assistance and supervision of the installation as required, and shall be present during the UL inspection.

C. Lightning Protection System shall be installed in a neat and inconspicuous manner.

D. All mounting and penetration of roof surface shall be coordinated with roofing contractor to assure maximum roofing guarantee. All through-roof penetration flashings shall be furnished, sealed and guaranteed by a licensed roofing contractor.

E. Excavate and backfill as required. Finish grade and restore to original condition.

F. All metal bodies within six feet of the conductor shall be bonded to the system with approved fittings and conductors. Connections between dissimilar metals shall be made with approved bimetallic connections.

G. As the work progresses, legibly record all field changes on a set of project contract drawings. When the project is complete, furnish a complete set of reproducible "As-built" drawings for the Project Record Documents per Section 01720.

H. Air Terminals:

1. Air terminals shall be spaced so as not to exceed 20 feet apart around the outside perimeter of the roof or ridge and not over 50 feet apart through the center of flat roof areas.

2. Air terminals shall not project more than 24 inches nor less than 10 inches above the protected object.

I. Conductor Routing:

1. All main conductors shall maintain a downward or horizontal course, free from "U" or "V" pockets.

2. Conductors shall not form an angle of less than 90 degrees nor less than an eight-inch radius bend.

3. Metal roofing and siding, eave downspouts or other metal parts subject to displacement will not be permitted as substituted parts of the lightning conductor system.

4. Fasteners shall be spaced not more than three feet horizontally or vertically and shall be the same material as the conductor.

5. Bimetallic fittings shall be used for all connections between dissimilar metals.

J. Down Conductors:

1. Down conductors shall follow the most direct patch possible between roof conductors and ground terminals.

2. All buildings with a ground perimeter less than 250 feet shall have a minimum of two down conductors installed at the diagonally opposed corners of the building.

3. Any building with a ground perimeter in excess of 250 feet shall have down conductors installed so that the distance between the conductors does not exceed 100 feet.

4. Within the building, the down conductors shall be placed in Schedule 80 PVC conduit in the wall. Care shall be taken not to damage the conductors. Connections through roof shall be made with through-roof connectors.

5. Splices will not be permitted on conductors embedded in concrete.

6. Down conductors shall be installed concealed. When conductors cannot be concealed they shall be substantially guarded to prevent mechanical injury or displacement. The guards shall protect the conductor from grade level to a height of at least 6 feet. All conduit used for physical protection of down conductors shall be Schedule 80 PVC.

K. Roof Conductors:

1. Roof conductors shall interconnect and provide a two-way path from all air terminals.

2. Roof conductors shall bond together all air terminals and shall be installed exposed except that where connections are made to equipment located under roof.

3. Conductors on perimeters of flat roofs shall form closed loops.

4. Dead end air terminals shall not be permitted.

5. All interconnecting cables from air terminals to roof conductors or metal roof decks shall be similar to roof conductor.

L. Pitch Pockets:

1. Contractor shall subcontract all pitch pocket work to a qualified roofing contractor.

M. Grounding System:

1. Ground rods shall be provided at each down conductor and they shall be installed a minimum of three feet away from the foundation walls.

2. The ground rods shall be in addition to the ground rods provided for the system grounding grid.

3. Connectors used to connect ground rods to the down conductors shall make contact with the ground rods for a distance of 1-1/2" measured parallel to the ground rod. In addition, ground terminals shall be interconnected with the grounding grid, and all grounding mediums. This shall include electric and telephone service grounds and underground metallic piping systems.

4. Bonding of down conductors to the system grounding grid and splicing of conductors in concealed work shall be made by an exothermic weld process.

5. Where conductors are bonded to structural steel or metal roof decks, a bolted-on bonding plate shall be used. All other bonding of the lightning protection system shall be made with pressure clamps.

6. Contractor shall notify design Engineer prior to concealment for Engineer’s inspection.

3.02 TESTING

A. General:

1. The Lightning Protection System shall be tested for continuity of all conductors and air terminals.

2. Maximum resistance of system shall not exceed five ohms unless otherwise specified or scheduled.

3. Contractor shall submit written test results to the Engineer.

B. Indicators:

1. Stamped metal tags shall be attached to, or adjacent to, each down conductor indicating in feet the exact vertical depth in the ground of each ground terminal.

    a. Down leads connected to water pipes shall also be indicated.
    b. Tags shall be of a corrosion resistant metal and shall be placed at a height of five feet above finish grade.

END OF SECTION

SECTION 16600
UNDERGROUND SYSTEM

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish and install a complete underground system of raceways, manholes and handholes as shown on the Drawings and as specified herein. This work includes all underground raceways which are direct buried or concrete encased.

1.02 RELATED WORK

A. All concrete and reinforcing steel shall be as specified in Division 3, but the responsibility of furnishing and installing the material shall be that of this Section.

B. All trenching, excavation, and backfilling, including gravel and sand bedding and surface restoration shall be as specified in Division 2, but the responsibility of furnishing and installing the material shall be that of this Section.

C. Conduit, fittings, installation, etc. shall be as specified in Section 16110.

D. Ground rods and other grounding materials and methods shall be as specified in Section 16660.

E. Precast electrical concrete manholes and handholes shall be furnished under Division 16 and shall be in compliance with precast concrete structures as specified in Section 02605.

1.03 SUBMITTALS

A. Submit to the Engineer, in accordance with Section 01300, shop drawings and product data, for the following:

1. Manholes and handholes

2. Plastic duct spacers

3. Manhole and handhole frames and covers

PART 2 PRODUCTS

2.01 MATERIALS

A. Cable racks, supports, pulling-in irons, manhole steps and hardware shall be hot dipped galvanized steel as manufactured by Line Materials Co. or equal.

B. Precast concrete manholes and handholes shall be heavy duty type, designed for a Class H20 wheel load. Precast manholes and handholes shall be as manufactured by Brooks Products Co.

C. Manhole frames and covers shall be cast iron heavy duty type for class H-20 wheel loading, and shall be as manufactured by Neenah, or equal. Manhole covers shall be marked "ELECTRIC".

D. Handhole covers and frames shall be hot dipped galvanized and designed for a Class H-20 wheel load. Handhole covers and hatches shall have 316 stainless steel security bolts. Handhole covers shall be marked "ELECTRIC".

E. Bell ends and plastic duct spacers shall be as manufactured by Carlon or equal.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install raceways to drain away from buildings. Raceways between manholes or handholes shall drain toward the manholes or handholes. Raceway slopes shall not be less than three-in. per 100-ft.

B. Reinforce raceway banks as shown on the Drawings.

C. Lay raceway lines in trenches on a clean backfill bedding not less than six inches thick and well graded and compacted.

D. Make raceway entrances to buildings and vaults with rigid aluminum conduit not less than 10-ft long. Conduits which are not concrete encased for runs below floor slabs in slab-on-grade construction shall be conduit. Conduits which are concrete encased for runs below floor slabs in slab-on-grade construction shall be encased under the slab to their respective equipment.

E. Raceway terminations at manholes shall be with end bells for PVC conduit and insulated throat grounding bushings with lay-in type lugs for metal conduit.

F. For bends in two-inch and larger raceways, long radius elbows, sweeps and offsets shall be used.

G. All two-inch and larger raceways shall have a mandrel drawn through followed by a swab to clean out any obstructions which may cause cable abrasions. The mandrel shall be 12 inches in length and the diameter 1/2 inch less than the inside diameter of the raceway. All 1-1/2 inch and smaller raceways shall be swabbed clean before installing cables.

H. Plug spare raceways and seal them watertight at all buildings and structures.

I. Raceways in use shall be sealed watertight at all buildings and structures.

J. Install pulling-in irons opposite all raceway entrances to manholes.

K. Cables shall be trained in manholes and supported on racks and hooks at intervals not greater than three feet-0 inches and supports shall be installed on each side of all splices. Furnish inserts on all manhole walls for mounting future racks as well as racks required for present installation. Branch circuit conductors shall not be run in manholes.

L. All joints shall be made so as to prevent the passage of concrete inside the conduit to form obstructions or cause cable abrasions.

M. Manhole covers in streets shall finish flush with finished paving and in other areas shall finish three inches above crown of adjacent roadway. Floor elevations of manholes shall be so set that the center line of the lowest conduit entering will be not less than one foot above the floor and center line of the highest conduit entering will be not less than one foot below the roof slab. Underground

N. Concrete monuments shall be provided at each stubbed conduit location. Monuments shall be as shown on the Drawings and shall be installed in the same manner outlined for manhole covers.

O. A #6 bare copper wire (stranded) shall be installed in each four-inch PVC conduit containing control cable unless otherwise noted.

P. A 3/4-inch by 10-foot copperclad ground rod shall be driven in the bottom of each manhole. All bond wires, galvanized conduits and metal cable racks shall be bonded to the ground rod.

Q. Polyethylene warning tape shall be provided for all underground raceways, duct banks etc. Tape shall be placed along the raceways entire length and shall be installed 18" above the raceways on compacted backfill material.

R. Spare and empty conduits shall have a pull wire (3/16 inch polypropylene) installed.

S. As-built drawings shall be furnished showing each conduit terminations, elevations, locations, manholes, handholes, etc.

END OF SECTION

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SECTION 16660
GROUNDING SYSTEM

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and install a complete grounding system in strict accordance with Article 250 of the National Electrical Code (NEC), as shown on the Drawings and as specified herein.

B. All raceways, conduits and ducts shall contain equipment grounding conductors sized in accordance with the NEC. Minimum sizes shall be No. 12 AWG.

1.02 SUBMITTALS

A. Submit to the Engineer, in accordance with Section 01300, shop drawings and product data, for the following:

1. Manufacturer's name and catalog data for ground rods, materials and exothermic welding methods and materials.

PART 2 PRODUCTS

2.01 MATERIALS

A. Conduit shall be as specified under Section 16110.

B. Wire shall be as specified under Section 16120.

C. Ground rods shall be 3/4-in diameter by 10-ft copper clad steel and constructed in accordance with UL 467. The minimum copper thickness shall be 0.25 mm. Ground rods shall be Copperweld or equal.

D. Grounding conduit hubs shall be malleable iron type, manufactured by Thomas & Betts Co.; Catalog No. 3940 (3/4-in conduit size), similar to Burndy; O.Z./Gedney Co. or equal, and of the correct size for the conduit.

E. Waterpipe ground clamps shall be cast bronze saddle type, manufactured by Thomas & Betts Co. Cat. No. 2 (1/2-in, 3/4-in, or 1-in size), similar by Burndy; O.Z./Gedney Co. or equal, and of the correct size for the pipe.

F. Buried grounding connections shall be by Cadweld process, or equal exothermic welding system.

PART 3 EXECUTION

3.01 INSTALLATION

A. The service entrance equipment ground bus shall be grounded to a ¾-inch cold water pipe and to the ground as indicated on the Drawings. Run grounding electrode conductors in Schedule 80 PVC conduits and seal conduits watertight. Do not allow water pipe connections to be painted. If the connections are painted, disassemble them and re-make them with new fittings.

B. Install equipment grounding conductors with all feeders and branch circuits.

C. Bond all steel building columns in new structures together with ground wire in rigid conduit and connect to the distribution equipment ground bus, as shown on the Drawings.

D. Ground wire connections to structural steel columns shall be made by exothermic welding.

E. Metal conduits stubbed into a motor control center shall be terminated with insulated grounding bushings and connect to the motor control center ground bus. Bond boxes mounted below motor control centers to the motor control center ground bus. Size the grounding wire in accordance with NEC Table 250.122, except that a minimum No. 12 AWG shall be used.

F. Ground bus in all motor control centers and unit substations shall be connected to the service entrance equipment ground bus with a No. 1/0 conductor or as noted on the Drawings.

G. Ground transformer neutrals to the nearest available grounding electrode with a minimum conductor sized in accordance with NEC Article 250 or as shown on the Drawings.

H. Drive grounding electrodes (where rock is encountered, grounding plates may be used in lieu of grounding rods) and install ground grids as shown on the Drawings.

I. All equipment enclosures, motor and transformer frames, conduits systems, cable armor, exposed structural steel and all other equipment and materials required by the NEC to be grounded, shall be grounded and bonded in accordance with the NEC.

J. Seal exposed connections between different metals with No-Oxide Paint Grade A or equal.

K. Lay all underground grounding conductors slack and, where exposed to mechanical injury, protect by pipes or other substantial guards. If guards are iron pipe, or other magnetic material, electrically connect conductors to both ends of the guard. Make connections as specified herein.

L. Care shall be taken to ensure good ground continuity, in particular between the conduit system and equipment frames and enclosures. Where necessary, jumper wires shall be installed.

M. All grounding type receptacles shall be grounded to the outlet boxes with a No. 12 XHHW-2 green conductor connected to the ground terminal of the receptacle and fastened to the outlet box by means of a grounding screw.

3.02 INSPECTION AND TESTING

A. Inspect the grounding and bonding system conductors and connections for tightness and proper installation.

B. Use Biddle Direct Reading Earth Resistance Tester or equivalent test instrument to measure resistance to ground of the system. Perform testing in accordance with test instrument manufacturer's recommendations using the fall-of-potential method. Notify the Engineer in writing at least two weeks prior to scheduling any testing. Provide certified calibration sheets including dates for all equipment to be used for testing with notice of scheduled testing. Calibration sheets shall also indicate that the units have been calibrated within six months of the testing date.

C. All test equipment shall be provided under this Section and approved by the Engineer.

D. Resistance to ground testing shall be performed during dry season. Submit test results in the form of a graph showing the number of points measured (12 minimum) and the numerical resistance to ground.

E. Testing shall be performed before energizing the distribution system.

F. A separate test shall be conducted for each building or system.

G. Dry season resistance of the system at each testing location shall not exceed five ohms. If such resistance cannot be obtained with the system, provide additional grounding, as directed by the Engineer, at no additional cost to the District.

END OF SECTION

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