DETAILED DESIGN SPECIFICATIONS ISSUED FOR BID

Main Street Well No. 15 Wellhead Assembly and Raw Water Main JEA Project No. 8003508

JEA

AUGUST 2017

CDM Smith

TABLE OF CONTENTS

DIVISION 16 – ELECTRICAL

SECTION 01010
SUMMARY OF WORK

PART 1 GENERAL

1.01 LOCATION OF WORK

A. The work consists of construction of a well facility and associated raw water pipeline for the production well, designated Well No. 15, located at JEA-owned property (Parcels 072673-0000, 072674-0000, 072675-0000, 072677-0000, 072677-0010, and 072678-0000) at the corner of East 2nd Street and Clark Street in Jacksonville, Florida. The work continues from the property, crossing East 2nd Street before terminating at an existing 12-inch raw water main near existing abandoned Well No. 8. This project is located within the City of Jacksonville (COJ) rights-of-way.

1.02 SCOPE OF WORK

A. Furnish all labor, tools, materials, equipment and all other facilities and incidentals required to perform the following work at the Main Street Well No. 15 Wellhead Assembly and Raw Water Main Project in its entirety, as required by these Specifications, JEA Water and Wastewater Standards (2017) and shown on the Drawings. This project will consist of a new Well Header Facility and will route new raw groundwater flow pumped from the Floridan aquifer at new Well No. 15 across East 2nd Street and connect to the JEA Main Street Wellfield System tie-in point, near abandoned JEA Well No. 8.

B. The Contractor shall perform the Work complete, in place, test and make ready for continuous service, and shall include repairs, replacements and restoration required as a result of damages caused during construction.

C. The Work includes but is not limited to, the following:

1. Mobilization/Demobilization, General Requirements, Bonds and Insurance

2. New Raw Water Main

   a. Installation of approximately 250 feet of 16-inch Ductile Iron (DI) restrained pipe, valves, fittings by methods of open cut across East 2nd Street and tie-in to Owner's existing Main Street Wellfield System.

   b. Installation of a 20-inch cross, gate valves, fittings, and plugs along the northern Right-of-Way of East 2nd Street for future connections.

   c. Demolition of existing sidewalk along the property boundary (approximately 160-feet of 5-foot wide sidewalk).

   d. Cutting, demolition and capping of the existing 12-inch Cast Iron (CI) pipe (approximately 50 feet) at abandoned JEA Well No. 8 (tie-in point for the new raw water main).

   e. Verification and installation of additional restraining (if deemed necessary by engineer) downstream of the 12-inch cast iron tie-in point on the existing 12-inch cast iron pipe.

f. Erosion and Sedimentation control along the route, as necessary.

g. Dewatering to nearby discharge to City of Jacksonville stormwater system.

h. Maintenance of Traffic to construct the project.

i. New stamped sidewalks and driveway.

j. Tree removal (8 trees identified on the contract drawings and specifications).

k. Site restoration including, curb, pavement, seeding, subgrade compaction, and restoration.

3. New Well Facility at the new Production Well No. 15

a. Contractor shall confirm prior the all other construction activities the spatial location of the drilled well by a professional surveyor and mapper registered in the State of Florida.

b. Contractor shall remove the temporary wellhead installed by driller and install the final wellhead flange at an elevation of 20.80 feet elevation (NAVD 88). Base flange shall be welded such that bolt holes are oriented to allow for selected pump attachment and discharge nozzle centerline is aligned.

c. Construction of a new well facility slab and header pipe concrete pipe supports.

d. Installation of one (1) new 125-hp, variable frequency drive, vertical turbine pump (pumping unit shall include pump, motor, bowl, column, line shaft, discharge head and appurtenances).

e. Installation of a new 12-inch ductile iron pipe well header, including above-ground rubber flapper check valve (with limit switch), butterfly valves and fittings, as shown on the Drawings.

f. Installation of new well header air release valve (2-inch).

g. New commercial grade decorative fencing (6-feet high), in accordance to the contract documents.

h. Installation of a new well facilities instrumentation, including one (1) 12-inch venturi flow meter, pressure gages, submersible pressure transducer and transmitter panel.

i. Installation of new electrical equipment and service, including new underground electrical conduits, new electrical service (in accordance to Owner requirements), meter enclosure, meter mounting system, grounding rod and Motor Control Center (MCC).

j. Installation of a new Well SCADA panel and SCADA Mast and Antenna.

k. Site landscaping in accordance to the City of Jacksonville landscaping requirements. Work shall will include the planting and installation of ten (10) cabbage palm trees, six (6) Crape Myrtle trees (30-gal in size), seventy-five (75) Yaupon Holly shrubs (15-gal in size), perimeter mulch bed with 3-inch pine nugget mulch and an operational drip-irrigation system.

l. Installation of a 6-foot high black steel (ornamental) fence, 14-foot wide double gate, 3-foot wide access gate, concrete driveway, and gravel surface around the wellhead facility slab, as shown on the drawings.

m. Testing, startup, training and miscellaneous work as shown on the drawings and specified herein.

4. Contractor shall coordinate with JEA Power for an electrical feed line and temporary support of all existing wooden power poles within the proposed route and facility of the raw water main.

5. Field locate of all underground utilities within the construction limits including tie in to existing 12-inch water main, as shown the Drawings. Contractor shall contact all local public utilities locating service to locate utilities in the area prior to any excavation.

6. Contractor shall restore all driveways, drainage pipes, and headwalls to equate or better than existing conditions in both existing Rights-Of-Way and within any temporary easement areas.

7. Permits, including Notice of Intent and Right-of-Way and any other permits that are necessary. The FDEP permit application for PWS Components, Site Clearing/Tree Removal and MOT has been secured by Engineer. A dewatering plan shall be provided by the Contractor for fluids produced as part of construction.

8. Contractor shall disinfect and collect bacteriologically samples for the production well and associated pipeline in accordance with the JEA Water and Wastewater Standards (January 2017), Section 350-III.6.2. Owner shall provide analysis of bacteriological samples provided by Contractor from the field in support of the FDEP partial clearance request.

D. Substantial Completion: To satisfy the definition of Substantial Completion, all on-site Work including punch list items required by the Contract have been completed to where the Contractor can vacate the site and only those elements of submittal and closeout nature remain for the attainment of Final Completion and as previously described.

E. Final Completion: the last stage of construction shall be final contraction and shall include the final remaining items subject to Engineer's approval.

1.03 PROJECT REQUIREMENTS

A. The Contractor shall refer to the appropriate sections in JEA's Water and Wastewater Standards Manual for construction of the raw water main. Where a discrepancy may be found between the JEA Water and Wastewater Standards Manual and these specifications or as shown on the drawings, the bid shall be based on the more stringent requirement and notification of such discrepancy shall be provided to the Engineer prior to construction.

B. Contractor shall refer to the following specifications located in JEA's Water and Wastewater Standards Manual (January 2017) for the following items including in this project (not included under the set of specifications from Engineer):

1. Fencing – Section 492

2. Grassing – Section 441

3. Driveway – Section 491

4. Ductile Iron Pipe (below-grade) – Section 350

C. Contractor is responsible for all permits required for construction. Secured permits include the FDEP Notice of Intent for Groundwater Sampling and Discharge from an Un-contaminated Site, City of Jacksonville Major Utility Review and FDEP Potable Water Systems Permit. The Contractor shall be responsible for filling out, paying the appropriate permit fee and pulling the City of Jacksonville Right-of-Way (ROW) Permit for the project (**Attachment A** has the pre-populated ROW Application for the Project).

D. Contractor shall assume full responsibility for security of all his and his subcontractors' materials and equipment stored on the site. The Contractor shall care for and protect against loss or damage of all material to be incorporated in the construction duration of the Project and shall repair or replace damaged or lost materials and damage to structures and equipment.

E. There are various utility crossings and conflicts under this contract that may require relocation or protection of other utilities and temporary shutdown to the service of customers. The Contractor shall make every effort necessary to minimize the shutdown time and coordinate with the utility authorities prior to attempting any such shutdown. Furthermore, the Contractor shall provide any corrective measure or temporary equipment and facilities necessary to perform the work at no additional cost to the Owner. The Contractor shall contact the appropriate utility at the same time as he/she starts construction to avoid any delays in the construction of the work described in this contract. Contractor shall protect the electric lines and poles and should take all necessary cautions to avoid potential damage.

F. Contractor shall submit a detailed sequence of construction plan for the proposed work. Coordination with Owner pertaining the tie-in work and down-time of the existing Main Street wells shall be discussed during the Pre-Construction Meeting and submitted for review during shop drawings.

G. The Contractor shall take necessary precautions to prevent damage to existing structures whether on the surface, aboveground, or underground.

H. The Contractor shall implement any key noise variance procedures, as specified by the Owner and to be addressed during the Pre-Construction Meeting.

1.04 CONTRACTOR USE OF PREMISES

A. The Owner has purchased the parcels on the corner of East 2nd Street and Clark Street (Parcels 072673-0000, 072674-0000, 072675-0000, 072677-0000, 072677-0010, and 072678-0000). The Contractor shall coordinate use of premises with the Owner, and the Engineer. All conflicts over use of the premises shall be resolved without additional cost to the Owner.

B. The Contractor shall assume full responsibility for security of all materials and equipment stored on the site, include those stored by any subcontractors.

C. If directed by the Owner or Engineer, the Contractor shall move any stored items that interfere with operations of the Owner or other contractors at no additional cost to the Owner.

D. The approved hours of operation for construction activities for this project are Monday through Friday from 7 am to 5 pm, and Fridays 7 am to 12 pm, and shall not include holidays observed by Owner. Overtime, holiday or weekend hours must be approved in advanced by the Owner on a case by case basis.

1.05 CONSTRUCTION CONSTRAINTS

A. The Contractor shall meet the constraints below, and shall consider these constraints when developing the overall plan to schedule construction. These constraints are 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 areas are not necessarily listed in their required sequence of construction. A suggested sequence within each area, where necessary, is included.

B. Contractor shall coordinate with the Owner regarding the final tie-in work to the existing Main Street Wellfield system at the 12-inch water main near existing abandoned Well No. 8. Tie-in will require the closing of an existing raw water main valve near the Kennedy Swimming Pool at East 1st Street. All tie-in work shall be conducted in accordance to the Owner's operational schedule and as agreed during the pre-construction meeting.

C. The approved hours of operation for construction activities for this project are Monday through Friday from 7 am to 5 pm and shall not include holiday observed by Owner. Overtime, holiday, weekend or night hours must be approved in advanced by the Owner on a case by case basis.

D. If temporary plugs or appurtenances are required to complete the work these shall be provided by the Contractor at no additional cost to the Owner.

E. Erosion control and any temporary fencing of construction areas shall be performed within 30 days after the Notice to Proceed. All erosion control devices and storm drainage piping and inlets shown on the Drawings shall be installed prior to any grading and/or trench work.

F. 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 and the Owner's costs of dealing with regulatory agencies.

G. If the Contractor anticipates damage to a tree due to construction activities the Contractor shall contact the Engineer immediately and prior to commencing work in that area.

H. All new piping shall be tested, adjusted, and disinfected according to Specification Section 01445.

I. Properly remove and dispose of refuse materials, including old piping and valves offsite.

J. Any part of the Work that is not mentioned herein, or shown on the Drawings accompanying these Specifications, but which is necessary or normally required as a part of such Work, or is necessary or normally required to make each installation satisfactorily and legally operable, shall be performed by the Contractor as incidental work without extra cost to the Owner, as if

fully described in the Specifications and shown on the Drawings accompanying these Specifications, and the expense thereof shall be included in the applicable unit prices or lump sum bid for the Work.

1.06 OWNER OCCUPANCY

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

END OF SECTION

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 01152.

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 Bid Form. 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.

1. Acquisition of the City of Jacksonville Right-of-Way Permit.

2. Mobilization and demobilization including, but not limited to, those operations necessary for the movement of personnel, equipment, supplies and incidentals to the project site, and for the establishment of temporary offices, building facilities, safety equipment and first aid supplies, sanitary and other facilities, as required by these specifications, and state and local laws and regulations. (Maximum 2% of the Total Bid Amount).

3. Demolition and removal of existing sidewalk along the property boundaries, tree removal and demolition of a small segment of 12-inch cast iron pipe at the tie-in point for the new 16-inch raw water main.

4. Sediment and Erosion Control as specified in the stormwater pollution prevention plan in the contract documents.

5. Site Work including but not limited to grading, paving, fencing, gravel, irrigation, and landscaping as shown in the contract documents.

6. Installation of new production wellhead assembly (Main Street Well No. 15 Pump) and associated facility equipment, including but not limited to concrete pad, electrical equipment, instrumentation and controls, all above and below-grade ductile iron pipe and any other items located at the well site. Installation shall include but not be limited to all miscellaneous work required to successfully complete the installation.

7. Furnish and install 16-inch Ductile Iron (DI) raw water pipeline via open cut trench. This work includes but is not limited to excavation, backfill, pipe installation, flushing, testing, and connection to existing pipelines, restrained joints, fittings and bends, restraining, dewatering, sheeting and shoring, sodding, pavement repair and restoration, and maintenance of traffic. This Item will also include any other work which is not specified or shown but is required to complete the work shown on the contract drawings.

B. Progress payments will be based on the Schedule of Values prepared by the Contractor and approved by the Engineer and Owner 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.

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.

E. Payment

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

1.04 ALLOWANCES

A. Allowances, if any, specified in the Contract Documents and indicated in the Bid Form 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 Bid Form. No work may be performed under an allowance without prior written approval of the Owner.

B. Any unused balance of the allowances shall revert to the Owner 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.

E. Allowance items include:

1. Laboratory tests required to determine soil density, concrete compressive strength, and asphalt testing. Passed tests will be reimbursed by the Owner and the cost for the failed tests will be the Contractor's responsibility. All required soil, concrete, and bacteriological water testing shall be coordinated with and scheduled by the Contractor.

2. Allowance for additional pipe restraining at the existing 12-inch water main uncovered at the tie-in of the new 16-inch raw water main. Contractor shall uncover and submit verification of the restraining of the existing piping there for determination whether additional restraining will be required.

3. Supplemental work authorization for items, as directed and only approved by the Owner.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 01050
PROJECT CONTROLS (SURVEYING)

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall provide and pay for field engineering services required for project; including but not limited to:

1. Survey work required for project controls and layout.

2. Certified as-built surveys specified herein.

B. The Contractor shall retain the services of a registered land surveyor licensed in the state of Florida to:

1. The Contractor shall verify the existing control points and property line corners indicated on the Drawings.

2. The Contractor shall verify and record all existing structure locations in the vicinity of, or adjacent to, the proposed Work; and, the locations of all proposed structures and facilities within the project site.

3. The Contractor shall 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.

4. The Contractor shall maintain accurate locations of all new structures, including corner locations, tank locations and equipment locations within the project site.

1.02 RELATED WORK

A. Site Preparation is included in Section 02100, and in Section 406 in JEA's Water and Wastewater Standards Manual.

B. Record Drawings are included in Section 01720

C. JEA's Water and Wastewater Standards Manual, Section 501

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, and prior to final payment, the Contractor shall submit the certified drawings (with the Surveyor's title block) signed and sealed by the registered land surveyor with 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. These drawings shall be included with, and made a part of, the project record documents.

1. Certified site survey at 1-in = 50-ft scale or larger but not greater than 1-inch = 20 feet scale on 24-in by 36-in sheets, indicating the building corners, sidewalks, paved areas and location of all above ground structures within the project site or limits of construction.

2. Certified survey, drawn to the same scale as the Engineer's yard piping drawings, showing the locations, lines and grades in plan and profile views of all below-grade lines (piping and concrete-encased electrical ducts) exterior to buildings and other buried facilities (e.g., valves, tanks, etc.). 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. Certified survey showing the locations, lines and grades of all pipes 4-inch diameter and larger above ground, buried and exterior to buildings and other buried facilities (e.g. valves, tanks, vaults, etc.) installed as a result of the work. This shall be at the same scale as the Engineer’s yard piping drawing.

4. Certified survey showing elevations of all flow control points, such as weirs, elevations of all new structures, pipe inverts, rim elevations on manholes, and elevations of equipment.

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. The Contractor shall 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 on the plant 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. Building foundation, column locations and floor levels.

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

4. Slabs and floor levels

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

D. 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.

E. 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 Field Order 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 (including weirs) 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:

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

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

END OF SECTION

SECTION 01152
APPLICATION FOR PAYMENT

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

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

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

C. The Contractor shall maintain a copy of all books, records and documents pertinent to the performance under this agreement for a period of five (5) years following completion of the contract.

1.02 RELATED WORK

A. Agreement between Owner and Contractor.

B. Standard General Conditions of the Construction Contract.

C. Schedule of Values is included in Section 01370.

1.03 SUBMITTALS

A. Submit to the Engineer, applications typed on forms provided by the Owner, 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 project record drawings.

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. Execute certification with signature of a responsible officer of Contract firm.

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 Owner or the Engineer 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.

   5. Record drawings must be up to date (red-lined set at construction trailer).

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

C. As a prerequisite for payment, submit a “Surety Acknowledgement of Payment Request” letter showing amount of progress payment which the Contractor is requesting.

D. Maintain an updated set of drawings to be used as record drawings. As a prerequisite for monthly progress payments, exhibit the updated record drawings for review by the Owner 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.

C. Submit all Project Record Documents in accordance with Sections 01720 and JEA Water and Wastewater Standards – Section 501.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 01300
SUBMITTALS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section includes the requirements for compiling, processing and transmitting submittals applicable to shop drawings, product data, samples and O&M manuals, required for execution of the project. Detailed submittal requirements are specified in the Technical Sections.

B. All JEA Standards Equipment and materials supplied on the contract documents shall be submitted for review in accordance with this Section.

C. 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 approval. The following are examples of action submittals:
   a. Shop drawings (including working drawings and product data);
   b. Samples;
   c. Operation & maintenance manuals;
   d. Site Usage Plan (Contractor’s staging- including trailer sitting and material laydown area);
   e. Schedule of values; and
   f. Payment application format.

2. Informational Submittal: Information submitted by the Contractor that is required to be reviewed by the Engineer prior to work being completed. Engineer will provide review comments that may require revisions. Information submittals will be marked “REVIEWED” by the Engineer when submittal is considered acceptable. 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. Work plans
   g. Maintenance of traffic plans
   h. Outage requests
   i. Proposed testing procedures
   j. Test records and reports
   k. Vendor training outlines/plans
   l. Test and start-up reports
   m. Certifications
   n. Record Drawings
   o. Record Shop Drawings
   p. Submittals required by laws, regulations and governing agencies
   q. Submittals required by funding agencies
   r. Other requirements found within the technical specifications
   s. Warranties and bonds

t. As-built surveys
u. Contract close-out documents

D. All submittals shall be delivered directly to the **Office of the Consulting Engineers, CDM Smith, 8381 Dix Ellis Trail, Suite 400, Jacksonville, Florida, 32256, Attn: Cheryl Gullotto**.

E. All submittals shall be clearly identified by reference to section number, paragraph, drawings or detail as applicable.

F. Submittals shall be clean and legible of sufficient size for presentation of data.

1.02 RELATED WORK

A. Additional requirements may be specified in the General Conditions for the Contract.

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

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

D. Warranties and Bonds are included in Section 01740.

E. Project Controls are included in Section 01050.

F. 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(s)

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)

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

C. Submittal Log: 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. Date transmitted to the Engineer

4. Date returned to Contractor (from Engineer)

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

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

7. Date material released for fabrication

8. Projected (or actual) delivery date

D. Numbering System: Utilize a 9-character submittal identification numbering system in the following manner:

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 two digits shall be the numbers 01 to 99 to sequentially number each separate item or drawing submitted under each specific Specification Section, in the order submitted.

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:

   D-03300-008-B
   D = Shop Drawing
   03300 = Section for Concrete
   08 = the eighth different submittal under this section
   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.

F. Action Submittals

1. Shop Drawings, Working Drawings, Product Data and Samples, and Professional Engineer (P.E.) Certification Form
   a. Shop Drawings
      1) Shop drawings as defined in the General Conditions, and as specified in individual Sections 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, wiring diagrams, coordination drawings, equipment inspection and test reports, including performance curves and certifications, as applicable to the work.
      2) Contactor 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 show clearly 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 for field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data, and that it has been coordinated with other related shop drawings and the Contract requirements. Submittals directly from subcontractors or vendors will not be accepted by the Engineer.
      5) The Contractor shall be responsible 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.
      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.
      7) Submittals for equipment specified under Divisions 11, 13, 14, 15, and 16 shall include a listing of installations where identical or similar equipment manufactured by that manufacturer has been installed and in operation for a period of at least five years.
   b. Working Drawings
      1) Detailed installation drawings (sewers, equipment, piping, electrical conduits and controls, HVAC work, and plumbing, 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, signed and sealed by the P.E. licensed or registered in the state wherein the work is located.

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 therefore.

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 Owner 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 Owner 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 Owner. 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.

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

5. 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.

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

7. 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.

8. 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.

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

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

11. Vendor Training Outlines/Plans
    a. At least two weeks before scheduled training of Owner's personnel, provide lesson plans for vendor training in accordance with the specification for O&M manuals.

12. 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.

13. 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

14. Record Drawings
    a. No later than Substantial Completion, submit a record of all changes during construction not already incorporated into drawings – in accordance with Section 01700 and Section 01720. Contractor shall submit minimum 5 draft and final hard copies as-built drawings and corresponding AutoCAD file.

15. 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.

16. Submittals Required By Laws, Regulations And Governing Agencies
    a. 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.

17. Submittals Required by Funding Agencies
    a. 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.

18. Other Requirements of the Technical Specification Sections
    a. Comply with all other requirements of the technical specifications.

19. Warranties and Bonds
    a. Assemble a book(let) of all warranties and bonds as specified in the various technical specifications and in accordance with the specification on Warranties and Bonds and provide to the Engineer.

20. As-Built Surveys
    a. Engage the services of a licensed land surveyor in accordance with the Project Controls specification. Prior to Final Completion, provide an as-built survey of the constructed facility, as specified.

21. 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 Owner and Engineer. Incorporate comments from Owner or Engineer into a revised submittal schedule.

B. Maintain the submittal schedule and provide sufficient copies for review by Owner 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, Owner'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 Owner's 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 deviation or variation from Contract documents;
    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; and
    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 eight; six of which will be retained by the Engineer for record documents and to deliver to the Owner;
    2) Samples – three copies;
    3) Site Usage Plan – three copies;
    4) Product Data –three copies;
    5) Schedule of values – four copies; and
    6) 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. 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; and
      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 Owner 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) Code 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) Code 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) Code 3 - "APPROVED AS NOTED/CONFIRM" - This combination of codes is assigned when a confirmation of the notations and comments is 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. This confirmation shall specifically address each omission and nonconforming item that was noted. Confirmation is to be received by the Engineer within 15 calendar days of the date of the Engineer's transmittal requiring the confirmation.
      4) Code 4 - "APPROVED AS NOTED/RESUBMIT" - This combination of codes is assigned when notations and comments are extensive enough to require a resubmittal of the entire package. This resubmittal is to address all comments, omissions and non-conforming items that were noted. Resubmittal is to be received by the Engineer within 30 calendar days of the date of the Engineer's transmittal requiring the resubmittal.
      5) Code 5 – “NOT APPROVED” – 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.

6) Code 6 – "COMMENTS ATTACHED" – This code is assigned where there are comments attached to the returned submittal, which provide additional data to aid the Contractor.
7) Code 7 – "RECEIPT ACKNOWLEDGED (Not subject to Engineer's Review or Approval)" – This code is assigned to acknowledge receipt of a submittal that is not subject to the Engineer's review and approval, and is being filed for informational purposes only. This code is generally used in acknowledging receipt of means and methods of construction work plans, field conformance test reports, and health and safety plans.
8) Codes 1 through 5 designate the status of the reviewed submittal with Code 6 showing there has been an attachment of additional data.

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

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 large 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; and
      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. Engineers' 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 Owner. Engineer may elect not to

respond to Contractor regarding informational submittals meeting the Contract requirements.

b. If an informational submittal does not comply with the Contract requirements, Engineer will respond accordingly to the Contractor within 15 days. Thereafter, the Contractor shall perform the required corrective action, including retesting, if needed, until the submittal, in the opinion of the Engineer, is in conformance with the Contract Documents.

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 large 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 (printing enabled); and
      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 of Florida and that he/she has been employed by

_____ to design
(Name of Contractor)

_____
(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 Owner)

or Owner's representative within seven days following written request therefore by the Owner.

_____	_____
P.E. Name	Contractor's Name
_____	_____
Signature	Signature
_____	_____
Address	Title
	_____
	Address

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 14 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. Standard General Conditions of the Construction Contract are included in the Front End Documents provided by Owner.

B. Application for Payment is included in Section 01152.

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 furnished by the Owner; Contractor's standard forms and automated printout will be considered for approval by the Owner 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.

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

2. 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.

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.

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

1.05 FORM AND CONTENT OF SCHEDULE OF ASSET VALUES

A. The **Table 01370-1** includes the assets to be accounted for in the Schedule of Asset Values.

B. For each asset listed, provide a constructed cost which will include an allocation of construction activities including but not limited to, demolition, sitework, specialties, materials, labor, general conditions, and overhead and profit associated with the construction of the asset.

C. The combined value of the assets will equal the bid price for the project and will require adjustments as necessary due to change orders. The schedule of asset values will be updated on a monthly basis and will be included in the monthly pay request application for approval.

D. The Owner reserves the right to edit this list prior to the first pay request application and may add up to 10 percent more items than have been identified in the list

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

Table 01370-1 Schedule of Assets
125-HP Variable Frequency Drive, Vertical Turbine Pump, Pump Column and Bowl
12-inch Raw Water Ductile Iron Pipe and Fittings
16-inch Raw Water Ductile Iron Pipe and Fittings
Venturi Flow Meter
Conductivity Probe
12-inch Check Valve (Rubber Flapper with Limit Switch)
12-inch Butterfly Valve (2)
1-inch Air Vacuum Valve
3-inch Air Vacuum Valve
Well Header Pressure Gages (0-120 PSI)
Motorized Control Center (MCC)
Variable Frequency Drive
Hose Bib Station 1
1’’ Schedule 80 PVC (Lube Water for Pump)
Irrigation Bubbler System
Irrigation Drip Zone Valve
Irrigation Flush Valve
Rain Sensor
Irrigation air/vacuum relief
Submersible Pressure Transducer
Well SCADA Panel
SCADA Antenna
Transmittal Panel
Site Light Pole
Facility Fencing

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 01410
TESTING AND TESTING LABORATORY SERVICES

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. Contractor shall pay for the costs of all laboratory tests required to determine soil density, concrete compressive strength, and asphalt testing. Passed tests will be reimbursed by the Owner and the cost for the failed tests will be the Contractor's responsibility. All required soil, concrete, and bacteriological water testing shall be coordinated with and scheduled by the Contractor.

1. Contractor shall cooperate with the laboratory to facilitate the execution of its required services.

2. Selection of testing laboratory shall be approved by the Engineer and Owner.

3. Bacteriological water testing for the potable water components permitting compliance shall be sampled by the Contractor and analysis shall be conducted by the Owner.

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. Site Preparation is included in Section 02100, and in Section 406 in OWNER's Water and Wastewater Standards Manual.

2. Excavation and earthwork are included in Section 02200, and in Section 408 in OWNER's Water and Wastewater Standards Manual.

3. Concrete walkways and driveways are included in Section 437 in OWNER's Water and Wastewater Standards and on the Drawings.

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, and 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 Owner 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, fees incurred by laboratory due to Contractor's negligence, shall be backcharged to Contractor.

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 equipment supplier or Contractor's (as applicable) convenience.

H. If the test and any subsequent retests results indicate the materials or equipment fail to meet the requirements of the contract documents, the equipment supplier or Contractor (as applicable) shall pay for the laboratory costs directly to the testing firm, and these will not be reimbursable to the Equipment supplier or Contractor (as applicable).

I. Provide Owner and Engineer with all testing reports.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

THIS PAGE INTENTIONALY LEFT BLANK

SECTION 01445
PIPELINE TESTING AND CLEANING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall 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 JEA's Water and Wastewater Standards Manual (January 2017).

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

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

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

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

3.02 CLEANING PIPELINES

A. All pipelines shall be cleaned and swabbed in accordance with Section 350 – III.6 in JEA's Water and Wastewater Standards Manual.

3.03 TESTING PRESSURE PIPELINES

A. All pressure pipelines shall be pressure and leakage tested following the requirements in Section 350 – III-6.3 in JEA's Water and Wastewater Standards Manual, latest edition.

3.04 CHLORINATION OF PIPELINES

A. All disinfection of pipelines shall be completed in accordance following the requirements in Section 350 – III-6.2 of JEA's Water and Wastewater Standards Manual, latest edition.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

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. Transportation and handling shall be in accordance with manufacturer's instructions.

B. The Contractor shall 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. The Contractor shall coordinate delivery with installation to ensure minimum holding time for items that are hazardous, flammable, easily damaged or sensitive to deterioration.

D. Products shall be delivered 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. The Contractor shall provide necessary equipment and personnel to unload all items delivered to the site.

G. The Contractor shall promptly inspect shipment to assure that products comply with requirements, quantities are correct and items are undamaged. For items furnished by others (i.e. Owner, other Contractors), perform inspection in the presence of the Owner’s Representative. 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 Owner.

1.03 STORAGE AND PROTECTION

A. The Contractor shall 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 reviewed with the Owner’s Representative by him/her. Instruction shall be carefully followed and a written record of this kept by the Contractor. Arrange storage to permit access for inspection.

B. The Contractor shall 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 weathertight building to prevent injury. The building may be a temporary structure on the site or elsewhere, but it must be satisfactory to the Owner's Representative. 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 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, and in Section 501 of OWNER's Water and Wastewater Standards Manual.

1.02 RELATED REQUIREMENTS

A. Warranties and bonds are included in Section 01740.

B. As-built wiring diagrams are included in Section 01730.

C. As-built surveys are included in Section 01050.

D. Record shop drawings are included in Section 01300.

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 Owner's field orders 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. Field Orders, 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

6. Certificates of Compliance for materials and equipment

7. Record Shop Drawings

8. Samples

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 field orders.

3. Record drawings shall be accessible to the Owner 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 Owner at all times.

E. As a prerequisite for monthly progress payments, the Contractor is to exhibit the currently updated "Record Documents" for review by the Engineer and Owner.

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 field order, 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 Field Order, 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 indentified 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 and Addenda; 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 Field Order or by Change Order.

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. As 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 Owner, 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.

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

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 01730
OPERATION AND MAINTENANCE DATA

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. Warranties and Bonds are included in Section 01740.

1.03 OPERATING MANUALS

A. Provide operation and maintenance instructions for all electrical, mechanical, and instrumentation & controls equipment furnished under various technical specification Sections.

B. Six complete sets of operation and maintenance manuals approved by the Engineer covering all equipment furnished under Divisions 11, 13, 15 and 16 shall be delivered at least 30 days prior to scheduled start-up directly to the Owner. 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 Contractor and/or 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), as applicable
      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
   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. Contractor and/or 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
   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 Contractor's approved shop drawings
   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. Equipment attributes sheet for submittal of name plate data.
   q. Warranties and Bonds, as specified in the General Conditions and Section 01740.

3. Transmittals
   a. Prepare separate transmittal sheets for each manual. Each transmittal sheet shall include al least the following: Contractor’s name and address, Owner’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 otherwise directed by the Engineer.

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 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. List of original Manufacturer's spare parts and recommended quantities to be maintained in storage

7. Test and balancing reports, as required

8. Additional Requirements as specified in individual product specification

9. Design data for systems engineered by the Contractor or its Suppliers

10. 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
          - Maintenance is recommended
          - Assets have a value greater than $1,000
          - Assets are complete and usable, and perform a distinct function independently (i.e., they pump waste, remove solids, etc.)

       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 Contractor must provide information for:

    b. 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.
    c. 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.

F. Manual for Materials and Finishes – In addition to the requirements listed above, for each material or finish, provide the following:

1. Applied Materials and Finishes: Include product data, with catalog number, size, composition and color designations

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.

1.04 SERVICES OF MANUFACTURERS' REPRESENTATIVE

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 Owner'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 Owner'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.

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. Preliminary copies of manuals shall be submitted to the office of the Engineer, no later than 30 days following approval of the respective shop drawings.

2. Provide six final copies of complete manuals prior to testing and start-up.

B. The Engineer will review Operation and Maintenance manuals submittals on 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 copies (the number specified in paragraph 3.01.A.2) of as-built drawings or any other amendments for insertion in the final manuals. Submit the required number within 30 days of start-up and testing of the facility.

3.02 VENDOR TRAINING/INSTRUCTIONS (TO OWNER'S PERSONNEL)

A. Before final initiation of operation, Contractor's vendors shall train/instruct Owner's designated personnel in the operation, adjustment, and maintenance of products, equipment and systems at times convenient to the Owner.

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 Owner'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 Owner's normal day shift.

C. Use operation and maintenance manuals as basis for instruction. Train/instruct the Owner'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 Owner's Acknowledgement of Manufacturer's Instruction as indicated on the Equipment Manufacturer's Certification of Installation, Testing, and Instruction appended to this Section.

END OF SECTION

CDM Smith

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?

Operations and Maintenance Data

_____ 6. Is an overview description of the equipment and/or process included?

_____ 7. Does the description include the practical theory of operation?

_____ 8. Does each equipment component include specific details (design characteristics, operating parameters, control descriptions, and selector switch positions and functions)?

_____ 9. Are alarm and shutdown conditions clearly identified? Does it describe possible causes and recommended remedies?

_____ 10. Are step procedures for starting, stopping, and troubleshooting the equipment included?

_____ 11. Is a list of operational parameters to monitor and record for specific equipment included?

_____ 12. Is a proposed operating log sheet included?

_____ 13. Is a spare parts inventory list included for each component?

_____ 14. Is a lubrication schedule for each component included - or does it clearly state “No Lubrication Required"?

_____ 15. Is a maintenance schedule for each component included?

_____ 16. Is a copy of the warranty information included?

_____ 17. Are equipment attribute sheets provided as specified?

Review Comments

Is the submittal fully approved (yes/no)?

If not, see the following are the points of rejection that 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.

EQUIPMENT MANUFACTURER'S CERTIFICATE OF INSTALLATION, TESTING AND INSTRUCTION

Owner: JEA

Project: Main Street Well No. 15 – Wellhead Assembly and Raw Water Main

Contract No. _____

CDM Smith Project 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 satisfactorily tested, [is] [are] ready for operation, and that Owner assigned operating personnel have been suitably instructed in the operation, lubrication, and care of the unit[s] on Date: _____ Time: _____.

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

OWNER'S ACKNOWLEDGMENT OF MANUFACTURER'S INSTRUCTION

[I] [We] the undersigned, authorized representatives of the _____ and/or Plant Operating Personnel have received classroom and hands on instruction on the operation, lubrication, and maintenance of the subject equipment and [am] [are] prepared to assume normal operational responsibility for the equipment:

_____ DATE: _____

_____ DATE: _____

_____ DATE: _____

EQUIPMENT ATTRIBUTE SHEETS

In order to facilitate the creation of asset records and their corresponding preventive maintenance schedules and activities in the Computerized Maintenance Management System (CMMS), information should be completed using the Excel template provided. Examples are provided in the Equipment Attribute Sheets template to help convey how the information should be completed. In addition, each worksheet in the Excel template is described below. The Engineer will provide the Contractor a copy of the Excel spreadsheet for use in distributing to vendors/manufacturers for completion. The spreadsheet will be pre-populated with the list of assets for which information is required and the specific attributes that need to be completed.

Vendor-Manufacturer Worksheet

Information for the equipment Vendors and Manufacturers should be provided on the Vendor-Manufacturer worksheet. The information that is required is listed below.

Vendor ID / Manufacturer ID	A unique identifier for the Vendor or Manufacturer. If this is unknown enter an abbreviation for the Vendor / Manufacturer name.
Vendor/Manufacturer Name	The name of the Vendor or Manufacturer
Address	Company address
City	
State or Country	
ZIP Code	
Phone	Company phone number
Fax	Company fax number
Contact Name	Best contact person
Contact Phone	Contact information associated with the person identified in the Contact Name field
Contact Fax	
Contact email	

Local Representative Worksheet

Information for the local representative should be provided on the Local Representative worksheet. The information that is required is listed below.

Company Name	The company name of the Local Representative
Address	Company address
City	
State	
ZIP Code	
Contact Name	Best contact person
Contact Phone	Contact information associated with the person identified in the Contact Name field
Contact Fax	
Contact email	

Assets Worksheet

The following Asset information should be provided for all equipment. The equipment that should be included will be pre-populated.

Asset ID	Will be pre-populated
Asset Description	Will be pre-populated
Tag Number	Identifier from the P&ID
Model Number	Equipment Model Number
Serial Number	Serial Number that is specific to the piece of equipment
Vendor ID	Identifier for the Vendor associated with the piece of equipment. The Vendor ID should be defined on the Vendor-Manufacturer worksheet.
Manufacturer ID	Identifier for the Manufacturer associated with the piece of equipment. The Manufacturer ID should be defined on the Vendor-Manufacturer worksheet.
Cost	The installed cost of the equipment.
Warranty Duration	The length of the warranty on the equipment
Anticipated Warranty Start Date	The estimated date of substantial completion. Will help define when the warranty will expire.

In addition to the information above, additional asset-specific attributes must be completed. The additional fields that need to be completed will be defined for you on the Assets Worksheet for each different type of asset. See the Equipment Attribute Sheets template for examples.

Spare Parts Worksheet

Spare parts or kits that are to be used in the performance of recommended preventive maintenance activities should be listed on the Spare Parts worksheet. This will enable JEA to keep an inventory of the items and enable preventive maintenance work orders to reference the spare part requirements.

Spare Part or Kit ID	A unique identifier for the Spare Part of Kit
Spare Part / Kit Description	A useful description to help users of the CMMS and/or maintenance crews identify what is needed to perform the preventive maintenance task.
Vendor/Manufacturer ID	The unique identifier for Vendor or Manufacturer of the item. The identifier should reference the Vendor-Manufacturer worksheet.
Kit Contents	If the item is actually a kit that contains multiple items, the quantity and a brief description of each item in the kit should be listed individually.
Asset ID(s)	The list of Assets that the spare parts are applicable to. The Asset IDs are defined in the Assets worksheet.

Preventive Maintenance Worksheet

All recommended preventive maintenance (PM) activities for the equipment provided must be compiled on the Preventive Maintenance worksheet. This will facilitate the creation of the necessary preventive maintenance schedules for the equipment in the CMMS. It will also help JEA identify the specific tasks and materials that are involved in completing future PM work orders. The Preventive Maintenance worksheet contains two sections. The general list of preventive maintenance activities and their frequencies should be entered in the Preventive Maintenance Header. The tasks that a maintenance worker would execute as part of each PM should be entered into the Preventive Maintenance Tasks.

Preventive Maintenance Header

PM ID	Please specify a unique number for each recommended preventive maintenance (PM) activity. The first PM should have an ID of 1, and you should increment from there. The individual tasks that comprise the activity will be listed separately below and will reference this identifier.
PM Description	A useful description of the PM activity. It should also contain the frequency that the activity should be performed.
Frequency - Calendar	If the frequency is calendar based (every week, 2 weeks, month, etc) please enter the frequency.
Frequency - Runtime	If the PM should be scheduled based on equipment run-time, please enter the runtime interval at which the PM should be performed.
Applicable Asset ID(s)	In order to create the PM schedules in the CMMS, a list of the applicable Asset IDs is needed. If a PM is applicable to several assets that you are supplying, please list all those Asset IDs and create rows as necessary in Excel.

Preventive Maintenance Tasks

PM ID	This is the identifier from the Preventive Maintenance Header (above).
Task Number	A numeric identifier for each task listed under a scheduled PM. The first task should be "10" and each successive task should be incremented by 10.
Task Description	A useful description of the task. It is not necessary or desirable for this to be overly detailed. It is meant to be a checklist that a person could use in performing the recommended PM activities. The examples provided are an indicator of the desired level of detail.
Spare Part / Kit ID	If the task likely will require spare parts, the spare parts should be listed here. The ID that should be entered here should come from the Spare Parts worksheet.
Spare Part / Kit Quantify	The quantity of the specified parts that are likely to be necessary to complete the PM task
Special Tools / Equipment Description	If any special or unusual tools or equipment are necessary to perform the maintenance task, a description should be entered here.

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 01740
WARRANTIES AND BONDS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section specifies general administrative and procedural requirements for warranties and bonds required by the Contract Documents, including Manufacturer's standard warranties on products and special warranties.

1.02 RELATED WORK

A. Refer to Conditions of Contract for the general requirements relating to warranties and bonds.

B. Specific requirements for warranties for the work and products and installations that are specified to be warranted are included in the individual Sections of Divisions 2 through 16.

1.03 SUBMITTALS

A. Submit written warranties to the Owner via the Engineer 15 days prior to the date of 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 Owner.

B. When a designated portion of the work is completed and occupied or used by the Owner, by separate agreement with the Equipment Supplier or Contractor (as applicable) during the construction period, submit properly executed warranties to the Owner via the Engineer within 15 days of completion of that designated portion of the Work.

C. When a special warranty is required to be executed by the Contractor or 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 Owner via the Engineer for approval prior to final execution.

D. Refer to individual Sections of Divisions 2 through 16 for specific content requirements, and particular requirements for submittal of special warranties.

E. At Final Completion compile two copies of each required warranty and bond properly executed by the Contractor, or by the Equipment Supplier, or by the Manufacturer. Organize the warranty documents into an orderly sequence based on the table of contents of the Project Manual.

F. Bind warranties and bonds in heavy-duty, commercial quality, durable 3-ring vinyl covered loose-leaf binders, thickness as necessary to accommodate contents and sized to receive 8-1/2-in by 11-in paper.

G. 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.

H. 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, supplier and Manufacturer.

I. Identify each binder on the front and the spine with the typed or printed title "WARRANTIES AND BONDS", the project title or name and the name, address and telephone number of the Contractor.

J. 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 Contractor is responsible for the cost of replacing or rebuilding defective work regardless of whether the Owner has benefited from use of the work through a portion of its anticipated useful service life.

D. Owner's Recourse: Written warranties made to the Owner 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 Owner can enforce such other duties, obligations, rights, or remedies.

E. Rejection of Warranties: The Owner reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the contract Documents.

F. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the Equipment Supplier or Contractor (as applicable) of the warranty on the work that incorporates the products, nor does it relieve suppliers, manufacturers and subcontractors required to countersign special warranties with the Contractor.

1.05 MANUFACTURERS CERTIFICATIONS

A. Where required, the Equipment Supplier or Contractor (as applicable) shall supply evidence, satisfactory to the Engineer, that the Equipment Supplier or Contractor (as applicable) 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 Owner.

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 Owner.

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 1 year unless otherwise specified. The period of such warranties shall start on the date the particular equipment is placed in use by the Owner 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 will 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 shall repair or replace without charge to the Owner 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 machine(s) and the unit(s) restored to service at no expense to the Owner.

C. Obtain equipment warranties in accordance with Section 01740 from each of the respective suppliers or Manufacturers for all the equipment specified under Divisions 11, 15 and 16. The form of warranty is included at the end of this Section.

D. The Manufacturer's warranty period shall run concurrently with the Contractor's warranty or guarantee period. No exception to this provision shall be allowed. In the event that the Manufacturer is unwilling to provide a one year warranty commencing at the time of Owner acceptance, obtain from the Manufacturer a two-year warranty starting at the time of equipment delivery to the job site. This two-year warranty shall not relieve the Contractor of the 1 year warranty starting at the time of Owner acceptance of the equipment.

1.08 FINAL GUARANTEE

A. Final guarantee and Contractor’s warranty shall be as specified in the Front-End Documents of the Contract.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION
WARRANTY FOR EQUIPMENT ITEM

LOCATION OF PROJECT: _____

OWNER: _____

PROJECT NUMBER: _____

EQUIPMENT ITEM: _____

SECTION NO. / ITEM NO.: _____

SUPPLIER: _____

SUPPLIER'S ADDRESS: _____

_____

SUPPLIER'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 one year from the date of final acceptance by the Owner of the above-named project.

COMPANY_____

COMPANY ADDRESS_____

_____

BY_____

TITLE_____

SIGNED_____

DATE _____

SECTION 02100
SITE PREPARATION

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The CONTRACTOR shall furnish all labor, materials and equipment required and perform all site preparation at the Well No. 15 site, complete as specified herein. The Contractor shall clear and grub all of the area within the limits of construction as shown on the plans and approved by the Engineer and Owner prior to the beginning of any work. Tree removal and tree protection is designated on the Contract Documents. All site work shall conform to the applicable JEA's Water and Sewer Standards Manual.

B. The Contractor shall obtain all necessary permits required for site preparation work prior to proceeding with the work. A City of Jacksonville Site Work – Tree Removal Application was submitted by Engineer during design per the Contract Documents (Permit No. L-17-872447).

1.02 RELATED WORK

A. JEA Water and Wastewater Standards (January 2017) – Section 406.

B. Earthwork is included in Section 02200, and Section 408 in JEA's Water and Wastewater Standards Manual.

C. Erosion and Sedimentation Control in Section 02270.

1.03 SUBMITTALS

A. Submit, 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. The surface of the ground, for the area to be cleared and grubbed shall be completely cleared of 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. Clearing operations shall be conducted so as to prevent damage to existing structures and utilities and to structures and utilities under construction, and also to provide for the safety of employees and others.

B. Preserve and protect trees and other vegetation designated on the Drawings and in Paragraph 3.05 or as directed by the Engineer or Owner to remain.

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 in accordance with Section 02200 and JEA Standard Water and Wastewater Part VI and VII.

3.03 STRIPPING

A. Strip topsoil from all areas to be occupied by concrete slabs, structures, and roadways and all areas to be excavated or filled.

B. Topsoil shall be free from brush, trash, large stones and other extraneous material. Avoid mixing topsoil with subsoil.

C. Stockpile and protect topsoil until it is used in landscaping, loaming and seeding operations. Dispose of surplus topsoil after all work is completed.

3.04 DISPOSAL

A. Dispose of material and debris from site preparation operations by hauling such materials and debris to an approved offsite disposal area at the expense of the Contractor. No rubbish or debris of any kind shall be buried on the site. All debris from the site shall be removed prior to issuance of Final Completion on the project.

3.05 PROTECTION AND CONTROL

A. Trees and other vegetation designated on the Drawings or directed by the Engineer to remain shall 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 employees and others.

B. Per JEA Water and Wastewater Standards, Section 408 Part VIII, any existing fences and retaining walls effected shall be carefully removed and reinstalled by a personnel qualified to accomplish the work. The condition of the reinstalled facilities shall be equal to the original facilities.

C. Maintain protection until all work in the vicinity of the work being protected has been completed.

D. Do not operate heavy equipment or stockpile materials within the branch spread of existing trees.

E. Immediately repair any damage to existing tree crowns, trunks, or root systems. Roots exposed and/or damaged during the work shall 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.

F. Restrict construction activities to those areas within the limits of construction designated on the Drawings, within the City of Jacksonville Right-Of-Way, and within easements provided by the Owner. Adjacent properties and improvements thereon, public or private, which become damaged by construction operations, shall be promptly restored to their original condition, to the full satisfaction of the property owner.

G. Contractor shall control dust resulting from clearing and grubbing operations to prevent nuisance to adjacent property owners and the general public.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 02140
DEWATERING AND DRAINAGE

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall design, furnish, install, operate, monitor, maintain and remove a temporary dewatering system as required and lower and control water levels at least 3-feet below subgrades of excavations and to permit construction to proceed in-the-dry.

B. The Contractor shall furnish, maintain and remove temporary surface water control measures adequate to drain and remove surface water entering excavations.

C. The Contractor shall 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. Contractor shall become familiar with the Generic Permit 62-621.300 (2) for Discharge of Produced Groundwater From Any Non-Contaminated Site Activity. Contractor shall secure this permit and adhere to its conditions prior to any site activity commencing.

F. The Contractor shall collect and properly dispose of all discharge water from the dewatering and drainage systems in accordance with all Federal, State and local agency requirements.

G. The Contractor shall obtain and pay for any additional permits required for temporary dewatering and drainage systems or non-compliance under the General Permit 62-621.300. Original permits shall be prominently displayed on the site prior to constructing dewatering and drainage systems.

H. The Contractor shall repair damage caused by dewatering and drainage system operations.

I. The Contractor shall perform all work in accordance with current applicable regulations and codes of all Federal, State and local agencies.

1.02 RELATED WORK

A. Submittals are included in Section 01300.

B. Site Preparation is included in JEA's Water and Wastewater Manual, Section 406 – Site Preparation, Cleanup and Restoration, and Section 02100.

C. Earthwork is included in JEA's Water and Wastewater Standards Manual, Section 408 – Excavation and Earthwork, and Section 02200.

D. Trenching, Backfilling and Compaction is included in JEA's Water and Wastewater Standards Manual, Section 408- Excavation and Earthwork, and Section 02221.

E. Temporary Erosion and Sedimentation Control are included in Section 02270.

F. Loaming and Seeding is included in JEA's Water and Wastewater Manual, Section 441 – Grassing.

G. Replacement of Pavement, Walks or Driveways is included in City of Jacksonville City Standards and Specifications Section 141, and Section 02513 of these specifications.

1.03 SUBMITTALS

A. The Contractor shall submit, in accordance with Section 01300, detailed plans of the proposed dewatering methods. Dewatering and drainage system designs shall be prepared by a professional Engineer licensed in the State of Florida, and retained by the Contractor, and having a minimum of five (5) years of professional experience in the design and construction of dewatering and drainage systems.

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, hole sizes, filter sand placement techniques, sealing materials, development techniques, the number and location of dewatering points and observations wells, etc. Include the dewatering system design calculations in the plan.

C. Submittal will be for information only. The Contractor shall remain responsible for adequacy and safety of construction means, methods and techniques.

D. The Contractor shall 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. Sheet piles may be used for the advantage for reducing groundwater flow into the excavation if they can be embedded in confining or semi-confining layer(s). The plan shall also include detailed plans for settlement monitoring of existing structures within 150 feet of dewatering activities before and during construction, and provisions to address settlement of existing structures, should it occur, resulting from dewatering activities.

E. The Contractor shall not proceed with any excavation or dewatering activities until the dewatering submittals have been provided to the Engineer and permits have been obtained.

1.04 DESIGN AND PERFORMANCE RESPONSIBILITY

A. The Contractor is responsible for the proper design and implementation of methods for controlling surface water and groundwater.

B. 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 3-ft below the lowest excavation subgrade elevation. Additional groundwater lowering may be necessary beyond the 3-ft requirement, depending on construction methods and equipment used and the prevailing groundwater and soil conditions. 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 Owner.

C. The Contractor shall be responsible for damage to properties, buildings or structures, sewers and other utility installations, pavements and work that may result from dewatering of surface water control operations.

D. Design review and field monitoring activities by the Owner or of the Engineer shall not relieve the Contractor of his/her responsibilities for the work.

1.05 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 3-ft below the lowest level of the excavation, 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. Pipe for observation wells, if required, shall consist of minimum 2-in I.D., Schedule 40 PVC pipe and machine slotted PVC wellpoints, maximum slot size 0.010-in.

B. The Contractor shall provide piping, pumping equipment and all other materials required to provide control of surface water and groundwater in excavation, and equipment provided shall be suitable for the intended purpose.

C. The Contractor shall maintain at all sites standby pumping systems and a source of standby power.

PART 3 EXECUTION

3.01 GENERAL

A. The Contractor shall control surface water and groundwater such that excavation to final grade is made in-the-dry, the bearing soils are maintained undisturbed 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 not be limited to perimeter trenches and sump pumping, perimeter groundwater cutoff, well points, ejectors, deep wells, and combinations thereof.

C. 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 to the pipe bearing soils or to soils which support overlying or adjacent structures.

D. Provide protection against flotation for all work.

E. The impact of anticipated subsurface soil/water conditions shall be considered when selecting methods of excavation and temporary dewatering and drainage systems. Where groundwater levels are above the proposed bottoms of excavations, a pumped dewatering system is expected for pre-drainage of the soils prior to excavation to final grade and for maintenance of the lowered groundwater level until construction has been completed to such an extent that the foundation, structure, pipe, conduit, or fill will not be floated or otherwise damaged. Type of dewatering

system, spacing of dewatering units and other details of the work are expected to vary with soil/water conditions at a particular location.

F. Discharge water shall be clear, with no visible soil particles. Discharge from dewatering shall be disposed of in such a manner that it will not interfere with the normal drainage of the area in which the work is being performed, create a public nuisance, or form ponding. The operations shall not cause injury to any portion of work completed, or in progress, or to the surface of streets, or to private property. The dewatering operation shall comply with the requirements of appropriate regulatory agencies. Additionally, where private property is involved, advance written permission shall be obtained by the Contractor.

3.02 SURFACE WATER CONTROL

A. The Contractor shall construct 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 being delayed.

3.03 EXCAVATION DEWATERING

A. At all times during construction, the Contractor shall furnish and maintain proper equipment and facilities to remove promptly and dispose of properly all water entering excavations. Excavations shall be maintained in-the-dry, so as to obtain a satisfactory undisturbed subgrade foundation condition 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.

B. Pipe and masonry shall not be laid in water or submerged within 24 hours after being placed. Water shall not flow over new masonry within 4 days after placement.

C. 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.

D. Dewatering shall at all times be conducted in such a manner as to preserve the natural undisturbed capacity of the subgrade soils at proposed bottom of excavation. If the subgrade of the trench bottom or excavation becomes disturbed due to inadequate drainage, The Contractor shall excavate below normal grade as directed by the Owner’s representative and refill with screened gravel at the Contractor's expense.

E. 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. The Contractor shall dewater and excavate, at all times, in a manner which does not cause loss of ground or disturbance to the pipe bearing soil or soil which supports overlying or adjacent structures.

F. If the method of dewatering does not properly dewater the trench or excavation as specified, the Contractor shall install groundwater observation wells as directed by Engineer and shall not place any pipe or structure until the readings obtained from the observation wells indicate that the groundwater has been lowered a minimum of 3 feet below the bottom of the final excavation within the trench limits.

G. 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.

H. Water entering the excavation from precipitation or surface runoff shall be collected in shallow ditches around the perimeter of the excavation, drained to sump and pumped from the excavation to maintain a bottom free from standing water.

I. Drainage shall be disposed of in an approved area, and shall be coordinated with the Owner. All water discharged from temporary dewatering and drainage systems shall be disposed in accordance with the temporary erosion and sedimentation control plans as specified in Section 02270.

3.04 REMOVAL OF SYSTEMS

A. At the completion of the excavation and backfilling work, and when approved by the Owner's representative, all pipe, deep wells, well points, pumps, generators, observation wells, 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. The Contractor shall leave in place any casings for deep wells, well points or observation wells 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.

C. Where casings are pulled, holes shall be filled with sand. Where left in place, casings shall be filled with cement grout and cut off a minimum of 3-ft below finished ground level or 1-ft below foundation level so as not to interfere with finished structures or pipelines.

D. When directed by the Engineer, or Owner, 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.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 02200
EARTHWORK

PART 1 GENERAL

1.01 STATUTORY REQUIREMENTS

A. All excavation, trenching, sheeting, bracing, etc. shall comply with the requirements of OSHA excavation safety standards (29 CFR Part 1926.650 Subpart P) and State of Florida and local requirements. Where conflict between OSHA, State and local regulations exists, the most stringent requirement shall apply.

1.02 SCOPE OF WORK

A. The Contractor shall furnish all labor, materials, equipment and incidentals required and perform all excavation, backfill, fill and grading required to complete the work as shown on the Drawings and as specified herein.

B. The Contractor shall provide the services of licensed professional engineer registered in the State of Florida to prepare temporary excavation support system, and dewatering system designs and submittals.

C. The Contractor shall furnish and install temporary excavation support systems, if required, including trench box, drilled-in soldier piles with lagging, interlocking steel sheeting, or other methods, 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 JEA's Water and Wastewater Standards Manual, Section 408 – Excavation and Earthwork.

D. The Contractor shall furnish and install temporary dewatering and surface water control systems and operate to dewater and maintain excavations in a dry condition. The Contractor shall control drainage into excavations and remove seepage water and rainwater. Dewatering and surface water control shall be in accordance with JEA's Water and Wastewater Standards Manual, Section 408 – Excavation and Earthwork.

E. The Contractor shall examine the site and review the available geotechnical report prior to submitting his proposal, taking into consideration all conditions that may affect his work. The Owner and 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. No extra work shall be initiated without notification to the Engineer and Owner in writing and the written approval of the Owner in response.

G. Protection of existing structure and utilities shall be the responsibility of the Contractor.

1.03 RELATED WORK

A. Site Preparation is included in Section 02100, and in Section 406 in JEA's Water and Wastewater Standards Manual.

B. Dewatering and Drainage is included in Section 02140, and in Section 408 in JEA's Water and Wastewater Standards Manual.

C. Trenching, Backfilling and Compaction is included in Section 02221, and in Section 408 in JEA's Water and Wastewater Standards Manual.

1.04 SUBMITTALS

A. Excavation support system designs shall be prepared by a licensed professional engineer, registered in the State of Florida, having a minimum of 5 years of professional experience in the design and construction of excavation support systems. Submit an original and three copies of the licensed professional engineer's certification, on the P.E. form specified in Section 01300, stating that the excavation support systems designs have been prepared by the professional engineer and that the professional engineer will be responsible for their execution.

B. The Contractor shall submit, in accordance with Section 13000, an Excavation Work Plan that includes the proposed methods of construction, including, earthwork operations, excavation limits, slopes, ramp access, fill material moisture conditioning and handing, compaction equipment, and material sources for the various portions of the work.

C. The Contractor shall coordinate this submittal with the requirements of dewatering and support of excavation submittals.

1.05 REFERENCES

A. American Society for Testing and Materials (ASTM)

1. ASTM C 33 – Specification for Concrete Aggregates.

2. ASTM D 2487 – Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).

3. ASTM D 4751 – Standard Test Method for Determining the Apparent Opening Size of a Geotextile.

4. ASTM D 5034 – Standard Test Methods for Breaking Strength and Elongation of Textile Fabrics.

B. Geotechnical Exploration and Evaluation Report prepared by Meskel & Associates, PLLC, entitled "Final Report of Geotechnical Exploration for JEA Main Street Well WTP No. 15," Jacksonville, Florida, dated April 6, 2017.

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

D. American Association of State Highway and Transportation Officials (AASHTO) standards

1. AASHTO T-180 – Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and 457-mm (18-in.) Drop.

1.06 PROTECTION

A. Sheeting and Bracing

1. The Contractor shall furnish, put in place and maintain such sheeting and bracing as may be required by Federal, State and local safety requirements; to support the sides of excavations; to prevent any movement which could in any way diminish the width of the excavation below that necessary for proper construction; and to protect adjacent structures from undermining or other damage. If the Engineer is of the opinion that at any points sufficient or proper supports have not been provided, he/she may order additional supports put in, and compliance with, or failure to issue, such order shall not relieve or release the Contractor from his/her responsibility for the sufficiency of such supports. Care shall be taken to prevent voids outside of the sheeting. If voids are formed, they shall be immediately filled and rammed. Where soil cannot be properly compacted to fill a void, lean concrete shall be used as backfill.

2. The Contractor shall construct the sheeting outside the neat lines of the foundation, unless indicated otherwise, to the extent deemed desirable for the method of operation. Sheeting shall be plumb and securely braced and tied in position. Sheeting and bracing shall be adequate to withstand all pressures to which the structure or trench will be subjected. Any movement or bulging which may occur shall be corrected to provide the necessary clearances and dimensions.

3. Where sheeting and bracing is required to support the sides of excavations for pipeline trenches, engage a professional engineer, licensed by the State of Florida to design the sheeting and bracing. The Contractor shall provide detailed submittals of the sheeting and bracing design for review and comments. The sheeting and bracing installed shall be in conformity with the design and certification provided by the professional engineer. The Contractor shall submit P.E. Certification Form contained in Section 01300 to show compliance with this requirement.

4. The Contractor shall leave in place to be embedded in the backfill all sheeting and bracing not shown on the Drawings but which the Engineer may direct in writing to leave in place at any time during the progress of the work for the purpose of preventing injury to structures, utilities, or property, whether public or private. The Engineer may direct that timber used for sheeting and bracing be cut off at any specified elevation. All timber sheeting to be left in place within the limits of the structure shall be treated.

5. All sheeting and bracing not left in place shall be carefully removed in such a manner as not to endanger the construction or other structures, utilities, or property. All voids left or caused by withdrawal of sheeting shall be immediately refilled with sand by ramming with tools especially adapted to that purpose, or otherwise as may be directed by the Engineer.

6. The right of the Engineer to order sheeting and bracing left in place shall not be construed as creating any obligation on his/her part to issue such orders and his/her failure to exercise his/her right to do so shall not relieve the Contractor from liability for damages to persons or property occurring from or upon the work occasioned by negligence or otherwise, growing out of a failure on the part of the Contractor to leave in place sufficient sheeting and bracing to prevent any caving or moving of the ground.

7. No sheeting is to be withdrawn if driven below mid-diameter of any pipe and under no circumstances shall any sheeting be cut off at a level lower than 1 foot above the top of any pipe.

B. Pumping and Drainage

1. The Contractor shall at all times during construction provide and maintain proper equipment and facilities to remove all water entering excavations and keep such excavation dry so as to obtain a satisfactory undisturbed subgrade foundation condition until the fills, structures 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 levels. The Contractor shall submit to the Engineer for review the design of the dewatering system prior to commencing work.

2. The Contractor shall take all precautions to prevent uplift of any structure during construction.

3. Flotation shall be prevented by maintaining a positive and continuous operation of the dewatering system. The Contractor shall be fully responsible and liable for all damages which may result from failure of this system.

4. Dewatering and drainage systems shall be in accordance with Section 02140, and Section 408 in JEA's Water and Sewer Standards Manual.

1.07 COMPACTION REQUIREMENTS

A. Beneath foundations and slabs on grade (except sidewalks): Compact the top 24-in of existing subgrade (and each layer of fill if applicable) to a density of at least 98 percent modified Proctor maximum dry density (AASHTO T-180) at or near optimum moisture content (minus 2 to plus 2 percent). Each layer of Fill shall be placed in loose lifts not exceeding six inches in thickness.

B. Sidewalks: Compact the top 6-in of existing subgrade (and each 12-in layer of fill if applicable) to at least 98 percent modified Proctor maximum dry density (AASHTO T-180) at or near optimum moisture content (minus 2 to plus 2 percent).

C. Roads, paved areas and roadway embankments: Compact the top 12-in of existing subgrade and each layer of fill or backfill to at least 98 percent modified Proctor maximum dry density (AASHTO T-180) at or near optimum moisture content (minus 2 to plus 2 percent).

D. Compaction of backfill in pipeline trenches shall be in accordance with Section 02221.

1.08 COMPACTION TESTING

A. Prior to the general placement of the fill and during placement and compaction operations, the Engineer may select areas within the limits of the fill for testing the degree of compaction. Contractor shall cooperate fully in obtaining the information desired.

B. Payment for testing will be made by the Contractor and reimbursed by the Owner for the passed tests. If test results are unsatisfactory, all costs involved in the testing and correcting deficiencies in compacted materials shall be borne by the Contractor. All deficiencies shall be corrected to the satisfaction of the Engineer.

C. For well pad structure, at least two density tests shall be performed at the foundation subgrade, plus two density tests per lift of any site raising fill.

D. For pipelines, density testing shall be performed as specified in Section 02221.

E. At the request of the Engineer, additional testing shall be performed. Contractor shall cooperate fully with the Engineer's request for additional testing.

PART 2 PRODUCTS

2.01 MATERIALS

A. Structural Fill materials are specified in Section 408 in JEA's Water and Wastewater Standards Manual and shall also meet the following additional requirements:

1. Structural Fill materials shall be able to be properly dried and compacted to achieve the required compaction and moisture content.

2. Structural Fill material shall be non-plastic, granular soil having less than 10 percent material passing the No. 200 sieve and containing less than 4 percent organic material. Structural fill shall be sand, sand with gravel, sand with silt, or sand with clay, free of, loam, wood, trash, and other objectionable material.

B. AASHTO Class A-3 soil backfill materials are specified in Section 408 in JEA's Water and Wastewater Standards Manual.

PART 3 EXECUTION

3.01 EXCAVATION BELOW GRADE

A. If the bottom of any excavation is excavated below the limits shown on the Drawings, specified, or directed by the Engineer, it shall be refilled at the Contractor's expense with compacted layers of Structural Fill, or other material satisfactory to the Engineer.

B. If, in the opinion of the Engineer, the material in its undisturbed natural condition, at or below the normal grade of the excavation as indicated on the Drawings, is unsuitable for foundations, it shall be removed to such depth and width as approved by the Engineer and be replaced with suitable compacted material as directed by the Engineer for which compensation will be made in accordance with the Contract.

C. The excavation shall be backfilled in a controlled manner with Structural Fill. Excavated material that meets the requirements of Structural Fill may be reused to backfill the excavation.

3.02 EXCAVATION SUPPORT

A. Furnish, install, monitor and maintain excavation support (e.g., shoring, sheeting, bracing, trench boxes, etc.) as required by Federal, State or local laws, ordinances, regulations and safety requirements. Support the sides of excavation, to prevent any movement which could in any way reduce the width of the excavation below that necessary for proper construction and protect adjacent structures from undermining, settlement or other damage. Take care to prevent the formation of voids outside of sheeting. If voids occur behind sheeting, immediately backfill and compact the voids with common fill material. Voids in locations that cannot be properly compacted upon backfilling shall be filled with lean concrete.

B. Install excavation supports outside the neat lines of foundations. Supports shall be plumb and securely braced and tied in position. Excavation support shall be adequate to withstand all

pressures to which the supports will be subjected. Any movement or bulging of supports shall be corrected to provide the necessary clearances, dimensions and structural integrity.

3.03 STRUCTURE EXCAVATION

A. Excavation shall be made to the grades shown on the Drawings and to such widths as will give suitable room for construction of the structures, for bracing and supporting, pumping and draining. The bottom of the excavations shall be rendered firm and dry and in all respects acceptable to the Engineer.

B. Excavation and dewatering shall be accomplished by methods which preserve the undisturbed state of subgrade soils. The exposed subgrade for the structure's footings, slabs and mats shall be compacted to a density of at least 98 percent modified Proctor (AASHTO T-180) to a depth of 24 inches.

1. Density tests shall be conducted to verify that proper compaction has been achieved beneath each structure.

C. Dewatering to target levels shall be performed prior to performing excavation work. Dewatering shall be in accordance with Section 02140.

D. Excavation equipment shall be hand-operated equipment satisfactory for carrying out the work in accordance with the requirements specified. In no case shall the earth be ploughed, scraped, or dug with machinery so near to the finished subgrade as to result in excavation of, or disturbance of material below grade, the last of the excavated material being removed with pick and shovel just before placing of concrete or working mat thereon.

E. When excavation for foundations has reached prescribed depths, the Engineer shall be notified and will inspect conditions. If materials and conditions are not satisfactory to the Engineer, the Engineer will issue instructions as to the procedures.

F. During final excavation to subgrade level, the Contractor shall take whatever precautions are required to prevent disturbance and remolding. Exposed subgrade soils which has become softened and mixed with water shall be removed. Hand excavation of the final 3 to 6 inches will be required as necessary to obtain a satisfactory undisturbed bottom. The Engineer will be the sole judge as to whether the work has been accomplished satisfactorily.

G. Excavation bottom for all structures and pipelines (unless otherwise shown on the Drawings or otherwise specified herein) shall be compacted to a density of at least 98 percent modified Proctor maximum dry density (AASHTO T-180).

H. 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, coordinate with the soils testing laboratory to verify the suitability of existing subgrade soils and to perform in-place soil density tests as required to verify that the subgrade soils have been compacted to achieve the specified degree of compaction. 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.

I. Over-excavation beyond the limits and depths required by the Contract Documents shall be replaced with structural fill or other approved material subject to the prior approval of the Engineer at no additional cost to the Engineer.

3.04 MISCELLANEOUS EXCAVATION

A. Perform all miscellaneous excavation. Make all excavations necessary to permit the placing of loam and plants, for constructing roadways and any other miscellaneous earth excavation required under this Contract.

3.05 DISPOSAL OF UNSUITABLE, WASTE AND/OR SURPLUS MATERIAL

A. Unsuitable, waste and surplus excavated material shall be removed and disposed of off-site. 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. Suitable excavated material shall be used for fill or backfill on the different parts of the work as required.

C. Surplus fill shall become the property of the Contractor and shall be removed and disposed off site.

3.06 GRADING

A. Grading in preparation for placing of fill shall be performed at all places that are indicated on the Drawings, to the lines, grades and elevations shown and otherwise as directed by the Engineer and shall be performed in such a manner that the requirements for formation of embankments can be followed. All material encountered, of whatever nature, within the limits indicated, shall be removed and disposed of as directed. During the process of grading, the subgrade shall be maintained in such condition that it will be well drained at all times. When directed, temporary drains and drainage ditches shall be installed to intercept or divert surface water which may affect the prosecution or condition of the work.

B. If at the time of grading it is not possible to place any material in its final location, 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. The Engineer reserves the right to make minor adjustments or revisions to the lines or grades if found necessary as the work progresses, in order to obtain satisfactory construction.

D. Stones or rock fragments larger than 2 inches in their greatest dimensions will not be permitted in the top 12 inches of the finished subgrade of all fills or embankments.

E. In cuts, all loose or protruding rocks on the back slopes shall be barred loose or otherwise removed to line or finished grade of slope. All cut and fill slopes shall be uniformly dressed to the slope, cross-section and alignment shown on the Drawings or as directed by the Engineer.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 02221
TRENCHING, BACKFILLING AND COMPACTION

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and perform all trenching for the Well No. 15 raw water pipeline and appurtenances, including drainage, filling, backfilling, disposal of surplus material and restoration of trench surfaces.

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 shall 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 gravel 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 related closely to the rate of pipe laying. All excavation shall be made in open trenches.

D. All excavation, trenching and related sheeting, bracing, etc, shall comply with the requirements of OSHA excavation safety standards (29 CFR Part 1926.650 Subpart P) and to the Florida Department of Labor and Industries, Division of Industrial Safety "Rules and Regulations for the Prevention of Accidents in Construction Operations" (Chapter 454 CMR 10.00 et. seq.) and State requirements. Where conflict between OSHA and State regulations exists, the more stringent requirements shall apply.

E. Wherever the requirement for 98 percent compaction is referred to herein it shall mean "at least 98 percent of maximum dry density as determined by modified proctor AASHTO T-180".

F. Prior to the start of work submit the proposed method of backfilling and compaction to the Engineer for review.

1.02 RELATED WORK

A. Site Preparation is included in Section 406 in JEA’s Water and Wastewater Standards Manual, and Section 02100.

B. Dewatering and Drainage is included in Section 02140.

C. Earthwork is included in Section 02200, and in Section 408 in JEA’s Water and Wastewater Standards Manual.

D. Pavement Repair is included in Section 02513, and Section 141- Replacement of Pavement, Walks and Driveways in the City of Jacksonville Standard Specification.

1.03 REFERENCES

A. Geotechnical Exploration and Evaluation Report prepared by Meskel & Associates, PLLC, entitled “Final Report of Geotechnical Exploration for JEA Main Street WTP Well No. 15,” Jacksonville, Florida, dated April 6, 2017.

B. American Association of State Highway and Transportation Officials (AASHTO) standards

1. AASHTO T-180 – Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and 457-mm (18-in.) Drop.

PART 2 PRODUCTS

2.01 MATERIALS

A. Materials for use as backfill shall conform to Section 02200.

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. Material shall be furnished as required from offsite sources and hauled to the site.

C. The Contractor shall take all the necessary precautions to maintain the work area in a safe and workable condition.

D. The Contractor shall protect his work at all times by flagging, marking, lighting and barricading. It shall also be the Contractor's responsibility to preserve and protect all above and underground structures, pipelines, conduits, cables, drains or utilities which are existing at the time he encounters them. 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 OWNER.

3.02 TRENCH PROTECTION

A. All excavation, trenching, and related sheeting, bracing, etc., shall conform to the requirements of the Florida Trench Safety Act (Part IV, Chapter 553 of the Florida Statutes) which incorporates by reference, the Occupational Safety and Health Administration’s (OSHA) excavation safety standards, (29 CFR 1926.650 Subpart P).

B. Construct and maintain sheeting and bracing as required to support the sides of excavations, to prevent any movement which could in any way diminish the width of the excavation below that necessary for proper construction, and to protect adjacent structures, existing piping and/or foundation material from disturbance, undermining, or other damage. Care shall be taken to prevent voids outside of the sheeting, but if voids are formed they shall be immediately filled and rammed.

C. For pipe trench sheeting, no sheeting is to be withdrawn if driven below mid-diameter of any pipe, and no wood sheeting shall be cut off at a level lower than 1 foot above the top of any pipe unless otherwise directed by the Engineer. If during the progress of the work the Engineer decides that additional wood sheeting should be left in place, he may direct the Contractor in writing. If steel sheeting is used for trench sheeting, removal shall be as specified above, unless written approval is given by the Engineer for an alternate method of removal. Sheeting left in place shall be shown on the Contractor's record drawings.

D. All sheeting and bracing not left in place shall be carefully removed in such a manner as not to endanger the construction or other structures, utilities, existing piping, or property. All voids left or caused by withdrawal of sheeting shall be immediately refilled with sand by ramming with tools especially adapted to that purpose, by watering or otherwise as may be directed.

E. The right of the Engineer to order sheeting and bracing left in place shall not be construed as creating any obligation on his part to issue such orders, and his failure to exercise his right to do so shall not relieve the Contractor from liability for damages to persons or property occurring from or upon the work occasioned by negligence or otherwise, growing out of a failure on the part of the Contractor to leave in place sufficient sheeting and bracing to prevent any caving or moving of the ground.

3.03 JOB CONDITIONS

A. The Contractor shall examine the site and review the available test borings or undertake his own soil borings prior to submitting his bid, taking into consideration all conditions that may affect his work. The Owner and Engineer will not assume responsibility for variations of sub-soil quality or conditions at locations other than places shown and at the time the investigation was made.

B. Existing Utilities: Locate existing underground utilities in the areas of work. If utilities are to remain in place, provide adequate means of protection during earthwork operations.

1. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult the Engineer and the owner of such piping or utility immediately for directions. Repair damaged utilities to satisfaction of utility owner.

2. Demolish and completely remove from site existing underground utilities indicated on the Drawings to be removed.

C. Protection of Persons and Property: Barricade open excavations occurring as part of this work and post with warning lights. Operate warning lights as recommended by authorities having jurisdiction.

1. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout and other hazards created by earthwork operations.

3.04 TRENCH EXCAVATION

A. Trench excavation shall include material of every description and of whatever substance encountered, except rock and boulders. Pavement shall be cut with a saw, wheel or pneumatic chisel along straight lines before excavating.

B. Strip and stockpile topsoil from grassed areas crossed by trenches. At the Contractor's option, topsoil may be otherwise disposed of and replaced, when required, with approved topsoil of equal quality.

C. While excavating and backfilling is in progress, traffic shall be maintained, and all utilities and other property protected as provided in the Terms and Conditions and General Requirements.

D. Trenches shall be excavated to the depth indicated on the Drawings and in widths sufficient for laying the pipe, bracing and for pumping and drainage facilities. The bottom of the excavations shall be firm and dry and in all respects acceptable to the Engineer. Trench width shall be practical minimum. Boulders, loose rocks or rock fragments which might bear against the pipe will not be permitted in the trench bottom. Embedment material shall be worked in under the haunches of the pipe to ensure complete contact with the pipe bottom.

E. Excavation and dewatering shall be accomplished by methods which preserve the undisturbed state of subgrade soils. The trench may be excavated by machinery to, or just below the designated subgrade, provided that material remaining in the bottom of the trench is no more than slightly disturbed. Subgrade soils which become soft, loose, "quick", or otherwise unsatisfactory as a result of inadequate excavation, dewatering or other construction methods shall be removed and replaced with compacted Structural Fill as required by the Engineer at the Contractor's expense.

F. Where pipe is to be laid directly on the trench bottom, final excavation at the bottom of the trench shall be performed manually, providing a flat-bottom true to grade upon undisturbed material. Bell holes shall be made as required. Blocking shall not be used to raise pipes to grade. If rock is encountered, excavation shall be made to at least 6 inches below the finish grade of the pipe and the resultant over-excavation shall be filled and compacted with structural fill material. No section of pipe shall rest directly on rock.

G. Where pipe is to be laid on crushed stone bedding, the trench may be excavated by machinery to the normal depth of the pipe provided that the material remaining in the bottom of the trench is no more than slightly disturbed.

H. If large gravel material (3 inches in dimension or larger) is encountered at the pipeline invert elevation, it shall be removed and the void space shall be backfill with AASHTO A-3 soil backfill.

I. If large size debris (3 inches in dimension or larger), or significant quantities of debris are encountered at the pipeline invert elevation, then the pipeline trench shall be excavated to one foot below the pipe invert elevation and backfilled with compacted AASHTO A-3 soil backfill before laying pipes.

J. Organic or clay soils, if encountered at the trench bottom, shall be completely removed and replaced with compacted structural fill.

3.05 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. It is expressly understood that no excavated material shall be removed from the site of the work or disposed of, except as directed by the Engineer. When removal of surplus materials has been approved by the Engineer, dispose of such surplus material in approved designated areas.

C. Should conditions make it impracticable or unsafe to stack material adjacent to the trench, the material shall be hauled and stored at a location provided. When required, it shall be re-handled and used in backfilling the trench.

D. All surplus and/or unsuitable excavated material shall be disposed of in the following manner:

1. Transport from Owner's property and legally dispose of. Any permit required for the hauling and disposing of this material beyond Owner's property shall be obtained by Contractor prior to commencing hauling operations.

E. Suitable excavated material may be used for fill if it meets the specifications for structural fill and is approved by the Engineer. Excavated material so approved may be neatly stockpiled at the site where designated by the Engineer provided there is an area available where it will not interfere with the operation of the facility nor inconvenience traffic or adjoining property owners.

3.06 SHEETING AND BRACING

A. The Contractor shall furnish, install and maintain sheeting and bracing required by Federal, State or local safety requirements to support the sides of the excavation and prevent loss of ground which could endanger personnel, damage or delay the work or endanger adjacent structures. If the Engineer is of the opinion that at any point sufficient or proper supports have not been provided, he/she may order additional supports placed at the expense of the Contractor. Compliance with, or failure to issue, such order shall not relieve the Contractor from his/her responsibility for the sufficiency of such supports. Care shall be taken to prevent voids outside of the sheeting, but if voids are formed, they shall be immediately filled and rammed.

B. When moveable trench bracing such as trench boxes, moveable sheeting, shoring or plates are used to support the sides of the trench, care shall be taken in placing and moving the boxes or supporting bracing to prevent movement of the pipe, or disturbance of the pipe bedding and the screened gravel backfill.

1. When installing rigid pipe (R.C., V.C., A.C., etc.), any portion of the box extending below mid diameter shall be raised above this point prior to moving the box ahead to install the next pipe. This is to prevent the separation of installed pipe joints due to movement of the box.

2. When installing flexible pipe (PVC, etc.), trench boxes, moveable sheeting, shoring or plates shall not be allowed to extend below mid-diameter of the pipe. As trench boxes, moveable sheeting, shoring or plates are moved, screened gravel shall be placed to fill any voids created and the screened gravel and backfill shall be re-compacted to provide uniform side support for the pipe.

C. Permission will be given to use steel sheeting in lieu of wood sheeting for the entire job wherever the use of sheeting is necessary. The cost for use of sheeting will be included in the bid items for pipe and shall include full compensation for driving, bracing and later removal of sheeting.

D. All sheeting and bracing shall be carefully removed in such manner as not to endanger the construction of other structures, utilities, or property, whether public or private. All voids left

after withdrawal of sheeting shall be immediately refilled with sand by ramming with tools especially adapted to that purpose, by watering or otherwise as directed.

E. No payment will be given for sheeting, bracing, etc., during the progress of the work. No payment will be given for sheeting which has actually been left in the trench for the convenience of the Contractor.

F. Sheeting driven below mid-diameter of any pipe shall remain in place from the driven elevation to at least 1-ft above the top of the pipe.

3.07 DEWATERING AND DRAINAGE

A. Dewatering and drainage shall be performed as specified in Section 02140.

3.08 TEST PITS

A. Excavation of test pits may be required for the purpose of exploring and locating buried debris, underground utilities or structures as an aid in establishing the precise location of new work.

B. Test pits shall be excavated sufficiently in advance of proposed work in order to allow conflicts to be addressed and shall be backfilled and compacted as soon as the desired information has been obtained. The backfilled surface shall be maintained in a satisfactory condition for travel until resurfaced as specified.

3.09 EXCAVATION BELOW GRADE AND REFILL

A. Whatever the nature of unstable material encountered or the groundwater conditions, trench drainage shall be complete and effective.

B. If the Contractor excavates below grade through error or for the Contractor's own convenience, or through failure to properly dewater the trench, or disturbs the subgrade before dewatering is sufficiently complete, he may be directed by the Engineer to excavate below grade as set forth in the following paragraph, in which case the work of excavating below grade and furnishing and placing the refill shall be performed at his own expense.

3.10 BACKFILLING

A. Prior to placing the pipe, the pipeline trench bottom shall be compacted to at least 98% of the modified proctor maximum dry density compaction (AASHTO T-180). Where backfill is used beneath the pipe invert, the backfill material shall be placed in loose lifts not exceeding 6-inch. Should the bearing level soils experience pumping and soil strength loss during the compaction operations, compaction work shall be immediately terminated and (1) the disturbed soils removed and backfilled with dry structural fill which are then compacted; (2) allow the excess moisture content within the disturbed soils dissipate before recompacting.

B. Pipe subgrade material shall be pre-shaped by means of a template prior to placing the pipe. Blocking shall not be used to raise the pipe to grade. Bell holes shall be provided at each joint to allow the joints to be assembled.

C. As soon as practicable after the pipe has been laid and jointed, backfilling shall begin and thereafter performed expeditiously.

D. An impervious dam or bulkhead cutoff of clay or other impervious material shall be constructed in the trench as directed, to interrupt the unnatural flow of groundwater after construction is completed. The dam shall be effectively keyed into the trench bottom and sidewalls. Provide at least one clay or other impervious material dam in the pipe bedding between each manhole where directed or every 300-ft, whichever is less.

E. Where the pipes are laid cross-country, the remainder of the trench shall be filled with Structural Fill material in loose lifts not exceeding 6-inch to 24 inches above the pipeline crown elevation, and then in loose lifts not exceeding 12-inch thereafter, and mounded 3-in above the existing grade or as directed. Where a loam or gravel surface exists prior to cross-country excavations, it shall be removed, conserved and replaced to the full original depth as part of the work under the pipe items. In some areas it may be necessary to remove excess material during the clean-up process, so that the ground may be restored to its original level and condition.

F. Where the pipes are laid in streets or paved areas, the remainder of the trench shall be filled with Structural Fill material in loose lifts not exceeding 6-inch to 24 inches above the pipeline crown elevation, and then in loose lifts not exceeding 12-inch thereafter and thoroughly compacted,

G. To prevent longitudinal movement of the pipe, dumping backfill material into the trench and then spreading will not be permitted until Structural Fill has been placed and compacted to a level 1-ft over the pipe crown elevation.

H. Backfill shall be brought up evenly on all sides. Each lift of backfill material shall be thoroughly compacted by rolling, tamping, or vibrating with hand-operated compaction equipment, to 98 percent compaction. The backfill material should exhibit moisture content within 2 percent of the modified proctor optimum moisture content (AASHTO T-180) during compaction operations. If rolling is employed, it shall be by use of a suitable roller or tractor, being careful to compact the fill throughout the full width of the trench.

I. If water restrictions are in force, obtain water elsewhere, or compact the backfill by other approved methods at no additional cost to this Contract.

J. Where other methods are not practicable, compaction shall be by use of hand or pneumatic ramming with tools weighing at least 20 lbs. The material being spread and compacted in layers not over 6 in thick. If necessary, sprinkling shall be employed in conjunction with rolling or ramming.

K. Backfill around structures shall be Structural Fill material. All backfill shall be compacted to the specified degree of compaction, especially under and over pipes connected to the structures.

L. Bituminous paving shall not be placed in backfilling unless specifically permitted, in which case it shall be broken up as directed. Frozen material shall not be used under any circumstances.

M. All road surfaces shall be broomed and hose-cleaned immediately after backfilling. Dust control measures shall be employed at all times.

3.11 COMPACTION

A. The Contractor shall control soil compaction during construction to provide the percentage of maximum density specified. The Contractor shall provide the Engineer copies of all soil testing

reports, prepared by a professional Geotechnical Engineer licensed in the State of Florida, demonstrating compliance with these specifications.

B. When existing trench bottom has a density less than that specified, the Contractor shall moisture-condition to the optimum moisture content and recompact to the required depth and percentage of maximum density.

C. Percentage of Maximum Density Requirements

1. The upper 12 inch of subgrade soil at the bottom of the pipe trench shall be compacted to achieve a minimum density of 98% of the maximum dry density as determined by modified proctor AASHTO T-180.

2. Structural fill in pipe trench to grade shall be densified to a minimum density of 98% of the maximum dry density as determined by modified proctor AASHTO T-180.

3. Structural fill under and around structures, and to the extent of excavation shall be densified to a minimum density of 98% of the maximum dry density as determined by modified proctor AASHTO T-180.

4. Structural fill under roads, paved surfaces and/or roadways embankments shall be densified to a minimum density of 98% of the maximum dry density as determined by modified proctor AASHTO T-180.

D. Compaction Tests

1. As a minimum, one compaction test location shall be required for each 150 linear feet of pipe. The Engineer may determine that more compaction tests are required to certify the installation depending on field conditions. The locations of compaction tests within the trench shall be in conformance with the following schedule:

a. One test on compacted subgrade soils, at 150 foot intervals.

b. At least one test for each lift of backfill, at 150 foot intervals.

2. If based on compaction testing reports and inspection, backfill, which has been placed, is below specified density, the Contractor shall, at his own expense, provide additional compaction and testing prior to commencing further construction.

3.12 GRADING

A. Grading shall be performed at such places as are indicated on the Drawings, to the lines, grades, and elevations shown or as approved by the Engineer and shall be made in such a manner that the requirements for formation of embankments can be followed. All unacceptable material encountered, of whatever nature within the limits indicated, shall be removed and disposed of as directed by the Engineer. During the process of excavation, the grade shall be maintained in such condition that it will be well drained at all times. When directed, temporary drains and drainage ditches shall be installed to intercept or divert surface water which may affect the prosecution or condition of the work.

B. If at the time of excavation it is not possible to place any material in its proper section of the permanent structure, it shall be stockpiled in approved areas for later use. No extras will be considered for the stockpiling or double handling of excavated material.

C. The right is reserved to make adjustments or revisions in lines or grades if found necessary as the work progresses, due to discrepancies on the Drawings or in order to obtain satisfactory construction.

D. Stones or rock fragments larger than 2 inches in their greatest dimensions will not be permitted in the top 12 inches of the final grade line.

E. All fill slopes shall be uniformly dressed to the slope, cross-section and alignment shown on the Drawings, or as approved by the Engineer.

F. In cuts, all loose or protruding rocks on the back slopes shall be barred loose or otherwise removed to line or finished grade of slope. All cut and fill slopes shall be uniformly dressed to the slope, cross-section and alignment shown on the Drawings or as approved by the Engineer.

G. No grading is to be done in areas where there are existing pipe lines that may be uncovered or damaged until such lines which must be maintained are relocated, or where lines are to be abandoned, all required valves are closed and drains plugged at manholes.

H. The Contractor shall replace all pavements cut or otherwise damaged during the progress of the work as specified elsewhere herein.

3.13 RESTORING TRENCH SURFACE

A. Where the trench occurs adjacent to paved streets, in shoulders, sidewalks, or in cross-country areas, thoroughly consolidate the backfill and maintain the surface as the work progresses. If settlement takes place, immediately deposit additional fill to restore the level of the ground.

B. In and adjacent to streets, the 12-in layer of trench backfill below the specified initial pavement shall consist of compacted bank-run gravel. Should the Contractor wish to use material excavated from the trench as gravel subbase for pavement replacement, the Contractor, at his/her own expense, have samples of the material tested by an independent testing laboratory at intervals not to exceed 500-ft, in order to establish its compliance with the specifications. Only material which has been tested and approved by the Engineer shall be allowed to be incorporated into the work.

C. The surface of any driveway or any other area which is disturbed by the trench excavation and which is not a part of the paved road shall be restored to a condition at least equal to that existing before work began.

D. In sections where the pipeline passes through grassed areas, and at the Contractor’s own expense, remove and replace the sod, or loam and seed the surface to the satisfaction of the Engineer.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 02270
EROSION AND SEDIMENTATION CONTROL

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall 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 for the Well No. 15 Facility and Raw Water Pipeline. The work shall include, but not necessarily be limited to; installation of temporary access ways and staging areas, silt fences, sediment removal and disposal, device maintenance, removal of temporary devices, temporary mulching and final cleanup.

B. All soil erosion and sediment control activities, provisions and measures shall comply with the "Manual for Erosion and Sediment Control in Florida", latest edition, and NPDES General Permit. Contractor shall be responsible for designing, providing and maintain effective erosion and sedimentation control during construction. The control must ensure erosion and sedimentation will either be eliminated or maintained within acceptable limits as established by the Owner.

C. The effectiveness of sedimentation and erosion control depends on effective initial installation and continual modification and maintenance during the course of work. The Contractor shall make a continual reasonable effort to achieve the objective of providing positive sedimentation and erosion control over all disturbed areas of the work site at all times. Should the Engineer or the Owner observe that areas are not continuously controlled, 10 percent of payments due for work in the areas not properly controlled shall be withheld until appropriate and complete sedimentation and erosion control actions are achieved.

1.02 RELATED WORK

A. Granular fill material is included in Section 408 in JEA's Water and Wastewater Standards Manual.

B. Sodding and Seeding is included in JEA's Water and Wastewater Standards Manual, Section 441 – Grassing.

1.03 SUBMITTALS

A. The Contractor shall submit, in accordance with Section 01300, within 10 days after award of Contract, technical product literature for all commercial products to be used for erosion and sedimentation control.

B. Approval does not relieve the Contractor of responsibility as to the effectiveness of the controls. The Engineer or Owner may require the Contractor to modify the control program to maintain its effectiveness at any time during the course of the work. The Contractor shall submit revised drawings as changes are made during the period the controls are in effect.

1.04 QUALITY ASSURANCE

A. The Contractor shall 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 offsite 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 Owner will be considered.

B. Sedimentation and erosion control measures shall conform to the requirements of all permits and Regulatory Agencies, and to requirements outlined in the State of Florida Erosion and Sediment Control Designer and Reviewer Manual, latest edition, Florida Department of Transportation Design Standards, latest edition, and Stormwater Pollution Prevention Plan.

C. Sedimentation and erosion control measures shall conform to the details shown on the Drawings.

PART 2 PRODUCTS

2.01 MATERIALS

A. Crushed stone for sediment filtration devices, access ways and staging areas shall conform to Florida Department of Transportation Standard Specifications for Road and Bridge, latest edition.

B. Sediment Fence

1. Sediment fence shall be a prefabricated commercial product made of a woven, polypropylene, ultraviolet resistant material such as “Envirofence” by Mirafi Inc., Charlotte, NC or equal.

C. 1/4-in woven wire mesh for filter boxes shall be galvanized steel or hardware cloth.

D. 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.

E. Latex acrylic copolymer or organic tackifier shall be a commercial product specifically manufactured for use as straw mulch tackifier.

F. 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 Owner.

G. Erosion control blanket shall be installed in all seeded drainage swales and ditches as shown on the Drawings or as directed by the Engineer, or Owner. Erosion control blanket shall be 100 percent agricultural straw matrix stitch bonded with degradable thread between two photodegradable polypropylene nettings, such as Model S150 Double Net Short-Term Blanket (10 months) by North American Green, Evansville, IN or equal.

H. Temporary seeding shall be with annual ryegrass. Permanent grass and sod shall be in accordance with JEA's Water and Wastewater Standard Manual Section 441 – Grassing.

PART 3 EXECUTION

3.01 INSTALLATION

A. Sediment 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. The Contractor shall dig trench approximately 6-in wide and 6-in deep along proposed fence lines.

3. The Contractor shall drive stakes, 8-ft on center (maximum) at back edge of trenches. Stakes shall be driven 2-ft (minimum) into ground.

4. The Contractor shall hang filter fabric on posts carrying to bottom of trench with about 4-in of fabric laid across bottom of trench. Stretch fabric fairly taut along fence length and maintain secure both ways.

5. The Contractor shall backfill trench with suitable material as indicated in the geotechnical exploration report.

6. The Contractor shall install pre-fabricated silt fence according to manufacturer's instructions.

B. Filter boxes shall be constructed as detailed on the Drawings, from 1/4-in woven wire mesh or hardware cloth and wood. The Contractor shall fill with crushed stone and place over all drop inlets and manholes to storm drain system as each inlet is completed. This should be done prior to setting casting, if there is a delay between installation of inlet structures or drain manholes and setting of castings. An alternate method is to ring each inlet with a sediment fence.

C. Staging areas and access ways shall be surfaced with a minimum depth of 4-in of crushed stone.

3.02 MAINTENANCE AND INSPECTIONS

A. Inspections

1. The Contractor shall 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, the Contractor shall promptly install additional devices as needed. Sediment controls in need of maintenance shall be repaired promptly.

B. Device Maintenance

1. Sediment Fences
   a. The Contractor shall remove accumulated sediment once it builds up to 1/2 of the height of the fabric.

b. The Contractor shall replace damaged fabric, or patch with a 2-ft minimum overlap.
c. The Contractor shall make other repairs as necessary to ensure that the fence is filtering all runoff directed to the fence.

2. Filter Boxes
   a. The Contractor shall replace crushed stone when it becomes saturated with silt.
   b. The Contractor shall replace muck out trapped silt from dewatering operations when it has built up to within 6-inch of the top of the berm.

3. The Contractor shall 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. The Contractor shall 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 4-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 4-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 4-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 4-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 4-in. Overlap lower end of upstream roll 4-in past edge of downstream roll and staple.

1. To ensure full contact with soil surface, the Contractor shall roll matting with a roller weighing 100 lbs/ft of width perpendicular to flow direction after seeding, placing matting and stapling. The Contractor shall thoroughly inspect channel after completion. The Contractor shall correct any areas where matting does not present a smooth surface in full contact with the soil below.

3.05 PERFORMANCE

A. If temporary erosion and sedimentation control measures employed by the Contractor are insufficient, or fail to be effective in opinion of the Engineer or the Owner, or fail to produce

results which comply with the requirements of Owner, the Contractor shall immediately take whatever steps are necessary to correct the deficiency at no additional cost to the Owner.

3.06 REMOVAL AND FINAL CLEANUP

A. Once the site has been fully stabilized against erosion, the Contractor shall remove sediment control devices and all accumulated silt. The Contractor shall dispose of silt and waste materials in proper manner. The Contractor shall re-grade all areas disturbed during this process and stabilize against erosion with surfacing materials as indicated on the Drawings, and perform final topsoiling, preparation, and seeding per Section 441 of the JEA's Water and Wastewater Standards Manual.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 02513
ASPHALTIC CONCRETE PAVING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. CONTRACTOR shall furnish all labor, materials, equipment, and incidentals required and place asphaltic concrete pavement in accordance with the grades and typical sections shown on the drawings and as specified herein. This includes work associated with the asphaltic pavement replacement on East 2nd Street and pipeline to the south to the existing 12-inch cast iron tie-in point at abandoned Well No. 8.

1.02 RELATED WORK

A. Site Preparation is included in Section 02100, and in Section 406 in JEA's Water and Wastewater Standards Manual.

B. Earthwork is included in Section 02200, and in Section 408 in JEA's Water and Wastewater Standards Manual.

C. Pavement repair is included in Section 141 in City of Jacksonville Standard Specifications.

1.03 SUBMITTALS

A. Submit to the Engineer, shop drawings showing proposed formulas for asphaltic concrete paving.

PART 2 PRODUCTS

2.01 MATERIALS

A. The limerock base shall conform to applicable sections of the City of Jacksonville City Standard Specifications and Standard Details.

B. The material used for the prime coat shall conform with the City of Jacksonville City Standard Specifications and Standard Details.

C. Bituminous material for tack coat shall meet the City of Jacksonville City Standard Specifications and Standard Details.

D. The materials for the asphaltic concrete surface shall conform with City of Jacksonville City Standard Specifications and Standard Details.

E. The paint used for parking and traffic stripes shall be yellow traffic paint which shall conform with the City of Jacksonville City Standard Specifications and Standard Details

PART 3 EXECUTION

3.01 INSTALLATION

A. The sub-grade preparation shall comply with the requirements of the City of Jacksonville City Standard Specifications and Standard Details. All soft and yielding material and other portions of

the sub-grade which will not compact readily shall be removed and replaced with suitable material and the whole sub-grade brought to line and grade and to a foundation of uniform compaction and supporting power. The cost of removing and replacing unsuitable material shall be included in the bid for the paving.

B. The top 12 inches of the sub-grade, in both cut and fill sections, shall be compacted to a density of not less than 100 percent of the maximum density as determined by the AASHTO Method T-180. Unless the sub-grade material at the time of compacting contains sufficient moisture to permit proper compaction it shall be moistened as necessary and then compacted. Sub-grade material containing excess moisture shall be permitted to dry to the proper consistency before being compacted. The sub-grade shall be shaped prior to making the density tests. The required density shall be maintained until the base or pavement has been laid or until the aggregate materials for the base or pavement course have been spread in place.

C. The minimum compacted thickness of the limerock base shall be 12 inches applied in two layers of equal depth unless otherwise shown on the drawings.

D. Before the prime coat is applied, all loose material, dust, dirt or other foreign material which might prevent bond with existing surface shall be moved to the shoulders to the full width of the base by means of revolving brooms, mechanical sweepers, blowers supplemented by hand sweeping or other approved methods. The glazed finish shall have been removed from the base. The prime coat shall be applied by a pressure distributor so that approximately 0.1 gallons per square yard is applied uniformly and thoroughly to a clean surface.

E. Prior to the application of the surface course, all loose material, dust, dirt and all foreign material which might prevent proper bond with the existing surface shall be removed to the full width of the repair by means of approved mechanical sweepers and supplemented by hand sweeping if required.

F. Apply bituminous tack coat at a rate between 0.05 and 0.15 gallon per square yard. Bituminous material shall be heated as per Manufacturer's recommendations.

G. The asphaltic concrete shall be placed at an average thickness of one and one-half (1-1/2) inch unless otherwise shown on the drawings.

H. All manhole castings, valve boxes or other utility castings within the area to be surfaces shall be adjusted to the proposed surface elevation by the Contractor. The work shall be accomplished in such a manner as to leave the casting fixed permanently in its correct position.

3.02 PAVEMENT REPAIR

A. Pavement repair shall conform with City of Jacksonville Standard Specifications Section 141 and Standard Details, as shown on the Contract Documents.

B. All damage to pavement as a result of work (construction or maintenance) under this contract shall be repaired in a manner satisfactory to the Engineer and at no additional cost to the Owner. Pavement shall be repaired to match the original surface material and original grade. However, the asphalt concrete thickness shall not be less than 1 inch. The repair shall include the preparation of the sub-grade, the placing and compacting of the limerock base, the priming of the base, the placing and maintaining of the surface treatment, all as specified herein.

C. The width of all repairs shall extend at least 12 inches beyond the limit of the damage. The edge of the pavement to be left in place shall be cut to a true edge with a saw or other approved method so as to provide a clean edge to abut the repair. The line of the repair shall be reasonably uniform with no unnecessary irregularities.

D. Milling shall be completed in accordance with City of Jacksonville City Standard Specifications and Standard Details and as shown on the drawings.

E. The Contractor is responsible for bringing any inconsistencies in the existing roadway to be consistent with the final grade of the roadway.

3.03 TESTING

A. The Owner shall have density, soil bearing, materials and such other tests performed as it may deem necessary. The Contractor shall pay the costs of such tests. The Contractor shall fully cooperate with the testing agency. Should any test indicate that any portion of the materials or workmanship does not comply with these specifications, a retest shall be performed at the Contractor's expense. If the retest confirms the first test, that portion of the work shall be removed and replaced or reworked at no additional cost to the Owner until satisfactory compliance is attained.

3.04 PARKING AND TRAFFIC STRIPES

A. The Contractor shall paint the stripes indicated on the drawings. The paint shall be applied in strict accordance with printed specifications of the Manufacturer of the paint being applied and City of Jacksonville City Standard Specifications and Standard Details. Unless otherwise indicated, the width of the stripes shall be 4 inches.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 02622
BELOW GRADE DUCTILE IRON (DI) PRESSURE PIPE

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required to install and test below-grade ductile iron pipe and fittings for yard piping as shown on the Drawings.

1.02 POTABLE WATER PIPING

A. Shall be as specified in the JEA Water and Wastewater Standards (January 2017), Potable Water Piping – Section 350.

1.03 POTABLE WATER VALVES AND APPURTENANCES

A. Shall be as specified in the JEA Water and Wastewater Standards (January 2017), Water Valves and Appurtenances – Section 351.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 02800
AUTOMATIC IRRIGATION SYSTEM

PART 1 GENERAL

1.01 PURPOSE

A. The objective of these specifications is to provide an assembled and fully functioning automatic irrigation system, which will efficiently irrigate all areas to be covered and shall be acceptable in all aspects to the Owner. These specifications, design details, and irrigation plans are to be considered part of the Contract, and the Contractor shall follow the specifications with due perseverance.

1.02 SCOPE OF WORK

A. Conform to the State Standards regarding special conditions, materials of construction and technical specifications. Where conflicts with these specifications occur, the more stringent shall apply.

B. The work contemplated by these specifications consists of the Contractor furnishing all materials, labor, equipment, and services required for all work described herein to install a fully automatic sprinkler system. This includes, but is not limited to all permits, bonds, codes, and State Licensure where applicable.

C. Unless otherwise specified, the plan and specifications are intended to include everything necessary for proper installation and completion of the work whether each necessary item is mentioned herein or not. The plan and specifications are intended to be cooperative and any item called for in one and not the other shall be as if called for in both. If a discrepancy exists between the plans and the specifications, the plan takes precedence.

D. All work specified shall be executed in compliance with all governing ordinances, laws and regulations of the State or any other authority having jurisdiction over the work. Additionally, any changes and/or additions in the work necessary to meet these conditions will be made without additional cost to the Owner.

E. The work to be done under this Contract includes, but is not limited to the following:

1. Furnish and install new piping, fittings, isolation valves and necessary pipe line appurtenances.

2. Furnish and install new electric control valves assemblies, emitters, driplines, filters and other appurtenances as necessary for a complete functioning system.

3. Furnish and install an irrigation controller including all necessary electrical connections.

4. Provide a new 1-in irrigation water service. Coordinate work with the owner.

1.03 RELATED WORK

A. Landscaping, as referred to in Section 02900.

1.04 TIME OF COMPLETION

A. Delays caused by the Owner, the Owner's representative, others who are not party to the Contractor, but whose act or action must precede work performed under this Contract, Acts of God, organized labor disputes and fire are considered legitimate delays to the time of completion. A reasonable extension of completion date shall be mutually agreed upon, in writing, by the Owner and Contractor.

1.05 SITE INSPECTION

A. Each bidder must visit the site of the proposed work and fully acquaint itself with the conditions there relating to construction and labor involving the Contract. Bidder shall thoroughly examine any form or legal document regarding the contract or site visit.

1.06 OWNER'S AUTHORIZED REPRESENTATIVE

A. The only authority to approve work, estimates, or the final contract is the Owner or his authorized representative. For the scope of these plan and specifications, the term "Owner" refers to the Owner or his authorized representative.

1.07 UTILITIES AND PROTECTION

A. The Owner shall make available to the Contractor all necessary information regarding the known locations of existing utilities or drainage line within the site's property lines. Before beginning any work, Contractor shall mark locations of such utilities and/or any underground obstructions at the site. Also, Contractor shall call a Dig Safe service before beginning any work. The Contractor shall be fully liable for the damages to and the cost of repairing or replacing any utilities encountered during the installation of the work, unless it was not previously informed of such underground utilities.

1.08 HANDLING OF CONTRACTOR'S MATERIAL AND EQUIPMENT

A. A Contractor shall provide and pay for all transportation required to deliver and remove from the site all materials and equipment, as required for all the work shown and specified.

1.09 EQUIPMENT, TOOLS AND LABOR

A. The Contractor shall furnish all such equipment, materials, tools, and labor necessary to pursue the work in an acceptable manner, towards rapid completion. This Contract is based on the Contractor furnishing equipment, materials, tools, and labor which are suitable to carry out this contract in a professional and thorough manner, unless otherwise herein specified.

1.10 OWNER'S SUPERVISION

A. The Owner assumes no responsibility in the supervision and inspection of the work involved in the execution of this Contract beyond insuring, to the Owner's satisfaction, that the plan, general conditions, and specifications are being properly interpreted and implemented. This supervision and inspection will not relieve the Contractor of any responsibility for the performance of its work in accordance with the plan, general conditions, and specifications.

1.11 QUALIFICATION OF IRRIGATION CONTRACTORS

A. A list of three similar completed projects with references and telephone numbers shall be provided with the required submittal.

PART 2 PRODUCTS

2.01 MATERIALS

A. The materials chosen for the design of the irrigation system have been specifically referred to by the manufacturer so as to enable the Owner to establish the level of quality and performance required by the system design. In order to maintain this quality, all heads, electric valves, and controllers are to be manufactured by a single manufacturer. Equipment by other named manufacturers other than what is specified will be accepted (provided that the heads, valves, and controllers are made by a single manufacturer).

B. The major components of the irrigation system shall be covered by a two year over-the-counter warranty (major components include: emitters, driplines, electric zone valves, filters and the automatic controller).

C. Submittals

1. Material List
   a. Complete material list shall be submitted prior to performing any work. Material list shall include the manufacturer's model number and description of all materials and equipment to be used.
      1) Materials installed or furnished and not matching submitted material list shall be rejected by the Owner and shall require the Contractor to remove such equipment or materials from the site at its own expense.
   b. Manufacturer's warranties shall not relieve the Contractor of its liabilities and responsibilities under these specifications.

2. Equipment to be furnished at conclusion of the project
   a. Ten percent of the installed number of each type of emitter.
   b. Provide two of any special tools required for installation.

3. Before final acceptance of the work, Contractor shall provide written evidence that the Owner has received these materials.

2.02 AUTOMATIC CONTROLLER

A. The irrigation controller shall be capable of automatic, semi-automatic, and manual operations. It shall be housed in a high impact plastic, weatherproof, locking enclosure suitable for indoor or outdoor use.

B. The controller shall have the following features:

1. A power input of 120 VAC and shall be capable of operating at least two zones. The controller shall be compatible with the automatic control valves provided for this project, and shall provide 24 VAC output.

2. The controller shall have a 12/24 hour real time clock and 365 day calendar. Time of day, day of week, programming and operational status information shown in a large LCD display shall be provided.

3. Four separate irrigation programs with each program capable of running in a 14-day variable cycle, 1 to 14 day fixed interval cycle, or odd/ even day cycle.

4. The controller shall be equipped with surge protection on both the input side and each control valve output.

5. A lithium battery power backup shall be provided.

C. The automatic controller shall be Model IC-400M, manufactured by Hunter, or equivalent controller manufactured by Toro or The Rainbird Corporation.

2.03 DRIPLINE

A. The dripline shall be polyethylene tubing that contains pressure compensating, inline emitters spaced evenly.

B. The emitters shall provide a flow rate of 0.53 gph when system pressure is 20-40 psi.

C. The dripline shall be Model PLD-10-18 Dripline, manufactured by Hunter, or equivalent dripline as manufactured by Toro or The Rainbird Corporation.

2.04 CONTROL ZONE SYSTEM

A. A combination control valve and pressure regulating basket filter shall be provided.

B. The valve shall have the following features:

1. The electric remote control valve shall be a normally closed 24 VAC solenoid actuated globe/angle pattern design.

2. The valves shall be 1-inch in size.

3. The valve construction shall allow removal of all internal parts from the top of the valve without disturbing the valve installation.

4. The valve shall have a flow control stem for manual regulation or shut off.

C. The pressure regulating basket filter shall contain a 200 mesh stainless steel filter and a built-in 40 psi pressure regulator.

2.06 VALVE ACCESS BOX

A. Valve boxes shall be constructed of recycled solid structural material.

B. Valve boxes shall be provided in sizes sufficient to allow access to both the control valve and the basket filter.

C. The Contractor shall fill the entire area beneath the box with pea gravel before final installation of each box.

2.07 24 VAC CONTROL AND COMMON WIRE

A. All control and common wire shall be #14/1 direct burial type. The wire shall be solid copper and insulated with polyethylene or polyvinylchloride. Control wire shall be red in color. Common wire shall be white in color.

2.08 WIRE SPLICES

A. Wire splicing kits for single U.F. wire connections shall be direct burial kits consisting of sealant which shall not set up hard allowing splices to be reworked without cutting wires.

B. Direct burial kits shall have an application temperature range of 32 to 120 degrees F and service 600 VAC maximum.

2.09 POLYVINYL CHLORIDE (PVC) PIPE

A. All PVC pipe specified on the plan shall be virgin, high impact, polyvinyl chloride pipe, having a minimum working pressure rating of Class 160 or Class 200.

B. All PVC pipe shall be continuously and permanently marked with the manufacturer's name, material, size, and schedule or type. The pipe shall be capable of withstanding a long term pressure test (1000) hours of 420 psi and a quick termburst test of 630 psi.

C. The pipe shall conform to U.S. Department of Commerce Commercial Standard CS 207-60, or latest revision. Material shall conform to all requirements of Commercial Standard (cs 256-63), or latest revision.

D. Fittings for use with PVC pipe shall be Schedule 40 fittings produced from PVC Type 1, cell classification 12454-B.

E. The fittings shall be listed by the National Safety Foundation for potable water services. The fittings shall be listed by IAPMO for water services and gas yard piping in appropriate types and sizes. PVC fittings shall meet the following codes and specifications: ASTM D1784 and ASTM D246.

F. Cement for use on PVC fittings shall be NSF approved, for Type I and Type TT PVC pipe, and schedule 40 fittings. Cement is to meet ASTM D2564 and F493 for potable water, pressure, gas conduit and drain pipes. Application temperature shall be 35 to 110 degrees F.

2.10 POLYETHYLENE PIPE

A. All poly pipe specified on the plan shall be flexible, non-toxic polyethylene made from 100 percent virgin polyethylene material. Minimum working pressure is 100 psi. The pipe shall be permanently marked with the manufacturer's name, material, size, and schedule. The pipe shall be high density and approved by the National Sanitation Foundation.

B. The polyethylene pipe shall comply with the following standards and codes: ASTM D2239, PHS-81.

C. Fittings for poly pipe shall be internal fit, barbed style. The construction shall be from nylon or plastic. The fittings shall meet the following standards and codes: ASTM D2609, PVC Type 1, Grade 1.

D. Clamps for use on poly pipe insert style fittings shall be pincer type, 1-ear design made from 300 series stainless steel and specifically designed for underground irrigation systems. Clamps shall be constructed with patented "dimple" which increases in strength and creates a spring-like action that will permit the clamp to "breathe" without loosening. A crimping tool shall be used to tighten the clamp.

E. Plastic or brass saddles for use on poly pipe shall be used as a means of attaching the sprinklers from pipe to swing joint. The saddles shall be a clamp-on style with a threaded female hole. A punch or burning tool shall be used to create a hole for water access.

2.11 RAIN SENSOR

A. The rain sensor device shall be designed to prevent sprinkler operation during rainfall. The rain sensor shall install easily to roof eaves or 3/4-in galvanized steel pipe.

B. When exposed to rain water, a stack of absorbent disks within the rain sensor shall expand and open a microswitch, interrupting power to the control valves. An adjustments knob on the rain sensor shall allow the shut-off point set from 1/8 to 1-in of rainfall. When the rain stops, the disks dry out allowing the microswitch to close and the sprinklers to operate as scheduled. The normally-open/ normally-closed microswitch shall be rated 125 VAC, 4 Amp. The rain sensor shall be UL listed.

C. The rain sensor shall be Model Mini-Clik as manufactured by Hunter, or equivalent sensor as manufactured by Toro or The Rainbird Corporation.

2.12 BACKFLOW PREVENTER

A. The backflow preventer shall be a Reduced Pressure Device consisting of two independently operating, spring loaded, "Y" pattern check valves and one hydraulically dependent differential relief valve. The device shall automatically reduce the pressure in the zone between the check valves to at least 5 psi lower than the inlet pressure. Should the differential between the upstream and the zone of the unit drop to two psi, the relief valve shall open and maintain the proper differential.

B. Mainline and valve body and caps, including relief valves shall be bronze. Check valve moving member shall be center stem guided. All hydraulic sensing passages shall be internally located within the mainline and relief valve bodies and relief valve cover. Check and relief valve components shall be constructed so they may be serviced without removal. Shut-off valves shall be fully ported.

C. The device shall be rated to 175 psi water working pressure and water temperature range from 32 to 140 degrees F.

D. The backflow preventer shall be a 1-inch, model 009-QT-1, as manufactured by Watts, or approved equal.

PART 3 EXECUTION

3.01 INSTALLATION REQUIREMENTS

A. The word "piping" in this Section means pipe, fittings, nipples, and valves, and shall be considered as such in this installation.

B. The Drawing indicates the areas to be served by the sprinkler system. The Contractor shall take into consideration the fact that the sprinkler system installed must be coordinated with the landscape needs and that any further changes or additions needed to water the indicated areas shall be included as part of the Contract without additional charges unless agreed upon by the Owner.

C. Install pipes as shown on the Drawing, and directed during the installation as straight and direct as possible.

D. The arrangements, positions, and connection of pipes, drains, valves, and the like indicated on the Drawing, shall be followed as closely as possible, but the right is reserved by the Owner to change locations and elevations to accommodate conditions which may arise during the progress of the work prior to installation without additional compensation for such changes. The responsibility for accurately laying out the work and coordinating the installation with other trades rests with the Contractor. Should it be found that any work is laid out so that interferences will occur, report conflict to Owner before commencing work.

3.02 EXCAVATING AND BACKFILLING

A. The Contractor shall do all necessary excavating and backfilling required for the proper installation of the work excepting as noted on the plan.

B. On sodded areas the Contractor shall remove and replace the sod using a mechanical sod cutter or sod lifter hand tool where warranted from the trench area to the necessary width and depth required to facilitate installation.

C. When backfilling, all backfill material shall be free from rock, large stone or other unsuitable substances to prevent damage to the pipe and all common control wiring. Backfilling of trenches containing plastic pipe shall be done when the pipe is cool to avoid excessive contraction in cold weather. All backfill material will be compacted in 6-in layers as its brought up to finish grade so as to insure that no settling results.

3.03 PIPE INSTALLATION

A. The Contractor must provide effective protection at all times to prevent sand, rubbish, or any other debris from entering the piping. When work is stopped at night, or at any other time, the ends of the pips must be closed with plugs properly secured. Sidewalks shall be clear of project debris and equipment at all times and barricades and/or tape shall be installed around any trenches left open.

B. P.V.C. piping 2-in and smaller shall be trenched to a depth of 12 to 18-in as soil and grade conditions permit.

C. Any cutting or breaking of sidewalks and/or concrete necessary shall be performed by the Contractor and paving replaced as part of the Contract cost. Permission to cut or break sidewalks and/or concrete shall be obtained from the Owner. No hydraulic driving or drilling will be permitted under asphaltic concrete paving.

3.04 ELECTRICAL INSTALLATION

A. Provide under Division 16, 120 volt power supplies to controllers.

B. All control circuitry passing through the wall of the building or beneath a sidewalk, road, or drive, shall be installed in a suitable sleeve; whereas in all other locations they shall be installed in the pipe trench and protected by the pipe whenever possible. Conduit through construction of building shall be a metal pipe. Other sleeving may be of PVC material.

C. The joining of all underground wires shall be by the use of wire nuts, covered with Scotch Lok or D.B.Y. water-proof connection per installation instructions provided by the manufacturer.

D. Wire shall be coiled at all solenoid connections by wrapping at least five turns of wire around a rod or pipe approximately one inch in diameter, then withdrawing rod.

E. All electrical work shall comply with the National Electrical Code, local electrical inspectors requirements and the requirements of the local utility company.

3.05 CLEANING THE PREMISES

A. Clean up shall be performed as each portion of the work progresses. Refuse, rubbish and excess dirt shall be removed from the site. Upon completion of the job, the Contractor shall clean up all debris caused by its work and leave the job in a neat and clean condition. All sidewalks and paving shall be broomed or washed down. All debris removed from the job will be taken away from the premises.

3.06 TESTING THE SYSTEM

A. Work included under this section includes all tests required under laws, ordinances, rules and regulation of State or local agencies and any other authority having jurisdiction over the work, and shall be made in accordance therewith to prove water-tightness of both systems.

B. The system shall be tested by the Contractor for a minimum time limit of two hours at the normal system hydrostatic pressure and upon visual inspection of the ground, should any leak be found, it shall be promptly repaired. The line shall then be retested until proven watertight.

C. The work under this section shall include the furnishing of all testing instruments, gauges, pumps, etc, and other equipment with appurtenances required or necessary for all test.

D. Owner shall be notified at least forty-eight hours in advance of all tests and all tests shall be conducted to Owner's full satisfaction.

3.07 ADJUSTING AND BALANCING THE SYSTEMS

A. Contractor shall adjust all sprinkler emitters and valves for optimum performance and to prevent, as much as possible, any wasted water. No spray is permitted on buildings. Such adjustments shall include adjusting or changing nozzle sizes, installing and replacing pressure compensating devices (PCD's).

B. Following all tests for water-tightness and integrity, and following the above adjustments, Contractor shall perform complete coverage tests of both systems in presence of the Owner to confirm adequate and complete coverage to Owner's full satisfaction.

3.08 AS-BUILT DRAWING

A. Within sixty days after completion of the piping installation, Contractor shall furnish an "as-built" drawing showing all sprinkler heads, valves, drains, and pipelines to scale with dimensions where required. Instruction sheets, parts sheets, and manufacturer's manuals covering all equipment and materials will be bound into a single hard cover three ring binder and furnished to the Owner.

3.09 INSTRUCTIONS

A. After completion and testing of the system, Contractor shall instruct Owner's personnel in the proper and full operation and maintenance of the systems. Confirmation of such instruction shall be furnished in writing at conclusion of the project.

3.10 SERVICE AND GUARANTEE

A. The Contractor shall submit a single guarantee that all portions of the work are in accordance with the Contract requirements and providing for maintenance of the system. The Contractor shall guarantee all work against faulty and improper material and workmanship for a period of one year from date of final acceptance by the Owner, except that where guarantees or warranties for longer terms are specified herein, such longer term to apply. Within forty-eight hours after notification, Contractor shall correct any deficiencies that occur during the guarantee period at no additional cost to the Owner, all to the satisfaction of the Owner. The Contractor shall also obtain similar guarantees from its Subcontractors.

B. The Contractor shall be responsible for all leaks in all pipes for a period of one year from date of acceptance of work under this Contract. Repair at no cost to the Owner all such leaks that occur within forty-eight hours prior to the completion of this Contract at once. The Contractor shall be responsible for any damage caused by such leaks and repair.

C. The Contractor shall provide all service necessary to maintain the system for a period of one year from date of final acceptance from the Owner. This shall include properly winterizing the system in the winter and starting the system in spring.

END OF SECTION

SECTION 02900
LANDSCAPING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and service required and complete all planting and related landscaping work indicated on the Drawings and as specified herein, including but not necessarily limited to the following:

1. Supplying of loam for all plant pits and planting beds. Be responsible for all topsoil preparation, testing, conditioning and fertilization and shall ensure the overall quality of the material. Loam stockpiled from other construction operations under this Section may be used.

2. Excavation of pits for trees.

3. Furnishing and planting trees and shrubs as shown on the Drawings.

4. Supplying accessory materials and wrapping, guying and staking of all trees.

5. Pruning of plant materials as specified and as approved by the Engineer.

6. Supplying and spreading mulch for tree pits and planting beds as specified herein.

7. Maintenance and guarantee.

8. Final cleanup and all other work required to complete the job in accordance with the Drawings and as specified herein.

B. The planting work shall be performed by a landscape contractor who is fully experienced in projects of this scope and whose main business is landscaping. Selection of the landscape contractor shall be subject to the approval of the Engineer.

1.02 RELATED WORK

A. Site preparation is included in Section 02100.

B. Automatic irrigation is included in Section 02800

1.03 SUBMITTALS

A. Submit, in accordance with Section 01300, samples of all materials for inspection and approval.

1.04 REFERENCE STANDARDS

A. American Association of Nurseryman (AAN)

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 FERTILIZER, SOIL AND PLANT CONDITIONERS

A. Fertilizer shall be commercial mixed free flowing granules or pelleted fertilizer, 10-10-10 (N-P2O5-K2O) with at least 40 percent of the nitrogen in the fertilizer to be slowly available (organic) form. Fertilizer shall be delivered to the site in original unopened containers each showing the manufacturer's guaranteed analysis conforming to applicable state fertilizer laws.

B. Peat Moss: When required, shall be domestic brown sphagnum peat, free of woody materials and of mineral matter such as sulfur and iron and shall have a pH value between 4 and 5. Deliver air dry.

C. Weed Retarder: When required, shall be "Garden Weeder" by Am. Chem. Products Inc. or equal, delivered in manufacturer's containers and used according to manufacturer's instructions.

D. Anti-desiccant: When required, shall be an emulsion which provides a protective film over plant surfaces to help retain moisture, but permeable enough to permit transpiration. Anti-desiccant shall be delivered in the manufacturer's containers and shall be mixed with water in proportions recommended by manufacturer. Anti-desiccant shall be "WILT-PRUF" available from Nursery Specialty Products Inc., Greenwich, CT or equal.

E. Bone Meal: When required, shall be commercial raw bone meal, finely ground, having a minimum analysis of 4 percent nitrogen and 20 percent phosphoric acid.

F. Mulch: Shall be Pine Bark Nuggets mulch consisting of pine bark nuggets no longer than 2-in in any dimension, free of wood chips, stones or other undesirable matter with a pH range between 4 and 5.

G. Soil Sterilent: When required, shall be "TRIOX" by Ortho Chemical Co. or equal.

H. Water used in this work shall be furnished by the Contractor and shall be suitable for irrigation and free from ingredients harmful to plant life. Hose and other watering equipment required for the work shall be furnished by the Contractor.

2.02 ACCESSORY MATERIALS

A. Stakes: Shall be used for supporting all trees and shall be of sound wood, uniform in size, reasonably free of knots and capable of standing in the ground at least 2 years. Stakes shall be treated with a non-toxic preservative stain with a rich dark brown color. A sample shall be provided for approval by the Engineer. Stakes shall be 2 by 4 and not less than 8-ft in length.

B. Wire: For tree staking, shall be Double No. 10 gauge galvanized soft steel wire, twisted.

C. Hose: To encase wires, shall be two-ply fiber-bearing black rubber garden hose, not less than 1/2-in inside diameter and a minimum of 8-in in length.

D. Wrapping Material: Shall be first quality, heavy waterproof crepe paper manufactured for this purpose. Strips shall be 6 to 10-in wide. Twine for tying shall be coarse sisal yarn.

2.03 PLANT MATERIALS

A. Furnish and install trees and shrubs as shown on the Drawings. Plants shall be nursery grown under climatic conditions similar to those in the locality of the project and shall conform to the variety and sizes indicated. Plants shall conform also to the indicated botanical names and standards of size, culture and quality for the highest grades and standards as adopted by the AAN in the American Standard for Nursery Stock.

B. All plants shall be freshly dug. No heeled-in plants or plants from cold storage shall be used. All plants shall be typical of their species or variety and shall have a normal habit of growth. Plants shall be sound, healthy and vigorous, well-branched and densely foliated when in leaf; shall be free of disease, insect pests, eggs or larvae and shall have healthy, well-developed root systems. All parts of the plant shall be moist and shall show active green cambium when cut.

C. The height of the trees, measured from the crown of the roots to the top of the top branch, shall not be less than the minimum size designated. The trunk of each tree shall be a single trunk growing from a single unmutilated crown of roots. No part of the trunk shall be conspicuously crooked as compared with normal trees of the same variety. The trunk shall be free from sun-scald, frost cracks, or wounds resulting from abrasions, fire, or other causes. No pruning wounds shall be present having a diameter of more than 2-in and such wounds must show vigorous bark on all edges.

2.04 INSPECTION OF PLANT MATERIALS

A. Inspection of plants before digging shall be at the option of the Engineer. Be present if requested by Engineer, for inspection of plants at nursery.

B. Plants shall be subjected to inspection and approval upon delivery for conformity to specified requirements as to quality, size and variety. Such approval shall not impair the right of inspection and rejection during the progress of the work.

C. Plants shall be accompanied by State Nursery inspection certificates.

PART 3 EXECUTION

3.01 DIGGING, HANDLING AND PROTECTION OF PLANTS

A. Plants shall be dug with firm natural balls of earth, of sufficient diameter and depth to include most of the fibrous roots and conforming to the standards of AAN. No plants will be accepted with plastic burlap or if the ball is cracked or broken except upon special approval of the Engineer.

B. Roots or balls of plants shall be adequately protected at all times from sun and from drying winds.

C. Plants which cannot be planted immediately upon delivery shall be set on the ground and be well-protected with soil, wet moss, bark mulch, or other acceptable material.

D. No plant shall be bound with wire or rope at any time so as to damage the bark or break branches.

3.02 PLANTING SEASONS

A. Planting shall only be done during the periods within the seasons which are normal for such work as determined by weather and by locally acceptable practice and which are approved by the Engineer. If planting occurs between June 15th and August 15th or during periods of drought, irrigation shall be furnished as directed by the Engineer.

3.03 PLANTING OPERATIONS

A. Planting: Shall be done by experienced workmen familiar with planting procedures under the supervision of a qualified foreman.

B. Stake out locations of and secure the Engineer's approval before excavating plant pits.

C. All plant pits shall be excavated with vertical sides.

D. Tree Pits: Shall be 2-ft greater in diameter than the root ball of the tree and sufficiently deep to allow for a 1-ft thick layer of compacted loam and peat moss beneath the ball.

E. Shrub Beds: Shall be tilled to 18-in below top of loam.

F. Plant backfill mixture: Loam for backfilling all tree pits shall have 3 lbs of fertilizer and 1 lb of bone meal per tree and 1 lb of fertilizer and 1/2 lb of bone meal per shrub, incorporated with peat moss at a ratio of 2 parts loam to 1 part peat moss.

G. Plants shall be set in center of pits plumb and straight and at such a level that after settlement, the crown of the plant ball will be at the surrounding finished grade.

1. When balled and burlapped plants are set, loam shall be compacted around bases of balls to fill all voids. All burlap, ropes or wires shall be removed from the top 1/3 of the balls. Plastic burlap shall be completely removed.

H. Loam shall be backfilled in layers of not more than 9-in and each layer watered sufficiently to settle before the next layer is put in place.

I. Loam around balls shall be thoroughly compacted and watered. Immediately after the plant pit is backfilled, a saucer or shallow basin slightly larger than pit shall be formed with a ridge of soil to facilitate and contain watering.

3.04 WRAPPING, GUYING AND STAKING

A. Trees shall be inspected by the Engineer for injury to trunks, evidence of insect infestation and improper pruning before wrapping.

B. All shade trees, flowering trees and evergreen trees 5 to 6-ft in height and larger shall be staked in accordance with the tree staking detail.

3.05 PRUNING, MULCHING AND PLACEMENT OF WASHED GRAVEL

A. Each plant shall be pruned at the time of planting in accordance with AAN Standards to preserve the natural character of the plant and as directed by the Engineer.

B. Pruning shall be done with clean, sharp tools.

C. Immediately after planting operations are completed, all tree pits shall be covered with a 3-in layer of the specified mulch and shrub and ground cover beds shall be treated with weed retardant in accordance with manufacturer's instructions and covered with 3-in layer of mulch as indicated on the Drawings.

D. Washed gravel shall be placed to a 6-in depth in all areas as shown on the Drawings. Prior to placement of gravel the areas shall be treated with a soil sterilent in accordance with manufacturer's instructions.

3.06 OBSTRUCTIONS BELOW GROUND

A. In the event that underground boulders, underground construction work, or obstructions are encountered in any pit excavation work under this Contract, alternate locations may be selected by the Engineer at no additional cost to the Owner.

3.07 WATERING

A. Plantings must be flooded with water twice within the first 24 hours of the time of planting and not less than twice per week until permanent irrigation is installed and active or provisional acceptance.

B. Suitable water for planting will be the responsibility of the Contractor. The Contractor shall furnish his/her own hose and hose connections or other watering equipment until permanent irrigation is installed and active.

3.08 MAINTENANCE

A. Maintenance shall begin immediately after each plant is installed. Plants shall be watered, mulched, weeded, pruned, sprayed, fertilized, cultivated and otherwise maintained and protected until provisional acceptance. Settled plants shall be reset to proper grade and position, planting saucer restored and dead material removed. Guys shall be tightened and repaired. Defective work shall be corrected as soon as possible after it becomes apparent and as weather and season permit.

B. Upon completion of planting and prior to provisional acceptance, remove from the site excess soil and debris and repair all damage resulting from planting operations.

3.09 INSPECTION AND PROVISIONAL ACCEPTANCE

A. The Engineer will inspect all work for provisional acceptance, at the end of the 8 week maintenance period, upon the written request of the Contractor received at least 10 days before the anticipated date of inspection.

B. Furnish full and complete written instructions for maintenance of the planting to the Owner at the time of provisional acceptance.

C. After all necessary corrective work has been completed and maintenance instructions have been received by the Owner, the Engineer will certify in writing the provisional acceptance of the planting.

3.10 GUARANTEE PERIOD AND REPLACEMENTS

A. All plants and trees, including relocated material, shall be guaranteed for not less than one full year from the time of provisional acceptance.

B. At the end of this period, any plant that is missing, dead, not true to name or size as specified, or not in satisfactory growth, as determined by the Engineer, shall be replaced. In case of any question regarding the condition and satisfactory establishment of a rejected plant, the Engineer's decision is final. Furnish a guarantee for all replacement plants for at least one full growing season.

C. All replacements shall be plants of the same kind and size as specified. They shall be furnished and planted as specified herein. The cost of replacement shall be borne by the Contractor except where it can be definitely shown that loss resulted from vandalism.

3.11 FINAL INSPECTION AND FINAL ACCEPTANCE

A. At the end of the guarantee period, inspection will be made by the Engineer upon written request submitted by the landscape contractor at least 10 days before the anticipated date.

B. After all necessary corrective work has been completed, the Engineer will certify in writing the final acceptance of the planting.

END OF SECTION

SECTION 03301
CONCRETE AND REINFORCING STEEL

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and install all concrete work 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. Grout is included in Section 03600.

1.03 SUBMITTALS

A. Submit, in accordance with Section 01300, shop drawings and product data for:

1. Placing drawings and bar bending details in conformity with the recommendations of ACI 315.

2. Sources of cement, fly ash, aggregates, and batched concrete. Indicate name and address of mill or quarry, as applicable.

3. Air-entraining admixture. Product data including catalogue cut, technical data, storage requirements, product life, recommended dosage, temperature considerations and conformity to ASTM standards.

4. Water reducing admixture. Product data including catalogue cut, technical data, storage requirements, product life, recommended dosage, temperature considerations and conformity to ASTM standards.

5. Sheet curing material. Product data including catalogue cut, technical data and conformity to ASTM standard.

6. Material Safety Data Sheets (MSDS) for all concrete components and admixtures.

7. 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.

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 or ground granulated blast furnace slag. 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 7, 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. Certificate of conformance for concrete production facilities from NRMCA.

3. Certify that the Contractor is not associated with the independent testing laboratory proposed for use by the Contractor nor does the Contractor or officers of the Contractor's organization have a beneficial interest in the laboratory.

4. Certify that cement is produced by a manufacturer that does not use hazardous waste derived fuel as an energy source for its kilns.

D. Qualifications

1. Independent Testing Laboratory
   a. Name and address
   b. Names and positions of principal officers and the name, position, and qualifications of the responsible registered professional engineer in charge.
   c. Listing of technical services to be provided. Indicate external technical services to be provided by other organizations.
   d. Names and qualifications of the supervising laboratory technicians.

e. Statement of conformance provided by evaluation authority defined in ASTM C1077. Provide report prepared by evaluation authority when requested by the Engineer.
f. Submit as required above for other organizations that will provide external technical services.

1.04 REFERENCE STANDARDS

A. ASTM International

1. ASTM A82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.

2. ASTM A185 - Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.

3. ASTM A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.

4. ASTM C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.

5. ASTM C33 - Standard Specification for Concrete Aggregates.

6. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

7. ASTM C94 - Standard Specification for Ready-Mixed Concrete.

8. ASTM C143 - Standard Test Method for Slump of Hydraulic-Cement Concrete

9. ASTM C150 - Standard Specification for Portland Cement

10. ASTM C173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.

11. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.

12. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.

13. ASTM C311 - Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for use in Portland Cement Concrete.

14. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete.

15. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Portland Cement Concrete.

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 301 - Specification for Structural Concrete.

4. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete.

5. ACI 305R - Hot Weather Concreting.

6. ACI 306R - Cold Weather Concreting.

7. ACI 315 - Details and Detailing of Concrete Reinforcement.

8. ACI 318 - Building Code Requirements for Structural Concrete.

C. Concrete Reinforcing Steel Institute (CRSI)

1. MSP - Manual of Standard Practice

D. National Ready Mixed Concrete Association (NRMCA)

1. Quality Control Manual, Section 3- Certification of Ready Mixed Concrete Production Facilities

E. Truck Mixer Manufacturers Bureau (TMMB)

1. TMMB 100 - Truck Mixer, Agitator and Front Discharge Concrete Carrier Standards.

F. 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 stated specifications, codes, standards, and this Section when conflicts exist.

B. Independent testing laboratory shall meet the requirements of ASTM E329 and ASTM C1077 and be acceptable to the Engineer. Laboratories affiliated with the Contractor or in which the Contractor or officers of the Contractor's organization have a beneficial interest are not acceptable.

C. Use only one source of cement and aggregates for the project. Provide concrete uniform in color and appearance.

D. If, during the progress of the work, the materials from the sources originally accepted change in characteristics, make, at no additional cost to the Owner, new acceptance tests of materials and establish new concrete mixes with the assistance of an independent testing laboratory.

E. 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.

F. Develop concrete mixes and their testing by an independent testing laboratory engaged by and at the expense of the Contractor. Methods of testing shall comply with the latest applicable ASTM methods.

1.06 DELIVERY, STORAGE AND HANDLING

A. Ship and store reinforcing steel 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 designations as those shown on the submitted placement drawings. Provide reinforcing steel free from mill scale, loose rust, mud, dirt, grease, oil, ice or other foreign matter. Store off the ground, protect from moisture and keep free from rust, mud, dirt, grease, oil, ice or other injurious contaminants.

B. Store products in conformity with the manufacturer's recommendations.

C. Cement: Store in weathertight buildings, bins or silos to provide protection from dampness and contamination and to prevent warehouse set.

D. 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.

E. 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.

F. 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.

G. Fly Ash or Ground Granulated Blast Furnace Slag: Store in weathertight buildings, bins or silos to provide protection from dampness and contamination

H. Sheet Curing Materials: Store in weathertight buildings or off the ground and under cover.

I. 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.

C. Materials shall comply with this Section and any applicable State or local requirements.

2.02 MATERIALS

A. Cement: Domestic portland cement conforming to ASTM C150. 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. Type I or II with the addition of fly ash or ground granulated blast furnace slag resulting in C3A being below 8 percent of total cementitious content, Type II, Type II (MH) or Type III limited to 8 percent C3A.

B. Fine Aggregate: Washed inert natural sand conforming to ASTM C33.

C. Coarse Aggregate: Well-graded crushed stone or washed gravel conforming to ASTM C33, size 57. Limits of deleterious substances and physical property requirements as listed in ASTM C33, Table 3 for severe weathering regions.

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. Use admixtures compatible with the concrete mix including other admixtures.

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. 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 of Ignition (LOI) limited to 3 percent maximum and the optional physical requirements of Table 3.

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.

I. Deformed Concrete Reinforcing Bars: ASTM A615, Grade 60 deformed bars.

J. Welded Steel Wire Fabric: Conforming to ASTM A185.

K. 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.

L. Tie Wires for reinforcement: 16 gauge or heavier black annealed wire.

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 7, 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 or ground granulated blast furnace slag in combination with the cement to be used meets all strength requirements and is compatible with the other concrete additives.

D. Compression Tests: Provide testing of the proposed concrete mix or mixes to demonstrate compliance with the compression strength requirements in conformity with the provisions of ACI 318.

E. Entrained air, as measured by ASTM C231, shall be as shown in Table 1.

F. Slump of the concrete as measured by ASTM C143, shall be as shown in Table 1.

G. 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 1	Cement 2	Fine Aggregate 3	Coarse Aggregate 3	Cementitious Content 4
A	2500	Type II	Sand	57 (9)	440
B	3000	Type II	Sand	57	480
D2	4000	Type II	Sand	57	560

Class	W/C Ratio 5	SCM 6	AE Range 7	WR 8	HRWR 10	Slump Range 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
D2	0.44 max.	Yes	3.5 to 5	Yes	No	3-5

TABLE 1 NOTES:

1. Minimum compressive strength in psi at 28 days
2. ASTM designation in ASTM C150
3. Size Number in ASTM C33
4. Minimum cementitious content in lbs per cubic yard (where fly ash or ground granulated blast furnace slag is used cementitious content is defined as cement content plus fly ash or ground granulated blast furnace slag content)
5. W/C is Maximum Water Cementitious ratio by weight
6. Supplementary Cementitious Material (SCM) fly ash content in the range of 20-25 percent of the total cement content plus fly ash content, by weight. If ground granulated blast furnace slag is used in lieu of fly ash, the content of ground granulated blast furnace slag shall be in the range of 25-45 percent of the total cement plus ground granulated blast furnace slag content, by weight
7. AE is percent air entrainment
8. WR is water reducing admixture
9. Except as specified in Section (03800) for concrete electrical raceway encasement
10. HRWR is high-range water-reducing admixture

2.04 MEASURING, BATCHING, MIXING AND TRANSPORTING CONCRETE

A. Measure, batch, mix and transport concrete in conformance with ASTM C94 and the requirements herein or as otherwise approved in writing by the Engineer.

B. Ready-mixed concrete, whether produced by a concrete supplier or the Contractor shall conform to the requirements above. Do not hand mix.

C. Dispense admixtures into the batch in conformity with the recommendations of the admixture manufacturer.

D. Mix concrete until there is uniform distribution of the materials and discharge completely before the mixer is recharged. The mixer shall be rotated at a speed recommended by the mixer manufacturer and mixing shall be continued for at least 1-1/2 minutes after all the materials are in the mixer. Place concrete within 1-1/2 hours of the time at which water was first added, otherwise it will be rejected. Concrete which has been remixed or retempered, or to which an excess amount of water has been added, will also be rejected.

E. 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 or ground granulated blast furnace slag, 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.

F. 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

2.05 FORMS

A. Provide forms free from roughness and imperfections, watertight and braced and tied to prevent motion when concrete is placed. Wooden spreaders will not be allowed in the concrete.

B. Wire ties will not be allowed. Metal ties or anchorages which are necessary within the forms shall be so constructed that the metal work can be removed for a depth of at least 1-1/2-in from the concrete surface without damage by spalling. Clean forms before using and treat with form release agent, or other approved material.

C. All exposed edges of the finished concrete shall be chamfered 3/4-in.

PART 3 EXECUTION

3.01 CONSTRUCTION JOINTS

A. Locate construction joints where indicated or where approved by the Engineer.

B. Continue all reinforcing steel through the joint.

C. At construction joints and at concrete joints indicated to be "roughened", uniformly roughen the surface of the concrete to a full amplitude (distance between high and low points and side to side) of 1/4-in with chipping tools to expose a fresh face. Thoroughly clean joint surfaces of loose or weakened materials by waterblasting or sandblasting and prepare for bonding. At least two hours before and again shortly before the new concrete is deposited, saturate the joints with water. After glistening water disappears, coat joints with neat cement slurry mixed to the consistency of very heavy paste. The surfaces shall receive a coating at least 1/8-in thick, scrubbed-in by means of stiff bristle brushes. Deposit new concrete before the neat cement dries.

3.02 REINFORCING STEEL

A. Fabricate reinforcing steel accurately to the dimensions shown. Bend bars around a revolving collar having a diameter of not less than that recommended in ACI 318. All bars shall be bent cold.

B. 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.

C. 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.

D. Use precast concrete blocks where the reinforcing steel is to be supported over soil. 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 supports or plastic tipped metal supports in all other locations unless otherwise noted on the Drawings or specified herein.

E. Before placing in position, clean reinforcement of loose mill scale and rust, mud, dirt, grease, oil and other coatings, including ice that reduce or destroy bond. When there is a delay in

depositing concrete after the reinforcement is in place, bars shall be reinspected and cleaned again when necessary.

F. Coat reinforcement which is to be exposed for a considerable length of time after being placed with a heavy coat of cement grout.

G. Do not cover any reinforcing steel with concrete until the amount and position of the reinforcement has been checked and the Engineer has given permission to proceed.

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 Owner.

3.05 CONCRETE APPEARANCE

A. Remix concrete showing either poor cohesion or poor coating of the coarse aggregate with paste. If this does not correct the condition, the concrete shall be rejected.

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 herein.

3.06 PLACING AND COMPACTING

A. Do not place concrete until forms, condition of subgrade and method of placement have been approved by the Engineer. Remove all debris, foreign matter, dirt, ice and standing water from the forms before depositing concrete. Do not place concrete on frozen subgrade, snow or ice. The contact surface between concrete previously placed and new concrete shall be cleaned and brushed with cement paste. Concrete, except as indicated on the Drawings, shall not be placed in water or submerged within 24 hours after placing, nor shall running water be permitted to flow over the surface of fresh concrete within 4 days after its placing.

B. Deposit concrete as near its final position as possible to prevent segregation due to rehandling or flowing. Pumping of concrete will be permitted when an approved design mix and aggregate sizes suitable for pumping are used. Do not deposit concrete which has partially hardened or which has been contaminated by foreign materials. If the section cannot be placed continuously, place construction joints as specified or as approved. Place concrete for walls using tremie tubes in 12-in to 24-in lifts, keeping the surface horizontal. Do not drop concrete more than 4-ft.

C. Use high frequency mechanical vibrators to obtain proper consolidation of the concrete. Do not use vibrators to move or transport concrete in the forms. Do not over-vibrate so as to segregate. Continue vibration until the frequency returns to normal, trapped air ceases to rise and the surface appears liquefied, flattened and glistening. Use spades, rods or forks so that concrete is completely worked around reinforcement, embedded items, pipe stubs, and openings and into corners of forms.

3.07 CURING AND PROTECTION

A. Protect all concrete work against injury from the elements and defacements of any nature during construction operations.

B. Cure all concrete in conformance with ACI 301. Concrete that is to be used for the containment of water shall be water cured. Water curing shall be by ponding, by continuous sprinkling or by covering with continuously saturated burlap. Other concrete shall be cured by either water curing, sheet material curing or liquid membrane curing compound except that liquid membrane curing compound shall not be used on any concrete surface where additional concrete is to be placed or where the concrete surface is to be coated or painted.

C. Protect finished surfaces and slabs from the direct rays of the sun to prevent checking and crazing.

D. During cold weather concrete shall be batched, delivered, placed, cured and protected in compliance with the recommendations of ACI 306R. Do not use salt, manure or other chemicals for cold weather protection.

E. During hot weather concrete shall be batched, delivered, placed, cured and protected in compliance with the recommendations of ACI 305R. The temperature of the concrete shall be such that it will cause no difficulties from loss of slump, flash set or cold joints. Immediately cover plastic concrete with sheet curing material during hot weather.

3.08 FIELD 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 6-in diameter by 12-in long non-absorbent cylindrical molds.

1. A "set" of test cylinders shall consist of four cylinders: one to be tested at seven days and two to be tested and their strengths averaged at 28 days. The fourth may be used for a special test at 3 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 strengths (where proper relation between seven 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 Owner.

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. Furnish material and labor required for the purpose of taking concrete cylinder samples. All shipping of specimens will be paid for by the Owner.

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.

3.09 STRIPPING AND FINISHING CONCRETE

A. Do not remove forms before the concrete has attained a strength of at least 30 percent of the specified design strength nor before reaching approximately "100 day-degrees" of moist curing (whichever is the longer). 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., 7 days at an average 50 degrees F = 350 degree-days).

B. Exercise care to prevent damaging edges or obliterating the lines of chamfers, rustications or corners when removing the forms or doing any other work adjacent thereto.

C. Clean all exposed concrete surfaces and adjoining work stained by leakage of concrete, to the satisfaction of the Engineer.

D. Immediately after removal of forms remove tie cones and metal portions of ties. 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 1 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.

E. Defective concrete and honeycombed areas: Chip down square and at least 1-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. Concrete to receive dampproofing and concrete not exposed in the finished work shall have off-form finish with fins and other projections removed and tie cones and defects filled as specified above.

G. Screed top surface of slabs to the established grades and to a true plane with a tolerance of 1/8-in when checked with a 10-ft straightedge. Pitch surface to drain unless otherwise noted on the Drawings. Finish the surface to give a smooth, hard, even surface free from high or low spots or other defects. Concrete subject to pedestrian traffic shall be given a broom finish. Failure to meet these conditions shall be cause for removal, grinding, or other correction as directed by the Engineer.

3.10 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 Owner. 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 Owner. In such cases of failure to meet strength requirements the Contractor and Owner 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 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 Owner.

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 Owner.

3.11 SCHEDULE

A. The following (Table 3) are the general applications for the various concrete design strengths to be used:

TABLE 3

Class	Design Strength (psi)	Description
A	2,500	Concrete fill and electrical raceway encasement
B	3,000	Concrete sidewalks and pavements
D	4,000	Pipe supports, slabs on grade, and all other structural concrete

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

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.

B. Perform all sampling and furnish all testing of materials and products by an independent testing laboratory acceptable to the Engineer but engaged by and at the expense of the Contractor.

1.02 RELATED WORK

A. Cast-in-place concrete and Reinforcing Steel is included in Section 03301.

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 Material Safety Data Sheet.

2. Commercially manufactured non-shrink epoxy grout. Include catalog cuts, technical data, storage requirements, product life, working time after mixing, temperature considerations, conformity to the specified ASTM standards, and Material Safety Data Sheet.

3. 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. Samples

1. Submit samples of commercially manufactured grout products when requested by the Engineer.

2. Submit samples of aggregates proposed for use in grout mixes when requested by the Engineer.

C. Certifications

1. 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.

D. Qualifications

1. Submit documentation that grout manufacturers have a minimum of 10 years' experience in the production and use of the grouts proposed.

2. Independent Testing Laboratory
   a. Name and address
   b. Names and positions of principal officers and the name, position, and qualifications of the responsible registered professional engineer in charge.
   c. Listing of technical services to be provided. Indicate external technical services to be provided by other organizations.
   d. Names and qualifications of the supervising laboratory technicians.
   e. Statement of conformance provided by evaluation authority defined in ASTM C1077. Provide report prepared by evaluation authority when requested by the Engineer.
   f. Submit as required above for other organizations that will provide external technical services.

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 C531 - Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts and 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 D695 - Standard Test Method for Compressive Properties of Rigid Plastics.

8. 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.

2. Independent testing laboratory shall meet the requirements of ASTM E329 and ASTM C1077 and be acceptable to the Engineer. Laboratories affiliated with the Contractor or in

which the Contractor or officers of the Contractor's organization have beneficial interest are not acceptable.

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 Owner.

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 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 equal.

B. Non-shrink Epoxy Grout

1. Non-shrink epoxy grout: Grout shall be pre-proportioned, prepackaged, three component, 100 percent solids system consisting of epoxy resin, hardener and blended aggregate. It shall have a compressive strength of 10,000 psi in 7 days when tested in conformity with ASTM D695 and have a maximum coefficient of thermal expansion of 30 x 10-6 in/in/degrees F when tested in conformity with ASTM C531. Masterflow 648 CP by BASF Building Systems; Five Star HP Epoxy Grout by Five Stars Products, Inc; Sikadur 42 Grout-Pak by Sika Corp.; E3-G Epoxy Grout by the Euclid Chemical Co. or equal.

C. 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.

D. 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

F. 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.

G. Non-shrink epoxy grouts do not require saturation of the concrete substrate. Do not wet concrete surfaces to receive non-shrink epoxy grout. Surfaces in contact with epoxy grout shall be completely dry before grouting.

H. 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.

I. Level and align the structural or equipment bearing plates in accordance with the structural requirements or the recommendations of the equipment manufacturer, as applicable.

J. 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 partial contraction joint.

F. Reflect all existing underlying expansion, partial contraction 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 3.01H. 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 INSTALLATION – NON-SHRINK EPOXY GROUTS

A. Mix in accordance with manufacturer's recommendations. Mix full batches only, to maintain proper proportions of resin, hardener and aggregate. Do not vary the ratio of components or add solvent to change the consistency of the grout mix. Do not overmix. Do not entrain air bubbles by mixing too quickly.

B. Monitor ambient weather conditions and contact the grout manufacturer for special placement procedures to be used for temperatures below 60 or above 90 degrees F.

C. Place grout rapidly and continuously to avoid cold joints. Place grout in lifts in accordance with manufacturer's recommendations.

D. Provide forms as specified in Paragraph 3.01H. Place grout into the designated areas and prevent entrapment of air. Fill all spaces and provide full contact between the grout and adjoining surfaces. Provide grout holes and vent holes as necessary.

E. Minimize "shoulder" length (extension of grout horizontally beyond base plate). In no case shall the shoulder length of the grout be greater than the grout thickness.

F. Finish grout by puddling to cover all aggregate and provide a smooth finish. Break bubbles and smooth the top surface of the grout in conformity with the manufacturer's recommendations.

G. Epoxy grouts are self-curing and do not require the application of water. Maintain the formed grout 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.

H. Provide grout control joints as indicated on the Drawings.

3.05 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 3-ft wide by 3-ft long.

2. Flowable (precision) non-shrink cementitious grout: Use under all base plates greater in area than 3-ft wide by 3-ft long. Use at all locations indicated on the Drawings to receive flowable (precision) non-shrink grout. Flowable (precision), non-shrink, cementitious grout may be substituted for general purpose non-shrink cementitious grout.

3. Non-shrink epoxy grout: Use at all locations specifically indicated on the Drawings to receive non-shrink epoxy grout.

4. Cement grout: Use where indicated on the Drawings.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

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 the specified materials, as specified herein and as shown on the Drawings.

B. Surface preparation and priming in field may be done only with the approval of the Engineer.

C. This Section does not apply to factory finished items, unless noted otherwise.

1.02 RELATED WORK

A. Finish Painting is included in Section 09902.

1.03 SUBMITTALS

A. Submit to the Engineer, in accordance with Section 01300, complete shop drawings, manufacturer's specifications, and data on the proposed primers and detailed surface preparation, application procedures, and dry mil thickness.

B. Submit to the Engineer, in accordance with Section 01300, representative physical samples of the proposed primers.

1.04 REFERENCE STANDARDS

A. The Society for Protective Coatings (SSPC)

1. SSPC SP 1 - Surface Preparation Specification No. 1, Solvent Cleaning

2. SSPC SP 2 - Surface Preparation Specification No. 2, Hand Tool Cleaning

3. SSPC SP 3 - Surface Preparation Specification No. 3, Power Tool Cleaning

4. SSPC SP 5 – Surface Preparation Specification No. 5, White Metal Blast Cleaning

5. SSPC SP 6 - Surface Preparation Specification No. 6, Commercial Blast Cleaning

6. SSPC SP 7 - Surface Preparation Specification No. 7, Brush-off Blast Cleaning

7. SSPC SP 10 - Surface Preparation Specification No. 10, Near-White Metal Blast Cleaning

8. SSPC SP 13 - Surface Preparation Specification No. 13, Preparation on Concrete Surfaces

B. American Society of Testing and Materials (ASTM)

1. ASTM D4258 - Standard Practice for Surface Cleaning Concrete for Coating

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. The Contractor shall give the Engineer a minimum of 3-days advance notice of the start of any field surface preparation work and a minimum of 7-days advance notice of the start of any shop surface preparation work.

B. All such work shall be performed only in the presence of the Engineer, unless the Engineer has granted prior approval to perform such work in his absence.

C. Inspection by the Engineer, or the waiver of inspection of any particular portion of the work, shall not relieve the Contractor of his responsibility to perform the work in accordance with these specifications.

D. Painting subcontractor shall provide 5 references, which show that the painting subcontractor has previous successful experience with the specified or comparable coating systems. Include the name, address, and the telephone number for the owner of each installation for which the painting subcontractor provided the protective coating.

E. Compatibility of Coating Systems:

1. 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 by the manufacturer for use together.

F. Primers containing lead will not be allowed.

G. VOC Content: Determine VOC (Volatile Organic Compound) content of solvent borne and waterborne paints and related coatings in accordance with EPA Method 24 or ASTM D3960.

PART 2 PRODUCTS

2.01 MATERIALS

A. All priming materials shall be by the Tnemec Company, Inc.; equals by Ameron (VyGuard); Carboline and or ICI/Devoe. The priming schedule has been prepared on the basis of Tnemec products (unless otherwise noted) and Tnemec recommendations for application. No brand other than those named will be considered for approval unless the brand and type of paint proposed for each item in the following schedule together with sufficient data substantiated by certified tests conducted at no expense to the Owner, to demonstrate its equality to the primer(s) named is submitted to the Engineer in writing for approval within 30 days after the Signing of the Notice to Proceed. The type and number of tests performed shall be subject to the Engineer's approval.

2.02 PRIMER SCHEDULE

A. The following types of primers by Tnemec Co have been used as a basis for the primer schedule:

1. Series N69-1255: Hi-build Epoxoline II - polyamidoamine gray epoxy primer.

2. Series 90-97: Tneme-Zinc – aromatic urethane, zinc rich primer.

3. Series N69-1255: Hi-Build Epoxoline II - Polamide Epoxy

B. The following surfaces shall have the types of primers scheduled below applied at the dry film thickness (DFT) in mils per coat noted:

1. Ferrous Metals
   a. Submerged or subject to splashing
      1 coat Series N69-1255 (3.5 - 4.5 mils DFT)

   b. Nonsubmerged and not subject to splashing (exterior)
      1 coat Series 90-97 (2.5 - 3.0 mils DFT)

   c. Nonsubmerged and not subject to splashing (interior)
      1 coat Series N69-1255 (3.5 - 4.5 mils DFT)

   d. Surfaces exposed to temperatures above 250 degrees F: See Section 09902

2. Non-Ferrous Metals and Galvanized Steel

   a. Submerged or subject to splashing
      1 coat Series N69-1255 (3.0 to 5.0 mils DFT)

   b. Nonsubmerged and not subject to splashing (exterior) - includes repair of cut edges and damage to galvanized steel
      1 coat Series 90-97 (2.5 to 3.5 mils DFT)

   c. Nonsubmerged and not subject to splashing (interior) - includes repair of cut edges and damage to galvanized steel
      1 coat Series 90-97 (2.5 to 3.5 mils DFT)

3. Aluminum embedded or in contact with concrete, masonry, or dissimilar materials shall be painted according to the schedule for aluminum in contact with dissimilar materials in Section 09902.

4. Non-primed Surfaces:

   a. Gears, bearings surfaces, and other similar surfaces that are 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.

5. Concrete Masonry Units (CMU): See Section 09902.

6. Plastic pipe: See Section 09902.

7. Insulated pipe (and cellular glass insulation): See Section 09902.

8. Exposed Bituminous Coated Pipe
   a. A test patch must be run initially to test the paint's compatibility with the tar.
   b. Before successive coats are applied per the schedule, any pipe scheduled to be painted and having received a coating of a tar or asphalt-compound shall be painted with:
      2 coats Series N69-1255 (3.0 - 4.0 DFT per coat).

PART 3 EXECUTION

3.01 APPLICATION

A. Surface Preparation and Priming

1. General
   a. Surfaces shall be dry and free of dust, oil, grease, dirt, rust, loose mill scale, and other foreign material before priming.
   b. Shop prime in accordance with approved paint manufacturer's written recommendations.
   c. Surface preparation for field painting unprimed surfaces or for touch up shall be the same.
   d. Surface temperature and all other application conditions shall be in accordance with approved primer manufacturer's recommendations. Enclosures and auxiliary heat shall be utilized as necessary to achieve compliance.

2. Ferrous Metals
   a. Nonsubmerged and not subject to splashing
      1) Clean in accordance with SSPC SP 6 immediately prior to priming.
      2) Fill all pits and dents and correct all imperfections to provide a smooth surface for painting.
      3) Prime as scheduled.
   b. Submerged or subject to splashing
      1) Blast clean in accordance with SSPC SP 5 immediately prior to priming.
      2) Grind and sand smooth all metal welds, blisters, and imperfections according to SSPC SP 5.
      3) Fill all pits and dents and correct all imperfections to provide a smooth surface for painting.
      4) Prime as scheduled.

3. Non-Ferrous Metals
   a. Clean in accordance with SSPC SP 1.

4. Concrete Masonry Units (CMU)
   a. Concrete masonry units' surfaces shall be smooth and cleaned of all dust, efflorescence, chalk, loose mortar, dirt, grease, oil, tar, and other foreign matter, conforming to ASTM D4258.

5. Plastic, PVC, and Other Plastic Matrix Surfaces scheduled to be painted in Section 09902
   a. Lightly sanded and cleaned of residue before painting.

6. Primed, Galvanized, and Previously Painted Surfaces
   a. All coated surfaces shall be cleaned prior to application of successive coats.
   b. Test galvanized steel for manufacturer-recommended treatment or any passivation or pretreatment required.
   c. Cut edges of galvanized sheets and exposed threads and cut ends of galvanized piping, electrical conduit, and metal pipe sleeves, which are not to be finish painted, shall be cleaned in accordance with SSPC SP 1 and primed as specified.
   d. Failing existing coatings, as determined by the Engineer, shall be removed and the surface shall be prepared as listed for the specific material to be painted.
   e. Galvanized and, when ordered, the other metal surfaces specified above shall be cleaned in accordance with SSPC SP 2 to provide a uniform 1-mil surface profile.
   f. Shop-Finished Surfaces:
      1) All shop-coated surfaces shall be protected from damage and corrosion before and after installation by treating damaged areas immediately upon detection. Abraded or corroded spots on shop-coated surfaces shall be cleaned in accordance with SSPC SP 2 and then touched up with the same materials as the shop coat.
      2) All shop-coated surfaces that are faded, discolored, or which require more than minor touch-up in the opinion of the Engineer shall receive new surface preparation before being repainted.
      3) All final cleaning shall be done in accordance with SSPC SP 1 provided the solvent is compatible with the shop finish coat.

7. Exposed Bituminous Coated Pipe
   a. Bituminous-coated pipe shall not be used in exposed locations. Pipe to be exposed in the finished work shall be primed in accordance with the requirements herein. Any bituminous-coated pipe that is inadvertently installed in exposed locations shall be cleaned in accordance with SSPC SP 6 (exposed, non-submerged and not subject to splashing), or SSPC SP 10 (submerged or subject to splashing) before priming and painting. After installation, all exterior exposed flanged joints shall have the gap between adjoining flanges sealed with a single component polysulfide sealant to prevent rust stains.
   b. Primed as scheduled.

8. Concrete
   a. Submerged or subject to splashing, outdoor chemical containment areas, and exposed concrete in enclosed tanks or wet wells scheduled to be painted or coated:
      1) Clean in accordance with SSPC SP 7, SSPC SP 13
      2) Remove all laitance and solid containments.
      3) Open up pinholes, air pockets, and other subsurface irregularities.
      4) Do not expose underlying aggregate.
      5) Strip, clean, and etch and provide a uniform surface profile similar to #100 grit sandpaper.
      6) Damp cure shall be used unless otherwise approved in writing.
      7) Moisture content at time of coating shall be less than 8 percent.
      8) Primer manufacturer shall review the quality of the concrete and recommend in writing any patching or special surface preparation. Patching shall involve

filling voids over 1-inch width by 1/2-inch depth with a non-shrink grout similar to Five Star Structural Concrete by U.S. Grout Corporation, or approved equal.

b. Non-submerged and not subject to splashing:
   1) Clean in accordance with SSPC SP 7, SSPC SP 13.
   2) Open all bug holes and air entrained holes with minimum aggregate exposure (unless otherwise noted).
   3) Provide a uniform surface profile similar to #100 grit sandpaper
   4) Confirm, in writing from the primer manufacturer, the proper cleaning of concrete with any releases or curing compounds before these items are used. See Division 3 for information on releases and curing compounds.

9. Stainless Steel, Aluminum, and Non-Ferrous Metals (scheduled to be painted or not)
   a. Clean in accordance with SSPC SP 1.

3.02 FABRICATED AND MANUFACTURED EQUIPMENT

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 SSPC SP 10 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 any prime coats not in accordance with this Section by SSPC SP 10 and apply the specified prime coat at no additional cost to the Owner.

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 equipment is required to be blast cleaned, the Contractor shall protect all motors, drives, bearings, gears, nameplates, and any other parts not required to be primed or painted, from blasting and from the entry of grit. Any equipment found to contain grit shall be promptly disassembled, thoroughly cleaned, and reassembled as ordered and approved.

END OF SECTION

SECTION 09902
FIELD PAINTING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Contractor shall furnish all materials, labor, equipment and incidentals required and perform all the painting necessary to complete this contract in its entirety as specified herein.

B. It is the intent of this section to paint all exposed structural and miscellaneous steel; mechanical and electrical equipment; site lighting poles; pipe, fittings and valves; electrical conduit and appurtenances; 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. The following items will not be painted under this Section:

1. Concrete (unless otherwise specified in the painting schedules)

2. Non-ferrous metals and stainless steels, unless specifically noted otherwise.

3. Mechanical and electrical equipment which has been finished painted in the factory as specified in Divisions 11, 15 and 16.

1.02 RELATED WORK

A. Concrete is included in JEA Water and Wastewater Standards

B. Nonferrous metalwork is included in JEA Water and Wastewater Standards

C. JEA Water and Wastewater Standards

1.03 SUBMITTALS

A. Submit the following:

1. Color cards, including standard and special colors for initial color selections

2. Three sets of 8-in by 8-in samples, on 1/4-in hardboard, of all colors required for all types of paint. Include special colors as required.

3. Submit to the Engineer shop drawings, working drawings, and product data including manufacturer’s specifications and data on the proposed paint systems and detailed surface preparation, application procedures, and dry film thickness (DFT). Certify that the systems submitted meet all applicable volatile organic carbon regulations. Equivalent systems are to be submitted at no additional costs to meet any new regulations.

4. Schedule of Painting Operations: Submit to the Engineer a complete Schedule of Painting Operations within 90 days after the Notice to Proceed. This Schedule is imperative so that the various fabricators may be notified of the proper shop prime coat to apply. Properly notify and coordinate the fabricators' surface preparation and painting operations with these specifications. This Schedule shall include for each surface to be painted, the brand name, the percent volume of solids, the coverage, the number of coats the Contractor proposes to use in order to achieve the specified DFT, color charts, and documentation of compatibility with prime coat. When the Schedule has been approved, apply all material in strict accordance with the approved Schedule and the manufacturer's instructions. Wet and dry paint film gauges shall be made available to the Engineer to verify the proper application while work is in progress.

5. Documentation of the compatibility between prime coats and finish coats shall be submitted along with the date and ambient conditions for all prime coat installation with an established recoat window allowed for each prime system. Corrective surface preparation techniques shall be submitted for all systems in the event that the recoat window is missed.

6. Resubmit until approved.

1.04 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials (AASHTO)

B. American Society for Testing and Materials (ASTM)

1. ASTM C150 - Standard Specification for Portland Cement

2. ASTM D4258 - Standard Practice for Surface Cleaning Concrete for Coating

C. NSF International (NSF)

1. NSF 61 - Drinking Water System Components - Health Effects

D. Occupational Safety and Health Act (OSHA)

1. Air Pollution Control Rules

2. Color Coding

E. The Society for Protective Coatings (SSPC)

1. SSPC-SP 1 - Solvent Cleaning

2. SSPC-SP 2 - Hand Tool Cleaning

3. SSPC-SP 3 - Power Tool Cleaning

4. SSPC-SP 6 - Commercial Blast Cleaning

5. SSPC-SP 7 - Brush-off Blast Cleaning

6. SSPC-SP 10 - Near-White Metal Blast Cleaning

7. SSPC-SP 13 - Surface Preparation of Concrete

8. SSPC-PA 2 - Measurement of Dry Paint Thickness with Magnetic Gages

9. SSPC VIS-1-89T - Pictorial Surface Preparation Standard

F. National Association of Corrosion Engineers (NACE)

1. RP0188-88 - Standard Recommended Practice for Discontinuing (Holiday) Testing of Protective Coatings

G. Where reference is made to one of the above standards, the revision in effect at the time of contract award shall apply.

1.05 QUALITY ASSURANCE

A. Manufacturer Representative

1. The Contractor shall require the paint manufacturer to furnish a manufacturer's qualified technical representative to visit the project site for technical support as required and ordered and as may be necessary to resolve field questions or problems attributable to or associated with the manufacturer's products furnished under this Contract or the application thereof.

B. Cold Weather Construction

1. All paint shall be at room temperature before applying, and no painting shall be done when the temperature is below 50 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. Lower temperatures will only be allowed with written instructions from the paint manufacturer.

C. Inspection and Testing

1. All materials and work shall be accessible and subject to inspection by the Engineer.

2. The completed work shall be inspected visually by the Engineer for skips, holidays, hiding, uniform color and appearance, and other imperfections. All defective work shall be corrected by the Contractor.

3. Coating thickness on steel shall be determined in accordance with SSPC PA 2. The number of readings will be a minimum of that stated in SSPC PA 2.

4. Coating integrity for coatings in immersion areas or subjected to splash and spillage shall be determined in accordance with NACE RP0188-88 using the low voltage wet sponge test method. All holidays will be clearly marked for repair.

5. The Contractor shall furnish to the job site and use for coating inspection and make available to the Engineer, the following test equipment:
   a. Wet film thickness gauge.
   b. Dry film thickness gauge (with certified thickness calibrator) equal to Mikrotest III; Elcometer Inspector III; or Positest.
   c. Surface Temperature Gauge.
   d. Holiday Detector, low voltage type such as Tinker & Rasor Model M-1, Series 9533.
   e. SSPC VIS-1-89T "Pictorial Surface Preparation Standard."
   f. Keane-Tator Surface Comparator Number 372, or equal.
   g. NBS Certified Coating Thickness Standards.
   h. Sling Psychrometer.
   i. Surface moisture metering device equal to Delmhors Model DB.

D. Warranty Inspection

1. A warranty inspection shall be conducted during the 11th month following completion of all coating and painting work. The Contractor, painting subcontractor, and a representative of the coating material manufacturer shall attend this inspection with the Engineer and Owner.

2. All defective work shall be repaired in accordance with these specifications and to the satisfaction of the Engineer and Owner.

1.06 DELIVERY, STORAGE, AND HANDLING

A. All painting materials shall be delivered to the mixing room in unbroken containers, bearing the manufacturer's brand, date of manufacture, 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 before using.

B. Painting materials shall be delivered to the job site in the original unopened containers, bearing the manufacturer's label. A Product Data Sheet and Material Safety Data Sheet for all painting, activators, thinners, accelerators, and other materials shall be obtained from the manufacturer for each shipment of materials to the job site. Painting materials shall be stored in a dry, well-ventilated area, not in direct contact with the ground, where the temperature is maintained between 40 and 120 degrees F. Damaged materials and/or materials exceeding the shelf life shall not be used.

C. Paints shall be mixed in proper containers of adequate capacity. All paints shall be thoroughly stirred before use and shall be kept stirred while using. No unauthorized thinners or other materials shall be added to any paint. Air shall not be used directly for agitation. Pigmented material shall be strained after mixing. Where application equipment has strainers, they should be sized so as to allow pigment to pass but not foreign material. Multiple (2 or more) component catalyzed materials may not be used beyond the recommended pot life.

D. Work areas will be designated by the Owner 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. All recommendations of the paint manufacturer in regard to the health and safety of workmen shall be followed.

1.07 MAINTENANCE - SPARE MATERIALS

A. Spare Material

1. Furnish one unopened gallon can of each type and each color of paint specified herein.

PART 2 PRODUCTS

2.01 MATERIALS

A. All painting materials shall be supplied by one manufacturer, unless otherwise approved by the Engineer. The paint schedule has been prepared on the basis of Tnemec Company Inc. products and application recommendations, unless otherwise noted in the schedule. Equals by Ameron (VyGuard) or Carboline. All materials shall meet NSF Standard 61 and be fully equal to the Tnemec products listed in the following schedule. No brand other than those named will be considered for approval unless the brand and type of paint proposed for each item in the following schedule together with sufficient data substantiated by certified tests, conducted at no expense to the Owner, to demonstrate its equality to the paint(s) named. The type and number of tests performed shall be subject to the Engineer's approval.

B. Shop priming shall be done with primers that are guaranteed by the manufacturer to be compatible with the finish paints to be used.

C. No paint containing lead will be allowed. Oil shall be pure boiled linseed oil.

D. All painting materials shall be delivered to the mixing room 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.

E. 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.

2.02 PAINT TYPES

A. The following types of paints by Tnemec Co. have been used as a basis for the paint schedule:

Series	Series Name	Generic Description
N69	Hi-build Epoxoline II	Polyamidoamine Epoxy

73	Endura-Shield	Semi-Gloss Acrylic Urethane
90-97	Tneme-Zinc	Organic Zinc-Rich Urethane
156	Enviro-Crete	Elastomeric Acrylate
218	Mortarclad	Epoxy Modified Concrete
435	Perma-Glaze	Modified Polyamine Epoxy

2.03 PAINT SCHEDULE

A. The following surfaces shall have the types of paints scheduled below applied at the dry film thickness (DFT) in mils per coat noted:

B. Ferrous Metals

1. Nonsubmerged (exterior)

Surface Preparation:	SSPC-SP6
Stripe Coat:	Series 90-97 (2.5 - 3.5 mils DFT) applied by brush over weld seams
Primer:	Series 90-97 (2.5 - 3.5 mils DFT)
Int. Coat:	Series N69 (3.0 - 5.0 mils DFT)
Topcoat:	Series 73 (2.0 - 3.0 mils DFT)
Min total DFT for 3 Coats:	9.5 mils

C. Non-Ferrous Metals and Galvanized Steel

1. Submerged or subject splashing (potable water)

Surface Preparation:	SSPC-SP1 and SSPC-SP7
1st Coat:	Series N140 (3.0 - 5.0 mils DFT)
2nd Coat:	Series N140 (3.0 - 5.0 mils DFT)
Min total DFT for 2 Coats:	10.0 mils

2. Nonsubmerged (exterior)

Surface Preparation:	SSPC-SP1 and scarify
Primer:	Series N69 (3.0 - 5.0 mils DFT)
Topcoat:	Series 73 (2.0 – 3.0 mils DFT)
Min total DFT for 2 Coats:	6.5 mils

3. Nonsubmerged (interior)

Surface Preparation:	SSPC-SP1 and scarify
1st Coat:	Series N69 (2.0 – 4.0 mils DFT)
2nd Coat:	Series N69 (2.0 – 4.0 mils DFT)
Min total DFT for 2 Coats:	6.0 mils

4. Aluminum in contact with dissimilar metals (nonsubmerged)

Surface Preparation:	SSPC-SP1 and scarify
1st Coat:	Series N69 (2.0 – 4.0 mils DFT)
2nd Coat:	Series N69 (2.0 – 4.0 mils DFT)
Min total DFT for 2 Coats:	6.0 mils

D. Plastic piping nonsubmerged

1. Interior

Surface Preparation:	SSPC-SP1 and scarify
1st Coat:	Series N69 (2.0 – 3.0 mils DFT)
2nd Coat:	Series N69 (2.0 – 3.0 mils DFT)
Min total DFT for 2 coats:	5.0 mils

2. Exterior

Surface Preparation:	SSPC-SP1 and scarify
1st Coat:	Series N69 (2.0 – 3.0 mils DFT)
2nd Coat:	Series 73 (2.0 – 3.0 mils DFT)
Min total DFT for 2 coats:	5.0 mils

E. Ductile iron pipe

1. Immersion (potable water)

Surface Preparation:	SSPC-SP6
1st Coat:	Series N140 (6.0 – 8.0 mils DFT)
2nd Coat:	Series N140 (6.0 – 8.0 mils DFT)
Min total DFT for 2 coats:	14.0 mils

2. Interior non-immersion

Surface Preparation:	SSPC-SP6
1st Coat:	Series N69 (6.0 – 8.0 mils DFT)
2nd Coat:	Series N69 (6.0 – 8.0 mils DFT)
Min total DFT for 2 coats: 12.0 mils	

3. Exterior

Surface Preparation:	SSPC-SP6
1st Coat:	Series N69 (6.0 – 8.0 mils DFT)
2nd Coat:	Series 66 (2.0 – 4.0 mils DFT)
3nd Coat:	Series 77 (2.0 –3.0 mils DFT)
Min total DFT for 3 coats:	12.0 mils

F. Any surfaces not specifically named in the Schedule and not specifically excepted shall be prepared, primed, and painted in the manner and with materials consistent with these specifications. The Engineer shall select which of the manufacturer's products, whether the

type is indicated herein or not, shall be used for such unnamed surfaces. No extra payment shall be made for this painting.

2.04 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 mechanical pipe and electrical conduit 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. When more than one pipe system is supported on the same bracket, the bracket shall be painted the same color as the adjacent wall or ceiling.

B. All pipes and equipment shall be painted according to Color Schedule attached. Elements which are not listed on the Schedule will be assigned a color 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.

D. All safety equipment shall be painted in accordance with OSHA standards.

E. All conduit shall be painted to match its background surface.

F. Control panels shall be factory finished.

G. All inline equipment and appurtenances not assigned another color shall be painted the same base color as the piping. The pipe system shall be painted with the pipe color up to but not including the flanges attached to pumps and mechanical equipment assigned another color.

H. All colors will be confirmed by the Engineer from color charts submitted by the Contractor based on the color coding schedule herein.

2.05 COLOR IDENTIFICATION

A. All colors numbers and names herein refer to master color card. Colors of specified equal manufacturers may be substituted with approval of the Engineer. Samples of the proposed colors shown in this paragraph shall be presented to Owner for final approval.

B. Building surface colors shall be painted as selected by Owner.

C. The following Tnemec colors shall be used as a basis for the Color Coding Schedule.

Colors	Tnemec	Tnemec#
White	White	11WH
Ivory	Bone	08BR
Tan	Longhorn	13BR
Safety Orange	Tangerine Orange	04SF
International Orange	International Orange	05SF

Bright Yellow	Bright Yellow	03SF
Safety Yellow	Lemon Yellow	02SF
Safety Green	Spearmint Green	09SF
Dark Green	Hunter Green	08SF
Light Brown	Twine	68BR
Dark Brown	Terra Cotta	07DR
Safety Red	Candy Apple Red	06SF
Light Gray	Slate Gray	32GR
Medium Gray	Gray	33GR
Dark Gray	Sinker	46GR
Blue Gray	Midnight Gray	14GR
Safety Blue	True Blue	11SF
Light Blue	Fountainbleu	25BL
Medium Blue	Mediterranean Blue	34BL
Dark Blue	Academy Blue	35BL
Aqua	Mermaid	13GN
Blue Green	Merlin	06GN
Dark Bronze	Dark bronze	86BR
Magenta	Cinder Cone	07GR

2.06 FABRICATED EQUIPMENT

A. Unless otherwise indicated, all fabricated equipment shall be shop primed and shop or field finished.

B. All items to be shop primed shall be thoroughly cleaned of all loose material prior to priming. If, in the opinion of the Engineer, any prime coating shall have been improperly applied or if material contrary to these specifications shall have been used, that coating shall be removed by sandblasting to white metal and reprimed in accordance with these specifications.

C. All shop prime coats shall be of the correct materials and applied in accordance with these specifications. Remove any prime coats not in accordance with these specifications by sandblasting and apply the specified prime coat at no additional cost to the Owner.

D. Shop primed surfaces shall be cleaned thoroughly and damaged or bare spots retouched with the specified primer before the application of successive paint coats in the field.

E. The Contractor shall be responsible for and take whatever steps are necessary to properly protect the shop prime and finish coats against damage from weather or any other cause.

F. A shop finish coat 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 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.

2.07 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 GENERAL

A. No outside spray painting shall be allowed if wind speed exceeds 5 miles per hour or the temperature/humidity exceeds the manufacturer's recommendations. The Contractor shall be responsible for repairs due to overspray.

3.02 PREPARATION OF SURFACES

A. All surfaces to be painted shall be prepared as specified herein and shall be dry and clean before painting.

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. All PVC pipe and other plastic matrix surfaces to be painted shall be lightly sanded and cleaned of residue before painting.

D. Galvanized, aluminum, and copper surfaces shall have all oxidation and foreign material removed before painting by SSPC SP1, 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 SP2 standards to provide a uniform 1 mil surface profile.

E. Stainless steel shall be solvent cleaned as specified above and then sanded to achieve a uniform one mil profile. Remove all sanding residue.

3.03 PAINTING SCHEDULE

A. All colors will be selected by the Engineer based on the color schedule herein.

B. The following types of paints by Tnemec Co. and Tamms Industries have been used as a basis for the paint schedule:

1. Hibuild Epoxoline (Series 66) polyamide cured epoxy
2. MortarClad (Series 218) – Epoxy-Modified Mortar
3. Tamoseal Ultra by Tamms Industries - waterborne cementitious acrylic
4. EnduraShield III semigloss (Series 73) highbuild acrylic polyurethane enamel.
5. Silicone Aluminum (No. 39-1261) high heat silicone aluminum (to 1200 degrees F).
6. Pota-Pox 100 (Series 22) 100% Modified Polyamine Epoxy. (NSF Standard 61 certified).

7. Hydro-Zinc (Series 91-H_2O) - organic vehicle zinc-rich (NSF Standard 61 certified).

8. Vinester (Series 120) - vinyl ester.

9. Tneme-Cryl (Series 6) - acrylic latex emulsion, eggshell finish.

10. PPG Industries Rez Polyurethane Satin Clear Plastic Interior Varnish 77-89 Urethane alkyd, clear, satin sheen with approved Rez alkyd-oil stain under.

11. Pota-Pox Plus (Series N140) NSF Standard 61 certified.

3.04 WORKMANSHIP

A. General

1. Primer and paint used for a particular surface shall, in general, be as scheduled for that type of new surface. Confirm with the paint manufacturer that the paint proposed for a particular repaint condition will be compatible with the existing painted surface. Sample repainted areas on the actual site will be required to insure this compatibility. Finished repainted areas shall be covered by the same guarantee specified for remainder of the work.

2. 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.

3. Protection of 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 nameplates 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.

4. 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.

5. Paints shall be mixed in proper containers of adequate capacity. All paints shall be employed where required

6. Smoking shall not be permitted while preparing surface or applying coatings.

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 subcontractor.

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 subcontractor.

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 subcontractor.

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. Surfaces of exposed members that will be inaccessible after erection shall be cleaned and painted before erection

9. Before final acceptance of the work, all damaged surfaces of paint shall be cleaned and repainted as directed by the Engineer.

10. Only the aluminum work noted on the drawings or in the painting schedule shall be field painted.

3.05 CLEANUP

A. At all times keep the premises free from accumulation of waste material and rubbish caused by employees or work. At the completion of the painting, remove all tools, scaffolding, surplus materials and all rubbish from and about the buildings and leave the work "broom clean" unless more exactly specified.

B. Upon completion, remove all paint where it has been spilled, splashed, or spattered on all surfaces, including floors, fixtures, equipment, furniture, etc, leaving the work ready for inspection.

3.06 COLOR SCHEDULE

A. The following list of piping is intended to identify all potential piping and establish a color selection for each based on industry standards. The final color selection will be determined by the Engineer and Owner at the time of shop drawing review. The Contractor shall submit color charts for color selections.

SCHEDULE 09902-A
Pipe Identification and Color Coding

Pipe System	Paint Color	Bands	Abbreviation
Raw Water	Olive Green		RW

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 11214
VERTICAL TURBINE PUMPS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required, install, complete and ready for operation and field test, one (1) vertical turbine pump, including the respective motor and variable frequency drive for JEA Main Street Water Treatment Plant Well No. 15 as shown on the Drawings and as specified herein.

B. These Specifications are intended to give a general description of what is required, but do not cover all details which will vary in accordance with the requirements of the equipment as offered. It is, however, intended to cover the furnishing, factory testing, delivery and complete installation and field testing of all materials, equipment and appurtenances for the complete pumping units as herein specified, whether specifically mentioned in these Specifications or not.

C. The work under this Section shall include supervisory services during installation and field testing of each unit and instructing the regular operating personnel in the proper care, operation and maintenance of the equipment.

D. The pump manufacturer (Manufacturer) shall coordinate the design of the pump and motor with the variable frequency drives, as specified in Sections 16150 and 16400.

1.02 RELATED WORK

A. Concrete work and the installation of anchor bolts are included in Division 3; however, anchor bolts for these units as recommended by the pump manufacturer (Manufacturer) shall be furnished by the Contractor under this Section.

B. Instrumentation and control work, except as specified herein, is included in Division 16. Instrumentation and controls provided in this section shall adhere to Instrumentation and Control Specifications Sections in Division 16.

C. Valves, mechanical piping and appurtenances and pipe hangers and supports are included in Division 15.

D. Electrical work except as hereinafter specified is included in Division 16.

1.03 REFERENCE STANDARDS

A. Design, manufacturing and assembly of elements of the equipment specified herein shall be in accordance with the following, where applicable:

1. American Concrete Institute (ACI).

2. American Gear Manufacturers Association (AGMA).

3. American Institute of Steel Construction (AISC).

4. American Iron and Steel Institute (AISI).

5. American Society of Mechanical Engineers (ASME).
6. American National Standards Institute (ANSI).
7. American Petroleum Institute (API).
8. American Society for Testing Materials (ASTM).
9. American Water Works Association (AWWA).
10. American Welding Society (AWS).
11. American Bearing Manufacturers Association (ABMA).
12. Hydraulic Institute (HI) Standards.
13. Institute of Electrical and Electronics Engineers (IEEE).
14. International Organization for Standardization (ISO).
15. National Electrical Code (NEC).
16. National Electrical Manufacturers Association (NEMA).
17. National Sanitation Foundation (NSF).
18. Occupational Safety and Health Administration (OSHA).
19. The Society for Protective Coatings (SSPC).
20. Underwriters Laboratories (UL).

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 SYSTEM DESCRIPTION

A. The vertical turbine well pump will pump raw water from the Lower Floridian aquifer to the Orange Street reservoir and Main Street Water Treatment Plant through the Main Street Raw Water Transmission System. The equipment to be furnished under this section shall include one (1) open line-shaft vertical turbine raw water pump, motor, variable frequency drives, and accessories, all as specified herein and as shown on the Drawings. Refer to Section 16900 for system description and control narratives. Contractor shall coordinate and be fully responsible for proper operation and compatibility between items in this scope of work and items in Division 16 scope.

1.05 QUALIFICATIONS

A. To assure unity of responsibility, the pumps, motors, and supporting wellhead flange for the pumps shall be furnished and coordinated by the Manufacturer. The Contractor and Manufacturer shall assume responsibility for the satisfactory installation and operation of the

entire pumping system including pumps, motors, variable frequency drives and well head flange as specified. Variable frequency drives are covered in Section 16400.

B. The equipment covered by this Section is intended to be standard pumping equipment of proven ability as manufactured by companies having extensive experience in the production of such equipment similar to the applications stated in Articles 1.04, 2.02 and 2.03. Units specified herein shall be furnished by a single manufacturer. The equipment provided shall be designed, constructed and installed to operate satisfactorily when installed as shown on the Drawings or as approved by the Engineer.

C. Pumps shall be manufactured in accordance with the Hydraulic Institute Standards, except where otherwise specified.

D. The Manufacturer shall be fully responsible for the design, arrangement, and operation of all connected rotating components of the assembled pumping unit mounted on a fabricated steel baseplate to ensure that neither harmful nor damaging vibrations occur at any speed within the specified operating range.

E. The Manufacturer or its representative shall have an authorized warranty center within a 3-day shipping radius of the job site, fully staffed with factory trained mechanics, and equipped with a stock of strategic spare parts for each model of pump furnished under this contract. The service facility and strategic spare parts shall be established prior to delivery of equipment for this project.

F. All equipment furnished under this Specification shall be new and unused, shall be the standard product of manufacturers having a successful record of manufacturing and servicing similar equipment and systems to that specified herein for a minimum of five years.

G. The pumping equipment shall be furnished complete with accessories required and shall meet the detailed requirements of the Specifications.

H. The Manufacturer shall be certified to the ISO 9001 standard for design and manufacture of vertical turbine pumps.

I. Welding of pressure-containing fabrications shall be by welders qualified to ASME Code Section 9 or AWS D1.1 Structural Welding Code – Steel.

J. Prior to manufacture, a submittal must be forwarded to the Engineer indicating that the required vibration analyses outlined herein have been performed and that the specified limitations will be met. For the dynamic vibration analysis described, minimum and maximum operating speeds will be in accordance with the operating speeds required to satisfy the conditions of operation specified in Article 2.02. The dynamic vibration analysis required by the following paragraphs shall be performed by Mechanical Solutions Inc. (MSI) of Whippany, NJ, or Engineering Dynamics Inc. (EDI) of San Antonio, TX or alternatively by the Manufacturer if Manufacturer's demonstrated, successful, vibration analysis experience, in at least twenty projects similar in scope, with proposed personnel involved, may be acceptable to the Engineer with analyses in accordance with the specified requirements.

1. Structural dynamic analysis of the combined pump/motor system including the nearby foundation and the piping out to the first pipe restraint or expansion joint. Analysis shall not simply assume the foundation is rigid rather it shall incorporate foundation design

shown on the Drawings. The structural dynamic analysis shall predict that no first or second bending mode frequencies will exist within a pump speed range from 890 cycles per minute to 2140 cycles per minute. .

2. A lateral rotordynamic analysis of the pump rotating system (i.e., motor rotor, line shafting, couplings, bowl shafting and impellers, etc.) shall identify and predict that the first lateral critical speed shall have a separation margin of at least 20 percent above the maximum pump speed or 20 percent below the minimum pump speed. If a design modification (i.e., such as changing the bearing span or shaft diameter) cannot resolve a separation margin deficiency or is not practical, a forced damped response analysis shall be performed to demonstrate that the pump will function properly over the speed range.

3. A torsional rotordynamic analysis of the complete rotating system (pump, motor, intermediate shafting, and coupling) shall identify and predict that no torsional natural frequencies occur within a separation margin extending from 20 percent below to 20 percent above the specified pump operating speed range. Additionally, no natural frequencies shall be +/- 10% of 2x times running speed, line frequency, 2x line frequency, vane pass frequency, and VFD control frequencies (if applicable). If a design modification (i.e., such as a shaft diameter change or different coupling arrangement) cannot resolve a separation margin deficiency or is not practical, a forced damped response analysis shall be performed to show that infinite life will be achieved with a safety factor of at least two.

4. Campbell diagrams shall be submitted, documenting the structural lateral, rotating component lateral, and torsional analysis results, graphically demonstrating the separation margins specified above.

5. Maximum vibration velocity in inches per second RMS, measured in the field, shall conform to the requirements of ANSI/HI 9.6.4.

1.06 SUBMITTALS

A. Submit, in accordance with Section 01300, copies of all materials required to establish compliance with the specifications. In the event that it is not practical to conform to certain details of the specifications because of different manufacturing techniques, describe completely all nonconforming aspects. Submittals shall include the following:

1. Certified dimensional drawings showing all important details of pump construction and auxiliary apparatus.

2. Baseplate and pump support design details showing anchor bolt locations and sizing information.

3. Literature and drawings describing the equipment in sufficient detail, including materials of construction, to indicate full conformance with the detail specifications.

4. Schematic electrical wiring diagram and other data as required for complete pump installation.

5. The total weight of the equipment including the weight of the single largest item.

6. A complete materials table for all equipment establishing compliance with these specifications.

7. A list of the Manufacturer's recommended spare parts with the Manufacturer's current price for each item. Include gaskets, packing, etc. on the list. List all bearings by the bearing manufacturer's numbers only.

8. All information required by Division 1.

9. A statement and supporting data indicating motor bearing life meets or exceeds specified value.

10. Complete data on motors and variable speed frequency drives in accordance with Section16150 and Section 16400 .

11. Compliance with noise levels as specified in Division 16 – Electrical.

12. Complete description of surface preparation and shop painting for pumps and motors.

13. Critical speed analyses report submittal including backup documentation and a statement of guarantee that the critical speed analyses as required in Paragraph 1.05 J of this Section have been completed and that the specified limitations will be met.

B. Design Data:

1. Data on the characteristics and performance of each pump. Data shall include guaranteed performance curves to ANSI/HI 14.6 acceptance grade 1U for all specified points, based on actual factory tests of similar units, which show that they meet the specified requirements for head, flow rate, efficiency, guaranteed maximum net positive suction head required (NPSH3), submergence and horsepower. Curves shall be submitted on 8-1/2-inch by 11-inch sheets, at as large a scale as is practical. Curves shall be plotted from zero flow at shut off head to pump flow rate at minimum specified total head (TH). The POR and AOR (refer to ANSI/HI 9.6.3) shall be clearly shown on the curves. This information shall be prepared specifically for the pump proposed. Catalog sheets showing a family of curves will not be acceptable.

C. Test Reports:

1. Certified motor test data as described in Section 16150.

2. Tabulated data for the drive motors including rated horsepower, full load rpm, power factor and efficiency curves at 1/2, 3/4 and full load, service factor and kW input, including when the pump is at its design point. Submit a certified statement from the motor manufacturer that the motors are capable of continuous operation on the power supply from the variable frequency drives to be furnished without affecting their design life for bearings or windings.

3. Description of proposed pump factory test procedures and equipment.

4. Factory and field performance test data as specified in PART 2 and PART 3.

5. A schedule of the date of factory testing and delivery of the equipment to the job site.

D. Instructions, Certifications, and Reports:

1. Manufacturer's Installation Instructions.

2. Manufacturer's certification of installation meeting Manufacturer's installation, operation and maintenance manuals and as specified in PART 3.

3. Manufacturer's field report as specified in PART 3.

4. Submit warranty information to demonstrate conformance to Article 1.10.

5. Identify the entity and experienced individual who will inspect the installation in accordance with Article 1.07.

6. Welder certifications.

E. Project Record Documents, reference Section 01720.

F. Six-month follow up vibration testing report as specified in Article 3.02.

1.07 MANUFACTURER SERVICES INCLUDING OPERATING INSTRUCTIONS

A. Operating and Maintenance Manual:

1. Operating and maintenance manual shall be furnished by the Manufacturer to the Engineer as provided for in Section 01730. The manuals shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, description, etc. that are required to instruct operating and maintenance personnel unfamiliar with such equipment. The maintenance instructions shall include trouble shooting data, full preventative maintenance schedules, and complete spare parts lists with ordering information.

B. Installation Inspection and Startup:

1. The Contractor shall include in his bid price the services of a Manufacturer's factory representative who has complete knowledge of proper operation and maintenance shall be provided to instruct representatives of the Owner and the Engineer on proper operation and maintenance. This work may be conducted in conjunction with the inspection of the installation and start-up. If there are difficulties in operation of the equipment because of the Manufacturer's design or fabrication, additional service shall be provided at no additional cost to the Owner. The listed service requirements are exclusive of travel time, and shall not limit or relieve the Contractor of the obligation to provide sufficient service necessary to place the equipment in satisfactory and functioning condition. VFD training shall be as specified in Division 16. Also refer to requirements in PART 3 of this Section.

2. Installation inspection: Complete review of installation as specified herein. Provide written certification that the installation is complete and operable in all respects, and that no conditions exist which may affect the warranty. Qualified supervisory services, including

Manufacturers' Factory representatives, shall be provided to ensure that the installation is done in a manner fully approved by the Manufacturer. The Manufacturer's factory representative shall specifically supervise the installation and alignment of the pump with the motor, the grouting, and the alignment of the connecting piping and the installation of the field installed packing or mechanical seal. If there are difficulties in the start-up or operation of the equipment due to the Manufacturer's design or fabrication, additional service shall be provided at no additional cost to the Owner. Services of the Manufacturer's factory representative and training shall be provided when the well pump is started.

a. Minimum time on-site shall be one 8-hour day per pump.

3. Start-Up: Provide written report, summarizing test procedures, tested and measured variables (flow rates, total heads, shaft-speed, vibration measurements, alignment check, etc.):

a. Minimum time on-site shall be one 8-hour day.

C. Training:

1. Field and classroom instruction on operation and maintenance of the equipment, including start-up, shut-down troubleshooting, lubrication, maintenance and safety.

2. The Manufacturer shall provide detailed manuals to supplement the training courses. The manuals shall include specific details of equipment supplied and operations specific to the project.

D. The Contractor alone shall be responsible for requesting these services, and shall coordinate these requests with all other relevant trades, to ensure the effectiveness of the Manufacturers' service. In the event that the lack of coordination by the Contractor results in the need to recall the Manufacturer's factory representative, the lost time shall not be counted against the above days.

1.08 TOOLS AND SPARE PARTS

A. Furnish all special tools and test equipment required for the proper servicing of all equipment. All such tools and test equipment shall be furnished in a suitable steel tool chest complete with lock and duplicate keys.

B. All spare parts shall be properly protected for long periods of storage and packed in containers that are clearly identified with indelible markings as to contents.

C. Furnish the following spare parts for each size pump.

1. Two sets of packing.

2. One packing gland.

D. Provide to the Owner a list of all spare and replacement parts with individual prices and location where they are available. Prices shall remain in effect for a period of not less than one year after start-up and final acceptance.

1.09 PRODUCT HANDLING

A. Delivery, storage and handling of equipment shall be in accordance with Section 01600 and as specified herein.

B. All equipment and parts must be properly protected against any damage during shipment. Store the equipment in accordance with Manufacturer's recommendations.

C. All completely assembled units shall be off loaded by the use of a primary and "tail" crane system. Additionally, when lifting the units from a horizontal position to a vertical position, the use of a primary and "tail" crane system shall be used.

D. Long Term Storage:

1. All parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of fabrication, including storage in accordance with Manufacturer’s requirements, until the unit and equipment are ready for operation.

2. If long-term storage is required on-site, Contractor shall follow Manufacturer's detailed recommendations for long term storage.

3. If the pumps are delivered and stored on-site in a horizontal position and left for an extended period of time, the rubber line-shaft bearings may become deformed and the shafts may take on a permanent "sag". The Contractor shall be responsible for rotating the shafting, in accordance with the pump Manufacturers requirements, so that damage does not occur.

E. Factory assembled parts and components less than 25 feet in length shall not be dismantled for shipment unless permission is received in writing from the Engineer.

F. For units greater than 25 feet in length that are shipped unassembled, all connecting parts shall be "match-marked" by the Manufacturer to ensure correct assembly on-site by the Contractor.

G. The finished surfaces of all exposed flanges shall be protected by wooden or equivalent blank flanges, strongly built and securely bolted thereto.

H. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion.

I. No shipment shall be made until approved by the Engineer in writing.

J. For protection of bearings during shipment and installation, the bearing shall be properly processed. Anti-friction bearings, if pre-lubricated, shall be protected in accordance with the bearing manufacturer's recommendations against formation of rust during a long period of storage while awaiting completion of installation and start-up of the machine in which they are used. Anti-friction bearings which are not pre-lubricated shall be properly treated in accordance with the bearing manufacturer's recommendation against formation of rust during a long period of storage while waiting completion of installation and start-up by the application of an appropriate rust preventative treatment.

1.10 WARRANTY

A. All equipment supplied under this Section of the Specifications shall be warranted for a period of one year from Substantial Completion by the Contractor and the Manufacturer. Warranty period shall commence on the date of Substantial Completion, as outlined in Division 1 and in Division 0.

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 machine(s) and the unit(s) restored to service at no expense to the Owner.

C. The Manufacturer's warranty period shall run concurrently with the Contractor's warranty period. No exception to this provision shall be allowed.

D. Refer to Section 01740 for additional warranty requirements.

PART 2 PRODUCTS

2.01 GENERAL

A. The pumping units shall all be supplied by one manufacturer and shall be complete including pumps, motors, variable frequency drives, bowls, column, line-shaft, discharge head and appurtenances such as, but not limited to, couplings, guards, and gauges. The pump shall conform to AWWA E-103, Horizontal and Vertical Line-Shaft Pumps Standard and ANSI/NSF 61 and ANSI/NSF 61 Annex G and ANSI/NSF 372 where not in conflict with the requirements specified herein. Ample room shall be provided for inspection, repairs and adjustments.

B. Discharge head lifting lugs or eye bolts shall be provided by the Manufacturer.

C. The pumps, motors, variable frequency drives, shall be designed and built for 24-hour continuous service at any and all points within the required range of operation, without overheating, excessive vibration or strain.

D. The top column section of the vertical turbine well pump shall be fabricated to include a flange for mounting of the pump to the casing. The mounting flange shall be welded to the top column section, designed to support the weight of the complete pump and motor assembly. The flange shall be designed to mount on top of the well casing flange as shown on the Drawings.

E. Each major piece of equipment shall be furnished with a stainless steel nameplate (with embossed data) securely mounted to the body of the equipment. At a minimum, the nameplate for the pumps shall include the Manufacturer's name and model number, serial number, rated flow rate, head, and speed. At a minimum, nameplates for motors shall include the manufacturer's name and model number, serial number, horsepower, speed, input voltage, amps, number of cycles and power and service factors. Nameplate information for the variable frequency drives shall include the manufacturer's name and serial number, input speed, voltage, current and frequency and horsepower at full load.

F. The pump and its driving equipment shall be designed and constructed to prevent reverse rotation using a non-reverse ratchet installed in the electric motor. As an alternate, the pump and motor shall be designed and constructed to successfully withstand a maximum turbining speed

of the unit resulting from backflow through the pump. Manufacturer shall determine maximum potential reverse rotational speed for design.

G. The maximum sound pressure level from one pump/motor when operating on utility power measured 3 feet from the equipment and 5 feet above the floor shall be 85 dBA.

H. The nameplate ratings of the motor and VFD shall not be exceeded, nor shall the design service factor be reduced when the pump is operating at any point on its performance curve within the specified operating range at maximum speed.

I. Mechanical equipment, including electric motors shall be supplied and installed in accordance with applicable OSHA regulations. The Contractor's attention is drawn to the requirement for guards on all rotation assemblies.

2.02 CONDITIONS OF OPERATION

A. The pumps shall be Model 16EMM 1 Stage by Flowserve; Model 14MD 2 Stage by Grundfos (Peerless); Model H14LC 2 Stage by National Pump Co. or pre-approved equal from Goulds and American Marsh

B. Design Information:

Design Information	**Well No. 15**
Approx. Grade Elevation (ft NGVD)	19.0
Well Casing Flange (ft NGVD)	20.80
Casing nominal diameter (in)	20
Open Hole nominal I.D (in)	18
Open Hole-Top Elevation (ft BLS)	530
Open Hole-bottom Elevation (ft BLS)	1,280
Well Depth (ft BLS)	1,280
Water Temperature (degree F)	72°F
Water pH	7.8-8.2
Static Water Level (ft BLS)	+12’ (artesian)
Drawdown (ft)[1]	30
Specific Capacity (gpm/ft)	83±
Pump Suction Elevation (ft. BLS)	120

MSL = mean sea level
ALS = above land surface
BLS = below land surface
1) Drawdown will need to be verified during well testing.

C. Each pump shall be designed for the conditions of service tabulated as follows and shall operate within the system head curve envelope as appended. All pumps shall have a continuously rising (from runout toward shutoff) head-flow rate performance curve for stable pump operation within the AOR.

D. The pumps shall operate throughout the specified operating range, within the vibration limitations specified in Paragraph 1.05 J.5 above.

TABLE 11214-1
PUMPING UNIT DESIGN REQUIREMENTS

Item Description	Design Conditions
Service	Raw Water
Number of Pumps (operating/standby)	1 (1/0)
Maximum Motor Full Load Speed (FLS) (rpm)	1780
Maximum Allowable Motor Horsepower (non-overloading throughout operating range) (HP)	125
Motor Design Voltage/Phase/Frequency	460/3/60
Maximum Anticipated Pumped Fluid Temperature (degrees F.)	72
Minimum Pump Discharge Nozzle Size (inches)	10
Minimum Pump Column Diameter (inches)	10
Pump Shut-Off Head at Motor FLS Acceptable Range (minimum/maximum) (feet)	170/260
Flow Rate at Secondary Operation Point (gpm)	1200
Minimum TH at Secondary Operation Point (feet)	150
Minimum Bowl Efficiency at Secondary Operation Point (%)	55
Maximum NPSH3 at Secondary Operation Point (feet)	30
Intermediate (Design) Point Flow Rate (gpm)	2500
Minimum TH at Intermediate (Design) Point (feet)	128
Minimum Bowl Efficiency at Intermediate (Design) Point (%)	78
Maximum NPSH3 at Intermediate (Design) Point (feet)	30
Best Efficiency Point (BEP) Flow Rate Acceptable Range (minimum/maximum) (gpm)	2100/2750
Minimum Bowl Efficiency at BEP (%)	79
Primary Operating Point TH (feet)	70
Minimum Flow Rate at Primary Operating Point (gpm)	3100
Minimum Bowl Efficiency at Primary Operating Point (%)	60
Maximum NPSH3 at Primary Operating Point (feet)	45
Minimum Submergence Above Pump Suction Bell (feet)	20

See attached pump and system curve envelope in Figure 11214-1.

2.03 PUMP CONSTRUCTION

A. Vertical turbine line-shaft pumps shall be product lubricated with open line-shaft bearings as specified below, completely equipped with motor support and discharge head and shall conform to AWWA E-103, Horizontal and Vertical Line-Shaft Pumps, and ANSI/NSF 61 and ANSI/NSF 61 Annex G and ANSI/NSF 372 where not in conflict with the specific requirements contained herein. All pump assemblies shall be evaluated by the Manufacturer for galvanic corrosion potential and zinc anode protection systems provided where required. Minimum diameter for the line-shaft shall be 1.5 inch.

B. Pump bowls, including suction bell, shall be ASTM A48 Class 30 cast iron, flanged and bolted construction with bearings as specified below. All bowl hardware shall be Type 304 stainless steel with monel nuts, where nuts used. Bowls shall be equipped with Type 420 stainless steel wear rings. In single stage pump designs the suction case bearing shall be in accordance with specified requirements below and packed and permanently lubricated with non-water-soluble food grade grease suitable for use with drinking water supply pumps in accordance with

AWWA E-103. The suction case bearing and multi-stage inter-bowl bearings shall be in accordance with specified requirements below and shall be provided with a separate external water flush system. Manufacturer shall design the system and provide the external piping necessary.

C. Impeller shall be 304 or 316 stainless steel, enclosed type; two-plane dynamic balance in accordance with ISO 1940-1 quality grade G2.5. As an alternate, CF8M cast stainless steel impellers are acceptable. Enclosed type impeller design shall include adequate material so as to provide for the future addition of wear ring to restore impeller efficiency.

D. Impeller shafts and couplings shall be 17-4 PH stainless steel. Collets and locknuts shall be Type 316 stainless steel.

E. Line-shafts and couplings shall be 17-4 PH stainless steel and shall be field replaceable Maximum shaft lengths shall be 10-ft and shall be verified with vibration analysis as specified in Paragraph 1.05J above and clearance limitations. Material for vibration isolation devices shall be consistent with materials used on other wetted components. Material selected should give consideration to potential for damage by sulfides or treatment chemicals such as chloramines.

F. Open line-shaft and bowl bearings above impeller shall be removable self-flushing product, synthetic materials as manufactured by Greene Tweed and Co. (model AR® HT) or Vesconite Hi-Lube bearing, as specified above Provision for connection to a protected clean water source at pump stuffing box shall be made. Refer to Article 2.10 for details of the seal/lubrication water control and monitoring system.

G. Discharge columns shall be schedule 40 steel, threaded and coupled construction in lengths not exceeding 10-ft. All flange hardware shall be Type 316 stainless steel with monel nuts. The minimum wall thickness on all columns with nominal diameters 12-in and above shall be 0.375-in. The minimum wall thickness on columns below 12-in nominal size shall be in accordance with Table E-1 of AWWA E-103.

H. Pump Discharge Head for Flange Mounted Pumps:

1. The discharge head shall be fabricated carbon steelwith150 lb ASME B16.5 or B16.47 flanged connections specifically designed to elevate the discharge head natural frequency above the operating speed plus specified separation margin. The 3-segment elbow type discharge head design shall have a 12-in discharge flange. The base of the discharge head shall be machined to match the drilling of the pump adaptor flange complete with Type 316 stainless steel bolts and washers and monel nuts. The pump shall be equipped with a 1-inch tapped vent in the pump baseplate with a 1-inch 316 stainless steel nipple, 316 stainless steel ball valve, and J-tube for the removal of air from the casing. A casing adapter flange shall be bolted to the casing flange at the location shown on the Drawings and as specified below. The casing adapter flange and the pump adapter flange shall be welded to the pump column.

2. Motor mounting flange for the vertical driving motor shall be of standard NEMA dimensions for commercially available motors.

3. The top of the discharge head shall have a registered fit for mounting driving motor.

4. The discharge head shall include a stuffing box and have large openings for pump adjustment and seal maintenance. Provide suitably sized drain connection and pre-lubricating water connection, if necessary, and tap for pressure gauge at discharge nozzle, complete with 1/4-in brass pipe nipple and stainless steel ball valve. Stuffing box must be located and accessible above pump baseplate.

I. Stuffing box/seal box sealed with packing: The discharge head shall be fitted with a packed type stuffing box arranged for fresh water flush of stuffing box. Stuffing box shall be supplied complete with bronze split gland, packing, stainless steel studs and nuts and bronze lantern ring. Any small diameter drain piping shall be secured to the pump column and be armored to prevent damage during installation and removal.

J. The construction of the pumps, position and number of column pipe flanges shall be such that the pumps can be readily installed and removed for repairs within the crane vertical lift limitations using normal methods of operation and handling without undue difficulties.

K. The Contractor shall furnish one pump blind flange that is normally uninstalled but, when a pump has been removed for maintenance, the pump blind flange can be bolted to the open well casing flange to protect against accidents and for general safety. The pump blind flange designed for maximum internal pressure, with holes drilled to match the top of the wellhead flange bolts and be fitted with a large lifting eye(s) in the middle to allow lifting by a crane.

2.04 MOTOR TO PUMP COUPLING

A. Pump shafting shall be directly connected to the motor by means of an adjustment nut on top of the motor, suitably sized to transmit the required driving torque, axial thrust and be easily accessible for impeller adjustment, packing or mechanical seal replacement.

2.05 MOTORS

A. Each pump shall be driven by a vertical, hollow shaft inverter duty rated squirrel cage induction electric motor with a maximum horsepower and speed as specified under Article 2.02 above and with Weather Protected (WP) Type I enclosure and include a thrust bearing capable of handling both the mechanical and hydraulic thrust of the pump. Motor shall be designed specifically for inverter duty, per NEMA MG1, Part 31, and shall be provided with a 1.15 service factor, Class F vacuum/pressure impregnated insulation with Class B temperature rise, and copper windings.

B. Bearings shall be anti-friction, oil-lubricated or grease lubricated with external reservoirs. Bearings shall have a minimum of L-10 life of 50,000 hours.

C. The electric motor shall be furnished with a non-reversing ratchet to prevent rotation in the reverse direction.

D. The electric motor shall be equipped with normally closed motor winding thermostat, and 120-volt space heaters. Provide wiring diagrams and space heater wattage rating with the pump and motor submittals.

E. All materials, design, construction and nomenclature for the motor, shall be in accordance with the NEMA standards for the class of installation and enclosure employed.

F. All lubrication fittings shall be brought to the outside of all equipment so that they are readily accessible from the outside without the necessity of removing covers, plates, housings, or guards, or without creating falling hazards. Fittings shall be buttonhead type. Lubrication fittings shall be mounted together wherever possible. Pressure grease-lubricated fittings shall be the "Zerk Hydraulic" type or the "Alemite" type. Housings of grease-lubricated bearings shall be automatically exhausted to the atmosphere to prevent excessive greasing.

G. Motors shall be mounted to the top of the pump discharge head motor stand with Heavy Hex Grade 8 bolts, nuts and washers torqued to the Manufacturer's recommended value.

2.06 VARIABLE FREQUENCY DRIVES

A. The speed control for variable speed pumps shall be Variable Frequency Drives, as specified in Section 16400, suitable for installation as shown on the Drawings.

B. The Variable Frequency Drives shall be supplied by the Manufacturer and shall be completely coordinated with the pumps and pump driving motors and shall include all internal auxiliaries required to meet the functional specifications.

C. The Variable Frequency Drives shall conform to all requirements stipulated in this section and Division 16, Electrical, and shall be designed for a speed range of 50% to 100% of full load motor speed. The VFD design shall incorporate the necessary components to accommodate receiving vibration data from the pump motor.

D. The Variable Frequency Drives shall be compatible with the motors provided by the Manufacturer.

2.07 PRESSURE GAUGES

A. Each pump shall be equipped with a discharge pressure gauge. Pressure gauges shall be bronze bourdon tube Ametek U.S. Gauge, SOLFRUNT Duragauge Series 1980 Black Phenol Turret type with 316 stainless steel rack and pinion movement or equal. The gauges shall be glycerin filled. Gauges shall be calibrated from 0 to 120 psig for discharge service. Gauges shall be 4-1/2-in diameter furnished with 1/4-in inlet. All fittings and cocks shall be Type 316 stainless steel. Pressure gauges shall be furnished with isolating pulsation dampers. Diaphragm seals shall be Teflon coated, oil filled, Type 316 stainless steel suitable for use with pressure gauges. All gauges and diaphragms shall be furnished by the Contractor.

2.08 CONE STRAINER

A. A 316 stainless steel cone strainer shall be provided. It shall have a net inlet area equal to at least three times the impeller inlet area. The maximum opening shall not be more than 75% of the maximum opening of the water passage through the bowl or impeller.

2.09 SHOP PAINTING

A. Each piece of equipment in the pumping system including pump, support system, motor and associated equipment shall be prepared, shop-primed and finished-coated in accordance with the Manufacturer's standard practice prior to shipment. Colors shall be Manufacturer's standard. Coating for Variable Frequency Drives shall be as specified in Section 16150. Adequate supply of touch-up paints shall be supplied by the Manufacturer.

B. All interior and exterior surfaces of discharge heads and the exterior of the bowl assemblies shall be cleaned of all rust and mill scale, grease, dirt, other foreign matter and supplied with Manufacturer's standard epoxy coatings.

C. All coatings on wetted surfaces shall be epoxy type and shall comply with AWWA E-103 and ANSI/NSF 61 and ANSI/NSF 61 Annex G and ANSI/NSF 372 for use with drinking water systems. Surface preparation shall conform to the coating manufacturer's recommendations.

D. All nameplates shall be properly protected during painting.

PART 3 EXECUTION

3.01 INSTALLATION

A. Take all necessary measurements in the field to determine the exact dimensions for all work and the required sizes of all equipment under this Contract. All pertinent data and dimensions shall be verified.

B. Installation shall be in strict accordance with the Manufacturer's instructions and recommendations in the locations shown on the Contract Documents and pump shop drawings. Refer to Article 1.07 for additional requirements. The Contractor shall furnish all required oil and grease for initial operation, if required, in accordance with the Manufacturer's recommendations. Anchor bolts shall be set in accordance with the Manufacturer's recommendations and setting plans.

C. If the Contractor does not provide qualified installation staff on the job during the pump installation, the Engineer may direct the Contractor to provide the services of a Manufacturer's factory representative to give the necessary instructions to ensure a proper installation.

D. Refer to Article 2.01 for additional installation (sole plate temporary support, grouting, etc.) requirements. Connection of piping to pumps shall be done in the presence of the Engineer. All piping connections to the pump shall be done without bending and/or twisting the piping to mate with the pump flange connections.

E. A certificate from the Manufacturer shall be submitted stating that the installation of their equipment is satisfactory, that the equipment is ready for operation, and that the Owner's operating personnel have been suitably instructed in the operation, lubrication, and care of each unit.

3.02 INSPECTION AND TESTING

A. General:

1. The Engineer shall have the right to inspect any equipment to be furnished under this Section prior to their shipment from place of manufacture.

2. The Engineer shall be notified in writing no fewer than ten working days prior to initial shipment, so that arrangements can be made for inspection by the Engineer.

3. Field tests shall not be conducted until such time that the pumping system, including controls, is complete and ready for testing.

B. Factory Pump Testing:

1. Each pump shall be factory tested as described in ANSI/HI 14.6, American National Standard for Rotodynamic Pumps for Hydraulic Performance Acceptance Tests, as specified herein.

2. The Manufacturer shall perform hydrostatic test on the pressure-containing parts in accordance with ANSI/HI 14.6. Test shall be conducted on each pump prior to shipment.

3. Cast surfaces of all components shall be examined by visual inspection per MSS SP-55.

4. Factory pump tests shall be the basis of acceptance of the hydraulic performance of the pumps. The Manufacturer shall factory test all pumps prior to shipment in accordance with the Hydraulic Institute standards. Flow rate, total head, efficiency and input KW shall be tested and recorded for at least five points on the pump performance curve. Test shall be performed to demonstrate that the pumps meet ANSI/HI 14.6, acceptance grade 1U for all specified points. The five points shall include the points specified in Article 2.02. If any pump tested fails to meet any specification requirement it will be modified until it meets all specification requirements. If any pump tested fails to meet the flow rate, head or efficiency requirements for any of the conditions listed in Article 2.02 of this specification and all reasonable attempts to correct the inefficiency are unsuccessful, the pump(s) shall be replaced with a unit(s) that meets the specified requirements.

5. Certified pump performance curves shall be submitted, including total head, flow rate, bowl efficiency and total brake horsepower for each pump supplied. Test data shall be submitted for approval by the Engineer prior to shipment.

6. If the Manufacturer does not have historical test records for NPSH3 at the specified design pump speed, one pump shall be tested to demonstrate NPSH3 versus flow rate.

7. All meters, gauges, and other test instruments shall be calibrated within the manufacturer's established time period prior to the scheduled test and certified calibration data shall be provided. If the Manufacturer has no ISO standard calibration period, Hydraulic Institute Standards shall govern.

8. In lieu of testing with all job equipment, job pump bowls may be tested with a laboratory column pipe and discharge head similar in size to that furnished for final installation. If possible, the length of column pipe will be the same as will be required to set the bowl in the field.

9. The pumps shall be tested at 100 percent of the design speed. Reduced speed curves will be determined using affinity laws.

10. Each pump shall be tested through the specified range of flow, and head/flow rate/ efficiency curves plotted at maximum output speed. During each test, the pump shall be run at each head condition for sufficient time to accurately determine flow rate, head, power input, and efficiency. In addition, during the tests, the overall efficiency shall be determined at each test point. The pump under test shall be modified until the specified conditions are met or replaced with a pump that will meet the specified conditions.

C. Pump motor tests, including physical testing after manufacture and before shipment to determine actual motor reed critical frequency of each motor, in two perpendicular planes denoted relative to the conduit box, at the motor manufacturer's facility and variable frequency drive tests as specified in Section16150 shall be submitted for approval by the Engineer prior to shipment.

D. Field Testing:

1. In the presence of the Engineer, necessary tests shall be performed to indicate that the pumps, variable frequency drives and motors generally conform to the operating conditions specified. The factory testing specified above will be the basis of performance acceptance. A 7-day operating period of the pumps will be required before acceptance. If a pump performance does not generally agree with the factory test results, corrective measures shall be taken or the pump shall be removed and replaced with a pump that satisfies the conditions specified. Provide, calibrate and install all temporary gauges and meters, make necessary tapped holes in the pipes, and install all temporary piping and wiring required for the field acceptance tests. Written test procedures shall be submitted to the Engineer for approval no fewer than 30 days prior to testing.

2. After installation and as soon as conditions permit full speed operation, the Contractor shall retain the services of a fully experienced independent mechanical vibration testing and analysis firm, either Mechanical Solutions Inc. (MSI) Whippany, NJ, or Engineering Dynamics Inc. (EDI) San Antonio, TX or pre-approved equal, to perform a detailed vibration signature analysis of each unit(s) in accordance with ANSI/HI 9.6.4, including both "Bump Tests" and X-Y vibration profiles, to (a) prove compliance with the specified vibration limitations and (b) prove there are no field installed resonant conditions due to misalignment, the foundation, or the connecting piping and its supports, when operating at any speed within the specified operating range. Testing shall occur at the design full speed, design minimum speed, and at a maximum of 3 Hz increments between minimum and full speed. A written report shall be submitted including a detailed schematic drawing of the units indicating thereon where and in which direction the vibration readings were taken and recorded showing (a) peak-to-peak displacement, in mils, (b) frequency spectrum, (c) peak velocity level, in inches per second, (d) velocity level, in inches per second RMS. The report shall contain a complete analysis of their findings, describing any problem encountered, if any, probable cause and specific recommendations for any required corrective action.
   a. If required, take corrective action and the units shall be retested to ensure full compliance with this Section. All costs associated with the field tests or any required corrective action shall be borne by the Contractor.

3. Motor tests:
   a. Prior to any pump mechanical test, the Contractor shall megger each motor winding before energizing the motor, and, if insulation resistance is found to be low, shall notify the Engineer and shall not energize the motor.
   b. Prior to any pump mechanical test, the Contractor shall check all motors for correct clearances and alignment and for correct lubrication in accordance with the motor manufacturer's instructions. The Contractor shall check direction of rotation of all motors prior to any pump mechanical test and reverse connections, if necessary.
   c. The Contractor shall meet all the testing requirements of Section 16150.

4. If required, take corrective action and have the units retested to ensure full compliance with the specified requirements. All costs associated with the field tests or any required corrective action shall be borne by the Contractor.

END OF SECTION

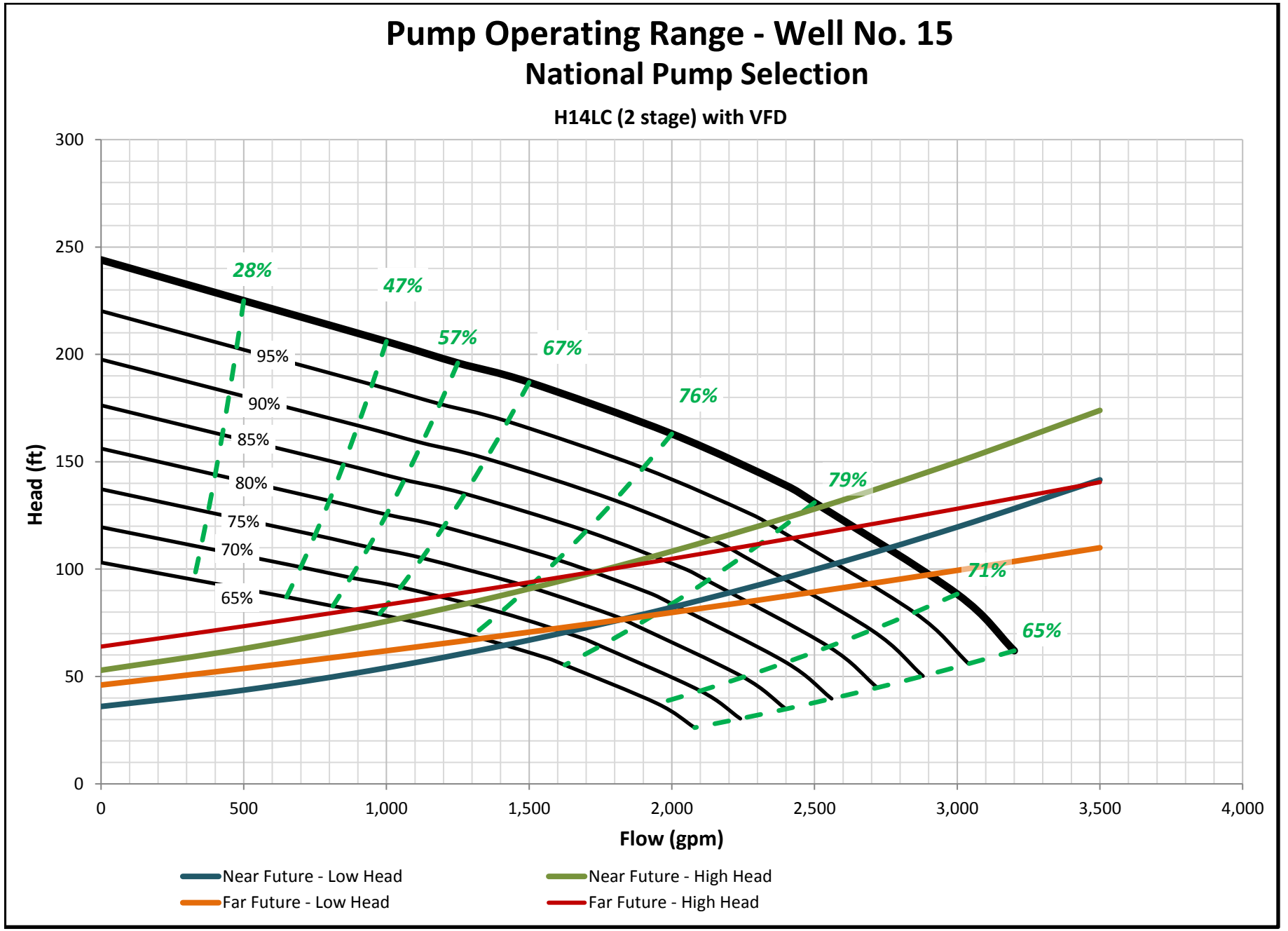

Figure 11214-1 Pump and System Curve Envelope

SECTION 15062
DUCTILE IRON PIPE AND FITTINGS

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, in utility tunnel or gallery and shall exclude pipe in valve vaults, manholes, cleanouts and similar yard structures.

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. Ductile iron pipe and fittings are included in Section 350 in OWNER’s Water and Wastewater Standards Manual, latest edition.

B. Yard Piping is included in Section 350 and Section 408 in OWNER’s Water and Wastewater Standard Manual, latest edition.

C. Delivery, Storage and Handling is included in Section 01600.

D. Painting is included in Division 9.

E. Valves and Appurtenances are included in Section 15100.

F. Piping Specialties are included in Section 15120.

G. Sedimentation and Erosion Control is included in Section 02270.

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. American Society for Testing and Materials (ASTM)

1. ASTM A377 - Standard Index for Specifications for Ductile-Iron Pressure Pipe

2. 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 for Water.

2. AWWA C110 - Ductile-Iron and Gray-Iron Fittings, 3-in Through 48-in (75mm Through 1219mm) 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 C150 - Thickness Design of Ductile-Iron Pipe.

6. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast for Water.

7. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.

8. AWWA C606 - Grooved and Shouldered Joints.

9. AWWA C651 - Disinfecting Water Mains.

D. National Sanitation Foundation (NSF)

1. NSF/ANSI 61 – Drinking Water System Components – Health Effects

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. 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 Owner, at the Owner's expense.

D. Inspection of the pipe and fittings will also be made by the Engineer or representative of the Owner 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. 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. 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 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.

PART 2 PRODUCTS

2.01 MATERIALS

A. Pipe

1. Ductile iron pipe shall conform to AWWA C115 and C110. Flanged pipe shall be Class 53 as per AWWA C150.

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; McWane, or equal.

B. Joints

1. Ductile iron pipe shall have flanged or grooved joints. Flange shall be flat face type, unless otherwise noted, meeting ANSI requirements B16.1 Class 125.

2. Flange gasket shall be full face type per AWWA C111 to provide positive sealing for the flanged ductile iron joints. Thickness shall be 1/8-in unless otherwise indicated.

3. Assembly bolts shall be hex headed 316 steel machine bolts with hexagon nuts per ANSI B18.2.

4. Grooved joints shall conform to AWWA C606 standard rigid couplings and shall be Style 31 couplings as manufactured by Victaulic Company of America or equal.

5. Sleeve type couplings shall be Dresser Style 38 or 138 as manufactured by Dresser Industries or equal.

6. Flanged coupling adaptors shall be Smith-Blair Type 913 or equal.

C. Fittings

1. Pipe fittings shall be ductile iron with a pressure rating of 250 psi. Fittings shall meet the requirements of AWWA C110 as applicable. Fittings shall have the same pressure rating, as a minimum, of the connecting pipe.

D. Interior Lining

1. Ductile iron pipe and fittings shall have the same type of lining as specified herein.

2. Ductile iron pipe and fittings shall have a cement mortar lining in accordance with AWWA C104. Cement mortar lining shall be double thickness.

3. At the option of the supplier, fittings may be lined in accordance with AWWA C550. Potable water cement mortar lining shall be NSF 61 certified.

E. Exterior Coatings

1. 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.

2. All pipe and fittings shall have a bituminous outside coating in accordance with AWWA C151 and C110, respectively.

PART 3 EXECUTION

3.01 PIPE INSTALLATION

A. General

1. All piping and fittings shall be installed true to alignment and rigidly supported. Anchorage shall be provided where required. Any 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. The 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. Any damage to the lining shall be repaired to the satisfaction of the Engineer. Field cut ends shall be sealed with an approved epoxy in accordance with manufacturer's instructions.

4. Ductile iron and fittings shall be installed in accordance with requirements of AWWA C600 modified.

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. 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 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.

E. Sleeves and wall pipes shall have thrust collar located at the mid-depth of wall.

F. Concrete inserts for hangers and supports shall be furnished and installed as recommended by the manufacturer as shown on the Drawings or as specified herein. The inserts shall be set in accordance with the requirements of the piping layout and their locations verified from approved piping layout drawings and the structural drawings.

G. Pipelines supported by pipe hangers from the ceiling, or otherwise supported where lateral displacement of pipe is probable. Supports or hangers shall be spaced so that maximum deflection between supports or hangers shall not exceed 0.050 inch for pipe filled with liquid, but shall not be further than 6 feet apart, whichever is closer, unless otherwise shown. The seismic bracing, as a minimum, shall consist of 3/8-in steel plate welded to pipe hanger, 1/2-in diameter all threaded rod, 1/2-in diameter flexible connector and eye rod inserted in the ceiling. Submit seismic loading and calculations for Engineer's review.

3.02 TESTING

A. All 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. All pipe and fittings shall be pressure tested using water as described in Section 01445.

C. Correct any leakage and repair any 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 DISINFECTION

A. Ductile iron pipe used for potable water service shall be disinfected after cleaning. Provide all necessary equipment and labor for the disinfection.

B. Disinfection shall be in accordance with AWWA C651.

C. Discharge of chlorinated water shall comply with all Federal, State and local standards. Provide sodium bisulfite for dechlorination prior to discharge.

3.05 PIPE MARKING

A. All exposed piping, exterior and interior, shall be identified by painted legend markers, directional arrow markers and number markers as required and as described in Section 09902. 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 3-in in diameter. Markers 2-1/2-in in width shall be installed on pipes 3-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. Pipe marking shall be conducted after pipe is painted.

B. Pipe marker letter legend shall be as follows:

Service Fluid Pipe		Marker Legend
RW:	Raw Water	RAW WATER

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 15064
PLASTIC PIPE AND FITTINGS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and install non-buried PVC piping and appurtenances as shown on the Drawings and as specified herein.

1.02 RELATED WORK

A. Buried piping is included under Division 2 and Section 350 in OWNER's Water and Wastewater Standards Manual, latest edition.

B. Concrete work is included in Division 3.

C. Field painting is included in Section 09902.

D. Valves and appurtenances are included in Section 15100.

1.03 SUBMITTALS

A. Submit, in accordance with Section 01300, shop drawings and product data required to establish compliance with this Section. Submittals shall include the following:

1. Shop drawings including piping layouts and schedules shall be submitted to the Engineer and shall include dimensioning, fittings, locations of valves and appurtenances, joint details, methods and locations of supports and all other pertinent technical specifications for all piping to be furnished.

2. Shop drawing submittals for piping under this Section shall include all data and information required for the complete piping systems. All dimensions shall be based on the actual equipment to be furnished. Types and locations of pipe hangers and/or supports shall be shown on the piping layout for each piping submittal.

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 D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120.

3. ASTM D2447 - Standard Specification for Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside Diameter.

4. ASTM D2464 - Standard Specification for Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

5. ASTM D2466 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.

6. ASTM D2467 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

7. ASTM D2564 - Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.

8. ASTM D2657 - Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings.

9. ASTM D2665 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste and Vent Pipe and Fittings.

10. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.

11. ASTM D3261 - Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.

12. ASTM D3311 - Standard Specification for Drain, Waste and Vent (DWV) Plastic Fittings Patterns.

13. ASTM D3350 - Standard Specification for Polyethylene Plastic Pipe and Fittings Materials.

14. ASTM D5260 - Standard Classification for Chemical Resistance of Poly(Vinyl Chloride) (PVC) Homopolymer and Copolymer Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds

15. ASTM F437 - Standard Specification for Threaded Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.

16. ASTM F438 - Standard Specification for Socket - Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40.

17. ASTM F439 - Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.

18. ASTM F441 - Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.

19. ASTM F493 - Standard Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.

20. ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws and Studs.

21. ASTM F594 - Standard Specification for Stainless Steel Nuts.

B. Plastic Pipe Institute (PPI)

1. PPI TR31 - Underground Installation of Polyolefin Piping.

C. American National Standard Institute (ANSI)

1. ANSI B16.5 Pipe Flanges and Flanged Fittings.

D. National Sanitation Foundation (NSF)

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. All plastic pipe and fittings of each type shall be furnished by a single manufacturer who is experienced in the manufacture of the items to be furnished; however, it shall not be a requirement that the pipe and fittings be manufactured by the same manufacturer, provided that the pipe and fittings are compatible in both compounding and size. The pipe and fittings shall be designed, constructed and installed in accordance with the best practices and methods and shall be suitable for the intended service.

1.06 SYSTEM DESCRIPTION

A. Piping shall be provided and installed in those locations as shown on the Drawings.

B. The equipment and materials specified herein are intended to be standard types of plastic pipe and fittings for use in transporting wastewater, water, air and chemicals.

C. Plastic piping systems shall be utilized for the following chemical systems.

System:	Air
Carrier Pipe Material:	Schedule 80 PVC
Containment Pipe Material:	Schedule 80 PVC
Pressure:	Atmosphere up to 100 psig
Flow Velocity:	Up to 7 ft/sec
Temperature:	35-deg F to 100-deg F
Special Conditions:	Vented at all high points
	Pulsation from pumps

PART 2 PRODUCTS

2.01 MATERIALS

A. Poly (Vinyl Chloride) Pipe and Fittings - PVC

1. Pipe shall be manufactured from PVC compounds meeting ASTM D1784, Class 12454-B in accordance with ASTM D1785, PVC 1120. The pipe shall have a minimum hydrostatic design stress of 2,000 psi at 73 degrees F and shall be suitable for field cutting and solvent welding. Pipe shall be of the sizes as shown on the Drawings and shall be Schedule 80 unless otherwise shown.

2. Fittings shall be the socket type for solvent welded joints conforming to ASTM D2467 or ASTM D2466 where Schedule 40 pipe is shown on the Drawings. Fittings shall be manufactured from PVC compound meeting ASTM D1784, Class 12454-B. Solvent

cement shall be as specified in ASTM D2564.Where applicable, chemical lines will use flanged fittings complying with ANSIU 16.5.

3. Pipe, fittings and solvent for use with potable water shall be certified by NSF in accordance with NSF Standard No. 14 and the seal shall be included on the pipe.

B. Polyethylene Pipe and Fittings - HDPE

1. Pipe shall be manufactured from High Density Polyethylene (HDPE) base resin conforming to Grade P34 (PPI PE3406 or better) in accordance with the requirements of ASTM D2447. The pipe shall have a minimum hydrostatic design stress of 630 psi at 73 degrees F and be suitable for field cutting and heat fusion joining. Pipe shall be of the sizes shown on the Drawings and shall be Schedule 80 unless otherwise shown.

2. Fittings shall be the butt type for heat fusion joints conforming to ASTM D3261, except that Schedule 80 fittings shall meet the sustained pressure test conditions as specified for Schedule 80 pipe in Table 3 of ASTM D2447. Fittings shall be manufactured from the same HDPE base resin, conforming to Grade P34, Class C (PPI PE3406 or better), as is used to produce the pipe to which the fittings are to be joined. Both pipe and fittings shall be manufactured by the same manufacturer to assure compatibility of the piping system components.

C. Threaded joints shall be as specified under the applicable ASTM standard for the pipe and fittings being used. Thread sealer shall be thread tape which shall be standard industrial quality Teflon, Type 1.

D. Flanged Joints

1. Where flanged joints are shown on the Drawings, they shall be supplied with 1/8-in thick full-faced Viton-N gaskets or equal.

2. Flange bolt spacing, number and dimensions shall conform to the requirements of ANSI B16.5. CPVC and PVC flanges shall be suitable for solvent cementing to the pipe and shall be suitable for a minimum pressure of 150 psi.

3. Bolts, nuts and washers for flanged joints shall be for corrosive service conditions and shall be ASTM F593 and F594, Type 316 stainless steel. Anti-seize compound for stainless steel bolts and nuts shall be of a molybdenum disulfide base such as Molycoat-G or equal.

E. Fittings, specials, unions and flanges shall be of the same schedule number and manufactured of the same materials as the pipe. Whenever unions are called out on the Drawings, flanged connections may be substituted, provided that dimensional controls do not preclude use of flanges.

F. Expansion joints for PVC and CPVC sizes 1/2-in to 6-in shall be telescoping type as manufactured by Plastinetics, Inc.; ASAHI/America or equal. Expansion in pipes smaller than 1/2-in shall be accommodated with expansion loops.

2.02 SURFACE PREPARATION AND SHOP COATING

A. All PVC and CPVC piping and fittings exposed to view shall have its surface prepared and be shop painted. Surface preparation and shop priming are a part of the work of this section.

2.03 PIPE HANGERS AND SUPPORTS

A. Pipe hangers and supports shall be provided at suitable distance along the pipeline, as recommended by the manufacturer in accordance with the specified conditions, regardless of whether they are shown or not on the drawings.

B. Pipe hangers and supports inside the existing sodium hypochlorite building shall match existing to be FRP.

PART 3 EXECUTION

3.01 INSTALLATION

A. The installation of plastic pipe shall be strictly in accordance with the manufacturer's technical data and printed instructions.

B. Joints for PVC and CPVC pipe shall be solvent cemented unless flanged or threaded are otherwise shown on the Drawings or are specified as other types herein. In making solvent cemented connections, clean dirt and moisture from pipe and fittings, bevel pipe ends slightly with emery cloth to remove any shoulder or burrs created by cutting of the pipe. Solvent cement joints shall be made in accordance with ASTM D2855 except that solvent cement formulated especially for and as specified above shall be used for joining CPVC pipe and fittings. Primer shall be used whenever recommended by the pipe, fitting, or cement manufacturer and in all cases for joints on pipe systems 4-in in diameter or larger. Making solvent cement joints shall not be performed and the work shall stop when the temperature, measured in the shade, is 40 degrees F and falling.

C. Joints between PVC drain, waste and vent pipe and cast-iron soil pipe shall be made with approved mechanical compression joints designed for such use.

D. Joints for HDPE pipe shall be butt heat fusion. Butt heat fusion joints shall be made in accordance with the requirements of ASTM D2657.

E. Installation of valves and fittings shall be in accordance with manufacturer's instructions. Particular care shall be taken not to overstress threaded connections. In making solvent cement connections, the solvent cement or primer shall not be spilled on valves. Any cement allowed to run from joints shall be cleaned from the pipe and fittings immediately.

F. All piping shall have a sufficient number of unions to allow convenient removal of piping and shall be as approved by the ENGINEER. PVC and CPVC pipe shall be installed with at least one expansion joint or loop near the center of each straight run of pipe which is 50-ft or longer with the maximum spacing between expansion joints or loops being 150-ft.

G. Where plastic pipe passes through wall sleeves, the space between the pipe and sleeve shall be sealed with a mechanical sealing element as specified in Section 01180.

H. All plastic pipe to metal pipe connections shall be made using flanged connections. Metal piping shall not be threaded into plastic fittings, valves, or couplings nor shall plastic piping be threaded into metal valves, fittings or couplings. Only socket to thread adaptors shall be used for threaded plastic pipe connections to other threaded devices.

I. Concrete inserts for hangers and supports shall be furnished and installed in the concrete as it is placed. The inserts shall be set in accordance with the requirements of the piping layout and the CONTRACTOR shall verify these locations from approved piping layout drawings and the structural drawings. Pipe hangers and supports are specified in Section 15140.

J. Due to its large coefficient of thermal expansion, HDPE pipe shall be installed at its maximum operating temperature to prevent sagging between the hangers or supports. Supports at each end of the straight HDPE pipe runs shall be of sufficient strength to develop anchoring forces adequate to oppose the tensile forces developed in the pipe due to thermal contraction. The exception to this requirement shall be for flanged HDPE connections, because, if the flanged connection is made up at the maximum operating temperature, the thermal contraction of the flange thickness will reduce the required tensile force in the flange bolts. Flanged HDPE connections shall, therefore be made up at the lowest expected operating temperature and then the entire piping system shall be brought up to the maximum operating temperature for final installation. (Note: Packing the flanges in ice may be necessary to achieve the proper installation temperature).

K. Vented ball valves shall be provided at all high points in the sodium hypochlorite chemical service lines.

L. Pipe spacers shall be attached to the carrier pipe every three feet prior to the installation on the double-wall containment piping. The spacers shall be designed to permit the carrier and containment pipes to expand and contract without stress or wear on the pipes as well as provide for drainage and free air circulation. Lay out the system, cut and dry fit the carrier piping, then place the containment pipe over the carrier pipe before joining. The containment pipe must be installed over the carrier pipe as the system is being assembled. Prior to solvent welding of the containment pipe and installation of the split fittings, the carrier pipe system shall be hydrostatically tested as detailed in Paragraph 3.02.

3.02 FIELD TESTING

A. All pipelines shall remain undisturbed for the minimum curing or cooling time specified for each type of pipe material but no less than 8 hours to develop full curing and complete strength at all joints.

B. All pipe systems shall be flushed clean and then subjected to a hydrostatic pressure test for 12 hours at a test pressure and temperature specified below. Testing procedures shall be as specified below and in Section 15052. Should the temperature not be attainable under hydrostatic conditions, then the test may be performed under hydro-dynamic conditions, provided that accurate measurements for loss of the test fluid can be made, or the pressure shall be proportionally increased to simulate the stresses of the higher temperature in relation to the lowest system temperature that is expected during the duration of the test. The proportionally higher test pressures shall be determined in accordance with the accepted temperature versus strength properties as published by the pipe manufacturer, PPI or other pipe material standards organization. Allowance for expansion of polyethylene pipe during the test shall be made in accordance with PPI Technical Report TR31.

C. The test pressures and temperatures for the various pipe lines shall be as follows:

1.	Drain piping:	15 psi at ambient temperature
2.	Vent piping:	15 psi at ambient temperature
3.	Chemical service carrier piping:	150 psi at 100-deg F

D. The test shall be performed by slowly filling the piping system, expelling entrapped air from all high points. The fill rate shall be controlled so that the fluid velocity within the pipe system is less than 2 fps. Upon completion of the filling process, the system shall be brought up to the specified test temperature as applicable, holding the system pressure to less than 10 percent of the test pressure. Once the system has been stabilized at the specified test temperature, the pipe should be slowly brought up to the test pressure in such a manner so as to not create shock, surge or water hammer in the pipe system. The test duration time limit shall not begin until the full pressure specified above has been reached and the system has been stabilized to within 5 percent of the test temperature. The system pressure and temperature shall be maintained to within 1/2 percent but no more than 5 percent of the specified value for the temperature and within 5 psi of the specified value for the pressure. These tolerances shall be held for the entire duration of the test. Upon completion of the test, the pressure shall be slowly removed by opening a valve or other pressure relieving device at a location remote to the location of the pressure/temperature monitoring equipment.

E. The pressure test shall be monitored by a recording type pressure gauge for tests not requiring temperature control or a dual pen pressure/temperature recording gauge when temperature control is required. The entire test process shall be recorded, including the initial temperature stabilization and pressurization of the piping system. The record shall be continuous through the system test and shall show the final de-pressurization of the pipe system.

F. All visible leaks detected during the pressure test shall be repaired and the pressure/ temperature test rerun. A successful test shall be a test in which no visible leaks are detected and the pipe system pressure can be maintained within 1/2 percent but no more than 5 psi of the specified value.

G. Prior to testing, the pipelines shall be supported in an approved manner to prevent movement during the tests.

H. After backfilling is completed, a 5 psig air test of the containment pipe shall be conducted to the satisfaction of the Owner.

3.03 PAINTING

A. All CPVC and PVC pipe and fittings exposed to the direct sunlight shall be field painted to provide additional UV protection. This painting shall be required whether or not marking is required and shall be in accordance with Section 09901.

B. Field finish painting is included in Section 09902. The Contractor shall identify pipe contents, direction of flow, and all else required for proper finish painting and marking of pipe.

C. Painting will not be required on PVDF and polypropylene pipe, however, marking the pipe to indicate normal direction of flow and the fluid being transported in accordance with the marking

schedule included in Section 09902 shall be required as part of the work of this section. Marking systems consisting of Mylar/aluminum sandwich sheets held in place by mastic or adhesive compounds which are compatible with the resin used to manufacture the pipe shall be used to identify pipe contents and direction of flow.

END OF SECTION

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. Valves and appurtenances shall be in accordance with Owner's Water & Wastewater Standards, latest edition, unless specified herein.

C. The equipment shall include, but not be limited to, the following. However, some items specified herein may not be included in this project.

1. Butterfly Valves for Fluid Service
2. Ball Valves
3. Rubber Flapper Swing Check Valves
4. Air Release/Vacuum Valves
5. Corporation Stop
6. Gate Valves (3 inches and Larger)
7. Pressure Regulating Valves (2-in and Smaller)

1.02 RELATED WORK

A. Instrumentation and Electrical, not specified herein, are included in Divisions 16.

B. Finish painting is included in Section 09902.

C. Certain appurtenances for individual types of pipe or systems are specified with the specific type of pipe or system. However, additional items are specified in this section.

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 data required to establish compliance with these Specifications in accordance with Section 01300. Submittals shall include the following:

1. Manufacturer's literature, illustrations, specifications, and Engineering data including:
   a. Certified drawings showing details of construction and dimensions.
   b. Descriptive literature, bulletins, and/or catalogs of the equipment.
   c. The total weight of each item.

d. complete bill of materials.
e. Additional submittal data, where noted with individual pieces of equipment.
f. Actuator weight.
g. Shop and finish coating.
h. Recommended spare parts.

B. Test Reports

1. Provide certified hydrostatic test data, per manufacturer's standard procedure or MSS-SP-61 for all 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 the 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 the Engineer as provided in Section 01730. The instructions shall be prepared specifically for this installation and shall include all 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. American Society for Testing and Materials (ASTM)

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 A153 – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

4. ASTM A159 – Standard Specification for Automotive Gray Iron Castings.

5. ASTM A240 – Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels.

6. ASTM A276 – Standard Specification for Stainless and Heat-Resisting Steel Bars and Shapes.

7. ASTM A436 – Standard Specification for Austenitic Gray Iron Castings.

8. ASTM A536 – Standard Specification for Ductile Iron Castings.

9. ASTM B30 – Standard Specification for Copper-Base Alloys in Ingot Form.

10. ASTM B62 – Standard Specification for Composition Bronze or Ounce Metal Castings

B. American Water Works Association (AWWA)

1. AWWA C105 – Polyethylene Encasement For Ductile-Iron Pipe Systems
2. AWWA C111 – Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
3. AWWA C500 – Metal-Seated Gate Valves Supply Service
4. AWWA C502 – Dry-Barrel Fire Hydrants
5. AWWA C504 – Rubber-Seated Butterfly Valves, Class B
6. AWWA C507 – Ball Valves, 6-inch Through 48-inch (150mm Through 1200mm)
7. AWWA C508 – Swing-Check Valves for Waterworks Service, 2-inch (50mm) Through 24-inch (600mm) NPS
8. AWWA C509 – Resilient-Seated Gate Valves for Water and Supply Service
9. AWWA C511 – Reduced-Pressure Principle Backflow-Prevention Assembly
10. AWWA C515 – Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service
11. AWWA C550 – Protective Epoxy Interior Coatings for Valves and Hydrants
12. AWWA C600 – Installation of Ductile-Iron Water Mains and Their Appurtenances
13. AWWA C800 – Underground Service Line Valves and Fittings

C. American National Standards Institute (ANSI)

1. ANSI B2.1 – 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-71 – Cast Iron Swing Check Valves, Flanges and Threaded Ends.

4. MSS-SP-72 – Ball Valves with Flanged or Butt-Welding Ends for General Services.

5. MSS-SP-80 – Bronze Gate, Globe, Angle and Check Valves.

6. MSS-SP-82 – Valve Pressure Testing Methods.

7. MSS-SP-98 – Protective Epoxy Coatings for the Interior of Valves and Hydrants.

8. MSS-SP-78 – Cast Iron Plug Valves, Flanged, and Threaded Ends.

F. National Electrical Manufacturers Association (NEMA)

G. Underwriters Laboratories (UL)

H. Factory Mutual (FM)

I. The Society of Protective Coatings (SSPC)

1. SSPC SP-6 – Joint Surface Standard Commercial Blast Cleaning

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. Qualifications

1. Valves and appurtenances shall be products of well-established firms who are fully experienced—minimum 5 years, reputable, and qualified in the manufacture of the particular equipment to be furnished.

2. The equipment shall be designed, constructed, and installed in accordance with the best practices and methods and shall comply with these specifications as applicable.

3. All units of the same type shall be the product of one manufacturer.

B. Certifications

1. The manufacturers shall furnish an affidavit of compliance with standards referred to herein as specified in Paragraph 1.03.C. Refer to PART 3 for testing required for certain items in addition to that required by referenced standards.

C. Provide the services of a qualified and factory-trained service representative of the manufacturer to provide operational and maintenance instruction for 1-day, 8-hour period for the slanting disc check valve with bottom mounted buffer.

D. Material Quality: Minimum quality standards for valve components shall comply with MSS SP-55. Materials of construction shall be clean and free from defects that would weaken the structural integrity of the valve or affect the ability of the valve to withstand hydraulic pressure over the life of the valve. Surface defects greater than 1/8 inch and 1/8 inch of wall thickness in any direction will not be acceptable. Indication of shrinkage, cracks, hot tears, sand inclusions (on machined surfaces), or porosity caused during the casting process will not be acceptable.

Valves determined to be defective in accordance with the above shall be replaced. Repair of valve and disc defects will not be permitted. Previously repaired valve bodies will be rejected prior to testing.

E. Inspection of the units may also be made by the Engineer or other representative of the Owner after delivery. The equipment shall be subject to rejection at any time due to failure to meet any of the Specification requirements, even though submittal data may have been accepted previously. Equipment rejected after delivery shall be marked for identification and shall be removed from the job sites at once.

1.06 SYSTEM DESCRIPTION

A. All of the equipment and materials specified herein are intended to be standard for use in controlling the flow of finished water as noted on the Drawings.

B. Valves, appurtenances, and miscellaneous items shall be installed as shown on the Drawings and as specified, so as to form complete, workable systems.

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. All valves and appurtenances shall be examined before installation, and no piece shall be installed which is found to be defective. Any damage to the coatings shall be repaired as acceptable to the Engineer.

2. Prior to shipping, the ends of all valves shall be covered to prevent entry of foreign material. Covers shall remain in place until after installation and connecting piping is completed.
   a. All valves 3 inches and larger shall be shipped and stored at each site with wood or plywood covers on each valve end until time of use.
   b. Valves smaller than 3 inches shall be shipped and stored as above, except that heavy cardboard covers may be used on the openings.
   c. Protect threads and seats from corrosion and damage. The stems of rising-stem 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. Any corrosion in evidence at the time of acceptance by the Owner 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 specifications and manufacturer's information for further requirements.

1.08 SPECIAL TOOLS AND SPARE PARTS

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.

B. Provide all special tools required for normal maintenance. Tools shall be packaged in a steel case, clearly and indelibly marked on the exterior to indicate equipment for which tools are intended.

C. Provide to the Owner a list of all spare and replacement parts with individual prices and location where they are available. Prices shall remain in effect for a period of not less than 1 year after final acceptance.

1.09 VALVE IDENTIFICATION

A. The Contractor shall prepare a valve schedule for all valves required for his work showing a number, the location, type, function, and normal operating position, for each valve. The schedule shall be submitted to the Engineer for approval prior to start-up.

B. The Contractor shall furnish tags for all the valves required for the work. Valve tags shall be 2-inch diameter, 19 gauge, and aluminum, with brass hooks suitable for attaching the tag to the valve operator. Tags shall be stamped or etched with the valve number and the information on the valve schedule coded in a system provided by the Owner. Submit two samples of the type of tag proposed and the Manufacturer’s standard color chart and letter styles to the Engineer for approval.

C. The Contractor shall install valve tags on all valves required for his work.

PART 2 PRODUCTS

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. The use of a manufacturer's name and/or model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.

C. Valves and appurtenances 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.

D. Valves and appurtenances shall have the name of the maker, nominal size, flow directional arrows, working pressure for which they are designed, and standard referenced cast in raised letters or indelibly marked upon some appropriate part of the body.

E. 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.

F. Joints, size, and material, unless otherwise noted or required by the Engineer:

1. Except where noted, all joints referred to herein shall be of the same type, nominal diameter, material, and with a minimum rating equal to the pipe or fittings to which they are connected.

2. Valves and appurtenances shall be of the same nominal diameter as the pipe or fittings to which they are connected.

G. Provide all special adaptors as required to ensure compatibility between valves, appurtenances, and adjacent pipe.

H. Valves and actuators shall be especially designed for submerged service where water may completely submerge the valve and operator.

J. All valves shall be provided with a permanent number plate. The location of number plates and the method of fastening shall be approved by the Engineer. Numerals shall be at least 1 inch high and shall be black baked enamel on an anodized aluminum plate. Plates shall be fastened prior to factory witness testing.

2.02 BUTTERFLY VALVES FOR FLUID SERVICE (METAL BODY)

A. Butterfly valves and operators 30-inch diameter and smaller shall conform to AWWA C504, Class 150B, except as specified herein. The manufacturer shall submit an affidavit of compliance stating that the 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 the Drawings or in this Section and be manufactured by Dezurik Water Controls; Henry Pratt; Keystone or approved equal.

B. Butterfly valves for above grade shall be ANSI 125/150 flanged end with face-to-face dimensions in accordance with Table 2 of AWWA C504 for short-body valve.

C. Valve seats shall be in the valve body and retained in accordance with AWWA C504. Seats shall be synthetic rubber (EPDM). Valve discs shall be constructed of cast iron, ASTM A48, Class 40; Ni-resist, ASTM A436, Type 1; or ductile iron, ASTM A536, Grade 65-45-12. The service class shall be AWWA Class 150B for all valves.

D. Spray coat interior wetted ferrous surfaces with an AWWA and U.S. Food and Drug Administration two-component epoxy approved for potable water.

E. The valve body shall be constructed of close-grain cast iron per ASTM A126, Class B with integrally cast hubs for shaft bearing housings of the 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 the operator end of the vane shaft.

1. Packing shall be of the self-compensating V-type. A sealing element utilizing O-rings shall also be acceptable.

2. Packing shall be held in place by a bolted corrosion-resistant retainer plate or gland. Retainer clips are not acceptable.

3. Replacement of seals, for all size butterfly valves, shall not require removal of the valve from the line.

F. The valve shaft and steel torque tube shall be turned, ground, and polished 18-8 Type 316 stainless steel and designed for both torsional and shearing stresses when the valve is operated under its greatest dynamic or seating torque. No reductions of shaft diameter will be allowed, except at the operator connection. Any reduction shall have a full radius fillet. The use of shafts having a hexagonal cross section will not be acceptable. Attach disc to shaft with stainless steel tapered pins and locking nuts.

G. The butterfly valve actuator shall conform to the requirements of AWWA C504, insofar as applicable and as specified herein.

H. Gearing for the actuators, where required, shall be totally enclosed in a gear case in accordance with AWWA C504.

I. The manual actuators shall conform to AWWA C504, insofar as applicable. Actuators shall have permanent indicators with raised or engraved marks to show position of the valve disc.

J. A foundry stamp consisting of foundry identification symbol, material identification, heat number, and serial number shall be cast into the surface of the pressure boundary parts of the valve body and cover. Manufacturer's identification shall be cast adjacent to the foundry cast. Additionally, valve size, class, and year of manufacture shall be cast into the body.

2.03 BALL VALVES

A. All ball valves shall comply with requirements included in Section 351 of OWNER's Water and Wastewater Standards Manual, latest edition.

2.04 RUBBER FLAPPER SWING CHECK VALVES

A. The Rubber Flapper Swing Check Valve shall have a heavily constructed ductile iron or ductile iron body and cover. The body shall be long pattern design (not wafer) with integrally cast-on end flanges. The flapper shall be Buna-N having an "O" ring seating edge and be internally reinforced with steel.

B. Flapper to be captured between the body and the body cover in a manner to permit the flapper to flex from closed to full open position during flow through the valve. Flapper shall be easily removed without need to remove valve from line. Check Valves to have full pipe size flow area. Seating surface to be on a 45-degree angle requiring the flapper to travel only 35 degrees from closed to full open position, for minimum head loss and non-slam closure.

C. Buna-N Flapper (hi-strength coated fabric – coated both sides with 70 Duro) which creates an elastic spring effect, molded internally, to assist the flapper to close against a slight head to prevent slamming.

D. Valve designed for 250 psi working pressure for wastewater.

E. Valve exterior and interior to be Fusion Bonded Epoxy coated8 mils minimum per Orange County's Appendix D for high resistance to corrosion.

F. A mechanical indicator shall be provided to provide disc position indication on valves 3-inch and larger. The indicator shall have continuous contact with the disc under all operating conditions to assure accurate disc position indication.

G. An inductive type proximity switch shall be furnished mounted to the mechanical indicator with its target mounted to the indicator rod or on the valve body with its target mounted internally on the flapper to transmit an electrical signal that the flapper is open or closed.

H. The Valve Manufacturer shall have been regularly engaged in the design and manufacture of Rubber Flapper Swing Check Valves for at least five years and shall submit a list of at least five separate installations in service for a minimum of five years for engineer approval prior to release to manufacture.

I. Materials of construction shall be certified in writing to conform to ASTM specifications as follows:

Body & Cover	ASTM A536 Grade 65-45-12 Ductile Iron
Rubber Flapper	Buna-N

J. Valve to be APCO Series 100 Rubber Flapper Swing Check Valve, as manufactured by Valve & Primer Corporation, Schaumburg, Illinois, U.S.A.; Val-Matic 500 Series or approved equal.

2.05 AIR/VACUUM VALVES (NORMAL OPERATION)

A. The air/vacuum valves shall be fully automatic operated valves designed to exhaust air which is present in the pump column on pump startup and allow air to re-enter the column on pump shutdown or should negative pressure occur. The air/vacuum valves shall be suitable for pressures up to 400 psig for raw water pump discharge service.

B. The air/vacuum valves shall be manufactured and tested in accordance with AWWA standard C512. The air/vacuum valves shall be certified to NSF/ANSI 61 standard.

C. The air/vacuum valve body, cover, and baffle shall be constructed of ASTM A536 Grade 65-45-12 cast ductile iron. The valve body shall provide a through flow area equal to the nominal valve size. The float, guide shafts, and bushings shall be constructed of Type 316 stainless steel. Floats shall be unconditionally guaranteed against failure including pressure surges. Resilient seats shall be Buna-N. Resilient seats shall provide drop tight shut off to the full valve pressure rating. If required by the valve manufacturer, the valve shall be equipped with a dual port throttling device to control the discharge of air from the valve and allow full vacuum through a separate port.

D. The 2-inch air/vacuum valve on the discharge header shall be model VM38SV by Val-Matic, or equal by Crispin.

E. The 1-inch air/vacuum valve on the well casing shall be model VM22.4SV or VM22.9SV by Val-Matic, or equal by Crispin.

F. Valve interiors and exteriors shall be coated with an NSF/ANSI 61 certified fusion bonded epoxy in accordance with AWWA C550 when specified.

2.06 CORPORATION STOPS

A. Corporation stops shall be of bronze or brass and shall be designed and manufactured in accordance with AWWA C800, except as modified herein.

B. Corporation stops for use with service clamps shall have IPS threads. Where corporation stops are used with plastic pipe, a brass companion flange shall be provided on the outlet of each corporation stop.

C. Stop and waste valves shall be similar to 150 psi-rated corporation stops as manufactured by Crane; Ford; McDonald or equal.

2.07 GATE VALVES (3 INCHES AND LARGER)

A. All gate valves shall comply with requirements included in Section 351 of OWNER's Water and Wastewater Standards Manual, latest edition.

2.08 PRESSURE REGULATING VALVES – 2-IN AND SMALLER

A. Pressure regulating valves 2-in and smaller shall be rated 150 psig working pressure, with bronze and brass body; renewable stainless steel seat and flexible diaphragm of suitable material. Outlet pressure shall be easily field-adjustable over pressure ranges tabulated.

B. Pressure regulating valves 2-in and smaller shall be Figure No. 43D as manufactured by GA Industries, Inc.; Watts Muesco Regulator Co. Series 115 for 1-1/4-in and larger and Model 223-S for units smaller than 1-1/4-in or equal with strainer and of size noted on Drawing. Shall be diaphragm type, pressure reducing globe valves designed for an inlet pressure of approximately 110 psig, and outlet pressures in range of 20 to 60 psig.

2.09 SURFACE PREPARATION AND COATINGS

A. Notwithstanding any of these Specifications, all coatings and lubricants in contact with potable water shall be certified as acceptable for use therewith.

B. If not specified herein, preparation and coatings shall comply with the requirements of Sections 09901 and 09902. In case of a conflict, the requirements of this section govern.

C. The exterior surface of various parts of valves, operators, floor stands, and miscellaneous piping shall be sandblasted per SSPC-SP5, and one shop coat of an approved rust-inhibitive primer, such as Inertol Primer No. 621, shall be applied in accordance with the instructions of the paint manufacturer or other primer compatible with the finish coat provided.

D. Unless otherwise noted, interior ferrous surfaces of all 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 DFT of 4 mil.

E. Ferrous surfaces 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.

F. Special care shall be taken to protect uncoated items and plastic items, especially from environmental damage.

2.10 FACTORY INSPECTION, TESTING, AND CORRECTION OF DEFICIENCIES

A. Factory inspection, testing, and correction of deficiencies shall be done in accordance with the referenced standards and as noted herein.

B. All powered actuators shall be factory tested to demonstrate that all functions are performed correctly.

C. See Division 1 for additional requirements. Also refer to PART 1 of this section, especially for required submission of test data to the Engineer.

D. In addition to all tests required by the referenced standards, the following shall also be factory tested and test reports submitted to the Engineer:

1. Butterfly valves

2. Rubber Flapper Swing Check Valves

PART 3 EXECUTION

3.01 INSTALLATION – GENERAL

A. All valves and appurtenances shall be installed per the manufacturer's instructions in the locations shown, true to alignment and rigidly supported. Any damage to the above items shall be repaired to the satisfaction of the Engineer before they are installed.

B. Install all supports, extension rods, guides, operators, and appurtenances as shown on the Drawings or otherwise required. Before setting these items, check all Drawings and figures, which have a direct bearing on their location. The Contractor shall be responsible for the proper location of valves and appurtenances during the construction of the Work. Submit shop drawings and working drawings for all piping and supports.

C. All materials shall be carefully inspected for defects in construction and materials. All debris and foreign material shall be cleaned out of openings, etc. All valve flange covers shall remain in place until connected piping is in place. All operating mechanisms shall be operated to check their proper functioning and all 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 the Owner.

D. Where installation is covered by a referenced standard, installation shall be in accordance with that standard, except as herein modified, and the Contractor shall certify such. Also note additional requirements in other parts of this Specification.

E. Unless otherwise noted, joints for valves and appurtenances shall be made up utilizing the same procedures as specified under the applicable type connecting pipe joint and all valves and other items shall be installed in the proper position as recommended by the manufacturer. Contractor shall be responsible for verifying manufacturers' torqueing requirements for all valves.

F. Whether or not shown on the Drawings, all valves or the piping at all valves shall be supported within 2 feet of the valve.

3.02 INSTALLATION OF MANUAL OPERATIONAL DEVICES

A. Unless otherwise noted, all operational devices shall be installed with the units of the factory, as shown on the Drawings or as acceptable to the Engineer to allow accessibility to operate and maintain the item and to prevent interference with other piping, valves, and appurtenances.

B. For manually operated valves 3-inch 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 the operating nut, with couplings as required and the elevation of the box top shall be adjusted to conform to the elevation of the finished floor surface or grade at the completion of the Contract. Boxes and stem guides shall be adequately supported during concrete pouring to maintain vertical alignment.

3.03 INSPECTION, TESTING, AND CORRECTION OF DEFICIENCIES

A. See also Division 1. Take care not to over pressurize valves or appurtenances during pipe testing. If any unit proves to be defective, it shall be replaced or repaired to the satisfaction of the Engineer.

B. No testing shall be performed until the connected equipment manufacturer's representative has provided written certification that the following installed equipment has been examined and found to be in complete accordance with the manufacturer's requirements.

C. Functional Test – Prior to installation, conduct a functional field test of each valve, including actuators and valve control equipment, in the presence of the Engineer to demonstrate that each part and all components together function correctly. Prior to system testing and startup, all valves shall be inspected for proper alignment, smooth operation, proper connection, and satisfactory performance. All valves shall be operated through at least ten complete cycles during system testing. All testing equipment required shall be furnished by the Contractor.

D. The various pipes in which the valves and appurtenances are installed are to be field pressure tested. During these tests any defective valve or appurtenance shall be adjusted, removed, and replaced or otherwise made acceptable to the Engineer.

3.04 CLEANING

A. All items including valve interiors shall be inspected before line closure, for the presence of debris. At the option of the Engineer, internal inspection of valve and appurtenances may be required any time that the likelihood of debris is a possibility. All pipes and valves shall be cleaned prior to installation, testing disinfection and final acceptance.

END OF SECTION

SECTION 15120
PIPING SPECIALTIES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section specifies the basic administrative and testing requirements for piping. Specific piping materials, systems, and related installation and testing requirements are specified in other sections of Division 15.

B. The items shall include the following:

1. Unions

2. Flanged Joints

4. Plugs and Caps

5. Miscellaneous Adaptors

6. Vents and Drains

7. Service Clamps

8. Quick-Connect Couplings

9. Flexible Connectors
   a. Sleeve Couplings
   b. Split or Grooved Couplings
   c. Flange Adapters
   d. Pump and Equipment Flexible Connectors
   e. Flexible Metal Hose

10. Harnessing and Restraints

11. Pressure Gauges

12. Diaphragm Seals for Gauges

13. Appurtenances and Miscellaneous Items

C. This section specifies piping specialties related to process piping.

1.02 RELATED WORK

A. Ductile iron pipe and fittings are included in Section 15062.

B. Valves and appurtenances are included in Section 15100.

C. Piping, valves and appurtenance are included in Section 350 and 351 in Owner's Water and Wastewater Standards Manual, latest edition.

1.03 SUBMITTALS

A. General submittals for piping, piping systems, and pipeline appurtenances are listed below. Submittals shall be in accordance with Section 01300. 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. Piping layouts in full detail.

2. Location of pipe hangers and supports.

3. Location and type of backup block or device to prevent joint separation.

4. Large scale details of wall penetrations and fabricated fittings.

5. Schedules of all pipe, fittings, special castings, couplings, expansion joints, and other appurtenances.

6. Catalog cuts of joints, couplings, harnesses, expansion joints, gaskets, fasteners, and other accessories.

7. Catalog cuts of all pipeline appurtenances specified herein.

8. Brochures and technical data on coatings and linings and proposed method for application and repair.

C. Samples

D. Design Data

E. Test Reports

F. Certificates

1. Copies of certification for all welders performing work in accordance with ANSI B31.1.

G. Manufacturers Installation (or application) instructions.

H. Statement of Qualifications

I. Manufacturers Field Report

J. Project Record Document

K. Operation and Maintenance Data in accordance with Section 01730.

L. Warranties

1.04 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1. ASTM A36 – Standard Specification for Structural Steel.

2. ASTM A126 – Gray Iron Casting for Valves, Flanges and Pipe Fittings.

3. ASTM A183 – Carbon Steel Track Bolts and Nuts.

4. ASTM A278 – Gray Iron Castings for Pressure-Containing Parts for Temperatures up to 650ºF.

5. ASTM A307 – Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.

6. ASTM A325 – Standard Specification for High-Strength Bolts for Structural Steel Joints.

7. ASTM A536 – Ductile Iron Castings

8. ASTM A575 – Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grade.

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 B2.1 – Specifications, Dimensions, Gauging for Taper and Straight Pipe Threads (except dry seals).

4. ANSI B16.1 – Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250 and 800.

5. ANSI B16.5 – Pipe Flanges and Flange Fittings

6. ANSI B18.2 – Square and Hex Bolts and Screws Inch Series Including Hex Cap Screws and Lag Screws.

7. ANSI B31 – Code for Pressure Piping, B31 Interpretation.

8. ANSI B31.1 – Power Piping

C. American Welding Society (AWS)

1. AWS B3.0 – Welding Procedure and Performance Qualifications

D. American Water Works Association (AWWA)

1. AWWA C-110 – Ductile-Iron and Gray-Iron Fittings 3-in Through 48-in, for Water and Other Liquids.

2. AWWA C-111 – Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings.

3. AWWA C-206 – Grooved and Shouldered Type Joints.

4. AWWA Manual M11 – Steel Pipe - A Guide for Design and Installation.

E. Plumbing and Drainage Institute (PDI)

1. WH 201 – Water Hammer Arrestors

F. 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. Install piping to meet requirements of local codes.

C. Provide manufacturer's certification that materials meet or exceed minimum requirements as specified. Reference to standards such as ASTM and ANSI shall apply to those versions in effect at the time of bid opening.

D. Coordinate dimensions and drilling of flanges with flanges for valves, pumps and other equipment to be installed in piping systems. Bolt holes in flanges to straddle vertical centerline.

E. Reject materials contaminated with gasoline, lubricating oil, liquid or gaseous fuel, aromatic compounds, paint solvent, paint thinner, and acid solder.

F. Pipe-joint compound, for pipe carrying flammable or toxic gas, must bear approval of Underwriters' Laboratories or Factory Mutual Engineering Division.

G. Unless otherwise specified, pressures referred to in all piping sections are expressed in pounds per square inch gauge above atmospheric pressure, psig, and all temperature are expressed in degrees Fahrenheit.

1.06 DELIVERY, STORAGE, AND HANDLING

A. During loading, transportation, and unloading, take care to prevent damage to pipes and coating. Carefully load and unload each pipe under control at all times. Place skids or blocks under each pipe in the shop and securely wedge pipe during transportation to ensure no injury to pipe and lining.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Specific piping materials and appurtenances are specified in the respective Piping or System Sections. The use of a manufacturer's name and/or model number is for the purpose of establishing the standard of quality and general configuration desired.

B. 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.

C. 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.

D. 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.

2.02 UNIONS

A. Unions shall be brass or bronze unions for joining nonferrous pipe, malleable brass or bronze-seated iron or steel unions for joining ferrous pipe, PVC unions for joining PVC pipe, and CPVC unions for joining CPVC pipe.

2.03 FLANGED JOINTS

A. Flanged joint bolt and nuts shall be Grade B, ASTM A307, unless otherwise specified—bolt number and size same as flange standard; studs same quality as machine bolts; 1/16-inch-thick rubber gaskets with cloth insertions; rust-resistant coatings.

2.04 DIELECTRIC CONNECTORS

A. Dielectric pipe fittings/insulators and unions shall be used to prevent galvanic action wherever valves or piping of dissimilar metals connect. This shall be particularly the case for copper, brass, and bronze piping connecting to cast iron or steel piping systems.

B. Dielectric unions shall be used for 2-inch and smaller connections. Steel union nuts shall meet ASTM A575 requirements. The steel or ductile iron connection end shall have a steel body and shall have accurately machined taper tapped pipe threads in accordance with ANSI B2.1. The copper connection end shall be a copper solder joint that meets requirements of ASTM B88. Dielectric unions shall be rated for at least 250 psi at 210°F.

C. Dielectric flange unions shall be used for connections 2-1/2 inches and larger. Cast iron flanges shall meet ASTM A126; the copper solder end shall meet ASTM B62 and the pipe thread shall meet ANSI B2.1. Dielectric flange unions shall be rated for at least 175 psi at 210°F.

D. Dielectric unions and flange unions shall be as manufactured by Epco Inc., Cleveland, OH or equal.

E. Flange insulating kits shall be as acceptable to the Engineer, as manufactured by PSI or equal.

F. Insulated sleeve couplings and flange adaptors shall be similar to those units as specified elsewhere.

2.05 PLUGS AND CAPS

A. Provide standard plug or cap as required for testing; plugs, caps suitable for permanent service.

B. Plug or cap or otherwise cover all piping work in progress.

2.06 MISCELLANEOUS ADAPTORS

A. Between different types of pipe and/or fittings special adapters may be required to provide proper connection. Some of these may be indicated on the Drawings or specified with individual types of pipe or equipment. However, it is the Contractor's responsibility to ensure proper connection between various types of pipe, to structures, and between pipe and valves, gates, fittings and other appurtenances. The Contractor shall provide all adapters as required, whether specifically noted or not.

B. As required, these adapters shall be suitable for direct bury, with proper dielectric insulation and, if metallic (not stainless steel or galvanized), with two coats of coal tar epoxy.

2.07 VENTS AND DRAINS

A. 1/2-inch vents shall be provided at the high point in each system. Vent connections may be tapped, provided the tap will accept three full threads on the bronze nipple.

B. 1 1/2-inch drains shall be provided at low points to permit drainage of each system; provide hose-end valve.

2.08 SERVICE CLAMPS

A. Service clamps for outlet sizes up to 2 inches shall have malleable or ductile iron bodies which extend at least 160 degrees around the circumference of the pipe and shall have neoprene gaskets cemented to the saddle body. Bodies shall be tapped for IPS. Clamps shall be of the double-strap design. Straps, nuts, and bolts shall be stainless steel. Service clamps shall be Style DR2S as manufactured by Mueller, or equal as manufactured by Smith Blair, Dresser Industries, Inc., or equal.

B. Service clamps for outlet sizes 4 through 12 inches, where the outlet size is not greater than half the size of the main pipe, shall have ductile iron bodies and a neoprene circular cross section O-ring gasket confined within the body. Outlet shall be AWWA C110 flange or AWWA C111 mechanical joint as required for the application. Straps, nuts, and bolts shall be 316 stainless steel, minimum 1/4 by 1-1/2 inch in cross section and fabricated with 3/4-inch threaded ends. Service clamps shall be Fig. A-10920 or A-30920 by American Cast Iron Pipe company or equal.

2.09 FLEXIBLE CONNECTORS

A. Sleeve Couplings

1. Provide plain end-type ends to be joined by sleeve couplings as stipulated in AWWA C201.
   a. Join welds on ends by couplings without pipe stops. Grind flush to permit slipping coupling in at least one direction to clear pipe joint.
   b. Outside diameter and out-of-round tolerances shall be within limits specified by coupling manufacturer.
   c. Provide lugs in accordance with ASTM A36.
   d. Provide hardened steel washers in accordance with ASTM A325.
   e. Plastic plugs shall be fitted in coupling to protect bolt holes.
   f. Nuts and bolts:
      1) Provide bolts and bolt studs in accordance with ASTM A307 and ANSI B1.1 with hexagonal or square heads, coarse-thread fit, threaded full length with ends chamfered or rounded.
      2) Project ends 1/4 inch beyond surface of nuts.
      3) Hexagonal nuts with dimensions in accordance with ANSI B18.2 and coarse threads in accordance with ANSI B1.1.

2. Middle ring of each mechanical coupling shall have a thickness at least equal to that specified for size of pipe on which coupling is to be used and shall not be less than 10 inches long for pipe 30 inches and larger and not less than 7 inches long for pipe under 30 inches in diameter.
   a. Omit pipe stop from inner surface of middle rings of couplings whenever necessary to permit removal of valves, flowmeters, and other installed equipment.
   b. Provide pipe stops in other couplings.

3. Clean and shop prime with manufacturer's standard rust inhibitive primer.

4. Furnish gaskets of a composition suitable for exposure to the fluid service.

5. Where shown on the Drawings, anchor sleeve-coupled joints with harness bolts. Weld harness lugs to steel pipe.
   a. Joint harness bolts shall be of sufficient length, with harness lugs placed so that coupling can be slipped at least in one direction to clear joint. Provide harnesses of sufficient number and strength to withstand test pressure.
   b. Each harness shall have a minimum of two 5/8-inch-diameter bolts.

6. Unless otherwise specified with the individual type of pipe, sleeve couplings (mechanical couplings) shall be ITT/Smith Blair Style 411; Dresser Style 38, similar models by Baker or equal, with the pipe stop removed.

7. Similar insulation-type couplings shall be provided at the face of buildings, between different type metals or where otherwise noted.

B. Split or Grooved Couplings

1. Split couplings shall be cast in two or more parts. When secured together with ASTM A183 bolts and nuts, couplings shall engage grooved or shouldered pipe ends and encase an elastomeric gasket to create a pipe seal. Gasket material shall be as recommended by the manufacturer for the service required.

2. Split couplings shall be as manufactured by Victaulic Company of America, Gustin-Bacon, or equal. Numbers below refer to Victaulic Co. items, for reference only.

3. Unless otherwise specified with the individual type of pipe:
   a. Flexible split ring couplings shall be:
      1) Grooved ends – Style 77 (For Ductile Iron – Style 31)
      2) Shouldered ends – Style 44
   b. Rigid split-ring couplings shall be:
      1) Grooved ends – rigid groove with Style HP-70 couplings on ductile iron less than 18-inch diameter with sufficient wall thickness per AWWA C606, on standard groove with Style 77 coupling on manufactured steel or other pipe.
      2) Shouldered ends – Style 44 coupling on ductile iron over 16-inch diameter or without sufficient wall thickness per AWWA C606 or on manufactured steel pipe or thin wall stainless steel pipe.

4. Ductile iron pipe for use with split-type coupling joints shall have radius grooved ends conforming to AWWA C606. Pipe shall have grooved ends to provide either a rigid joint or flexible joint as shown on the Drawings and as specified herein. Flexible joint grooving shall permit expansion and contraction and angular deflection. Rigid joint grooving shall allow no angular or linear movement. Minimum pipe wall thickness for grooved pipe shall be the following class:

Size	Class
4 thru 16	53
18	54
20	55
24	56

5. Grooved couplings for steel and stainless steel piping shall have roll grooving, machine-grooving, or ring collars fully welded to the pipe or fitting.

6. Rigid split couplings may be substituted for flanges as noted on the Drawings and in the individual pipe Specifications.

7. Certain minimum thickness of pipe walls are required by AWWA C606 and coupling manufacturers for use of various type split couplings with certain pipes. The Contractor shall be responsible for utilizing at least those minimum wall thicknesses required (unless a greater thickness is specified or required in the individual pipe specifications) with split couplings.

8. If minimum thicknesses are not utilized with grooving, then a shouldered-end treatment with couplings as noted shall be utilized.

9. All grooved joint couplings and fittings shall be of a single manufacturer. Fitting grooved ends shall be specifically designed for use with the couplings.

C. Flanged Adaptors

1. Flanged adaptor connections for grooved or shouldered end pipe compatible with split couplings at fittings, valves, and equipment shall be VIC-Flange Style 341 as manufactured by the Victaulic Company of America, or equal product as manufactured by Gustin-Bacon.

2. Flanged adaptor connections for plain-end pipe at fittings, valves, and equipment shall be Dresser Style 127 or 128, similar models by ITT (formerly Smith-Blair); Depend-O-Lok F x E FAC by Victaulic Depend-O-Lok, Inc. or equal.

D. Pump and Equipment Flexible Connectors

1. If shown on the Drawings, the flexible connectors shall be expansion/vibration joints of the single arch-type of butyl rubber construction with carcass of high grade woven cotton or suitable synthetic fiber and individual solid steel-ring reinforcement. Soft rubber fillers shall be integrally cured into the arches to provide a smooth flow path to prevent settling of material into the arch. Joints shall be constructed to pipeline size and to meet working pressures and corrosive conditions similar to the line where installed. Joints shall have full-faced fabric-reinforced butyl flanges integral with the body.

2. Split steel or ductile iron backup rings shall be provided to ensure a good joint. Rings shall be designed for mating with ANSI Standard minimum 150-pound flanges. All joints shall be finish coated with hypalon, or equal paint.

3. Expansion/vibration joints shall be furnished with control (harness) units. Harness units shall consist of minimum two drilled plates, stretcher bolts, and rubber washers backed by metal washers. The stretcher bolts shall prevent over-elongation of the joint. Extra nuts shall be provided on the stretcher bolts on the inside of the plate to prevent over-compression. All nuts, bolts, and plates shall be galvanized.

4. The manufacturer of the expansion joints shall be a member of the Rubber Expansion Joint Division of the Fluid Sealing Association. Expansion joints shall be Style 1025 filled arch as manufactured by General Rubber Corp., South Hackensack, NJ, or similar products of Mercer Rubber; Goodall Rubber, Garloc, Proco Products Inc., Stockton, CA, or equal.

E. Flexible Metal Hose

1. Flexible metal hose shall be constructed of corrugated inner tubing of tin-bronze or Type 321 stainless steel and shall have an outer shield of wire braid of either tin-bronze or Type 321 stainless steel.

2. The flexible hose connectors shall have a length not less than 5 times the nominal pipe diameter.

3. The connectors shall have 150 psi flanged ends in all sizes and shall be suitable for pressure up to 150 psig and temperatures to 400ºF.

4. Flexible hose connectors shall be manufactured by Flexonics, Metraflex, or equal.

2.10 HARNESSING AND RESTRAINT

A. Where harnessed couplings or adapters are noted, they shall conform to AWWA Manual M11, except as modified by the Drawings or this Specification.

B. Unless otherwise noted, size and material for tie rods, clamps, plates, and hex nuts shall be as shown on the Drawings or, if not shown on the Drawings, shall be as required in AWWA Manual M11 designed by the Contractor's Professional Engineer. Manufactured restraining

clamp assemblies shall be as manufactured by Stellar Corporation, Columbus, OH, or fabricated equal.

C. Restrained joints (such as welded, locking mechanical joints) shall be of the type specified with the individual type of pipe. If not specified, restrained (locking) mechanical joint pipe shall be of the manufacturer's standard design utilizing a locking device (ring or ears) integrally cast with the pipe.

D. For up through 18-inch-diameter ductile iron pipe only, the following may be used as an alternative to other restraint system:

1. The optional mechanical joint restraints shall be incorporated in the design of a follower gland. The gland shall be manufactured of ductile iron conforming to ASTM A536. Dimensions of the gland shall be such that it can be used with the standardized mechanical joint bell and tee-head bolts as specified with the pipe.

2. The restraint mechanism shall consist of numerous individually activated gripping surfaces to maximize restraint capability. The gripping surfaces shall be wedges designed to spread the bearing surfaces on the pipe. Twist-off nuts, sized same as tee-head bolts, shall be used to ensure proper actuating of restraining devices. When the nut is sheared off, standard hex nut shall remain.

3. The mechanical joint restraint device for ductile iron pipe shall have a working pressure of at least 250 pounds per square inch with a minimum safety factor of 2:1.

4. The mechanical joint restraint devices shall be of the type listed below or equal.

5. For Ductile Iron Pipe: EBAA Iron, Inc. Megalug 1100 series for up to 16 inches only.

E. The Contractor shall be responsible for anchorage including restraint as noted elsewhere in Division 15.

2.11 PRESSURE GAUGES

A. Bosses, connections, or nipples for gauges shall be provided. 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 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, one liquid fill, bar stock ball valve isolation valve, and threaded red brass connecting piping.

D. Gauge rating shall range from 0 to at least 2.5 percent higher than the rating of the pipe it is connected to.

E. Functional/Performance

1. Accuracy – Plus or minus 1.0 percent of span or better.

F. Physical

1. Case – Phenolic shock resistant or Type 316 stainless steel for surface/stem mounting with a pressure relieving back. The case shall be vented for temperature/atmospheric compensation. Gauge shall be capable of being liquid filled with glycerin in the field or at the factory and shall be provided with a filler/breather cap.

2. Window – Clear acrylic or shatter-proof glass.

3. Bourdon Tube – Type 316 stainless steel.

4. Connection – 1/2-inch NPT.

5. Gauge size – 5-inch minimum.

6. Pointer travel – Not less than a 200-degree arc nor more than a 270-degree arc.

7. Range – As indicated in the instrument device schedule.

G. Accessories/Options Required

1. Shutoff valve – Each gauge shall have a process shutoff valve which can also be used as an adjustable pressure snubber.

2. Special scales – Engineer reserves the right to require special scales and/or calibration if the manufacturer's standard is not suitable for the application.

3. Gauges shall be liquid filled at the factory.

4. Pressure gauges with annular seals and pressure switches (as required and specified) shall be shipped to the job site as a full assembly.

5. Spares – Furnish one spare unit for each range provided.

H. Manufacturers

1. Ametek/U.S. Gauge

2. Ashcroft

3. Dwyer/Mercoid

4. Wika

5. Or approved equal

2.12 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 Type 316 stainless steel interconnecting piping. Furnish also a 1/2-inch back-flushing connection and plug valve.

B. Diaphragm seals shall be minimum 1 1/2-inch 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 Type 316 stainless steel, with the lower housing of a material specifically chosen according to the fluid type and pressure being monitored, with Type 316 stainless steel bolts. Diaphragms shall be Type 315 ELC stainless steel.

2. Each diaphragm seal shall be connected to its respective piping or equipment with threaded Type 316 stainless steel 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-inch, except for connections to plant water piping which shall be minimum 1/2-inch. Furnish a plug valve shutoff valve between the pipeline or equipment and the diaphragm seal.

3. Each diaphragm seal shall have a minimum 1/4-inch NPT flush connection with plug 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.

C. Diaphragm seals for chemical piping pressure gauges shall be equal to Series 30 threaded-end (1/2- to 1-inch-diameter piping) or Series 40 wafer flange (1 1/2- to 2-inch-diameter piping) as manufactured by Red Valve or equal. Body shall be Type 316 stainless steel with PVC end caps. Diaphragms shall be hypalon.

D. Manufacturer

1. Dresser/Ashcroft

2. Fluid Isolation Technologies

3. Red Valve

4. Wika

5. Or approved equal

2.13 APPURTENANCES AND MISCELLANEOUS ITEMS

A. All gaskets, glands, bolts, nuts, and other required hardware shall be provided for connection of piping and appurtenances. Bolts and nuts shall be high strength, Type 316 stainless steel if submerged, buried, or subject to splashing and cadmium plated otherwise, with tee-head and hexagon nut. All other hardware shall be of the size, type and number as required and recommended by the piping or appurtenance manufacturer and as specified herein.

B. All gaskets for flanges shall be full face and suitable for the operating temperature and the fluids carried.

C. Plugs, caps, and similar accessories shall be of the same material as the pipe and of the locking type, unless otherwise noted.

D. Unions shall be of the same material as the pipe, except for dielectric connections.

E. Special protective tape shall be fabric-reinforced petroleum tape as manufactured by Denso Inc., Houston, TX, or equal.

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. Install piping in a neat manner with lines straight and parallel or at right angles to walls or column lines and with risers plumb. Run piping so as to avoid passing through ductwork or directly under electric light outlets, and/or interference with other lines or extending beyond furring lines as determined by Architectural Drawings. All work shall be accomplished using recognized methods and procedures of pipe fabrication and in accordance with the latest revision of applicable ANSI Standards, ASME Codes, and Pipe Fabrication Institute Standards.

1. Use full length of pipe except where cut lengths are necessary. Do not spring or deform piping to make up joints.

2. Pipe shall be cut square, not upset, undersize or out of round. Ends shall be carefully reamed and cleaned before being installed. Bending of pipe is not permitted. Use fittings for all changes in direction.

3. Do not use bushings except where specifically approved by the Engineer. Reducers shall be eccentric to provide for drainage from all liquid-bearing lines and facilitate air removal from water lines.

4. Verify the locations and elevations of any existing piping and manholes before proceeding with work on any system. Any discrepancies between the information shown on the Drawings and the actual conditions found in the field shall be reported at once to the ENGINEER. No claim for extra payment will be considered, if the above provision has not been complied with.

5. Where lines of lower service rating tie into services or equipment of higher service rating, the isolation valve between the two shall conform to the higher rating.

6. Mitering of pipe to form elbow is not permitted.

7. All piping interiors shall be thoroughly cleaned after installation and kept clean by approved temporary closures on all openings until the system is put in service. Closures should be suitable to withstand the hydrostatic test.

8. End caps on pre-cleaned pipe shall not be removed until immediately before assembly. All open ends shall be capped immediately after completion of installation.

D. Test Connections

1. Provide 1/2-inch female N.P.T. test connection equipped with 1/2-inch brass plug on all pump suction and discharge lines. Where indicated on the Drawings, test connections should be equipped with bar stock valve and gauge. Provide test connections at all steam traps. The connection shall be located on the discharge side of the trap between the trap and the first valve. It shall consist of a 1/2-inch branch connection terminated with a gate valve.

E. Installation of Expansion Joints and Flexible Connectors

1. Piping systems shall be aligned prior to installation of expansion fittings. Alignment shall be provided by fitting a rigid pipe spool in place of the expansion joint. Prior to testing of the piping system, the pipe spool shall be replaced with the specified expansion or flexible fitting.

2. In addition to the locations noted on the Drawings and in Part 2 of this section, expansion fittings and anchors shall be located and spaced as specified by the Expansion Joint Manufacturer's Association. The expansion joints/flexible connectors shall not be installed during times of temperature extreme or in a fully compressed or fully expanded condition.

F. Installation of Sleeve Couplings

1. Unless otherwise required by the manufacturer's instructions, prior to installation of sleeve couplings, the pipe ends shall be cleaned thoroughly for a distance of at least 12 inches. Soapy water may be used as a gasket lubricant. A follower and gasket, in that order, shall be slipped over each pipe to a distance of about 6 inches from the end. The middle ring shall be placed on the already installed pipe and shall be inserted into the middle ring flair and brought to proper position in relation to the pipe already installed. The gaskets and followers shall then be pressed evenly and firmly into the middle ring flares.

2. After the bolts have been inserted and all nuts have been made up finger tight, diametrically opposite nuts shall be progressively and uniformly tightened all around the joint, preferably by use of a torque wrench of the appropriate size and torque for the bolts.

3. The correct torque as indicated by a torque wrench shall not exceed 75 ft lb for 5/8-inch bolts and 90 ft lb for 3/4-inch bolts.

4. If a wrench other than a torque wrench is used, it should be no longer than 12 inches so that when used by the average person the above torque values shall not be exceeded.

5. To prevent sleeve couplings from pulling apart under pressure, a suitable harnessing or flange clamp assembly shall be provided and installed where shown on the Drawings, directed by the Engineer, or required elsewhere under Division 15 concerning anchorage.

6. Note the additional locations required for sleeve couplings in Part 2 of this Specification. Also note Contractor's responsibility for restraint.

G. Installation of Split Couplings

1. Prior to assembly of split couplings, grooves or shoulders of the pipe, as well as other parts, shall be thoroughly cleaned. The ends of the pipes and outside of the gaskets shall be moderately coated with petroleum jelly, cup grease, soft soap, or graphite paste, and the gasket shall be slipped over one pipe end. After the other pipe has been brought to the correct position, the gasket shall be centered properly over the pipe ends with the lips against the pipes. The housing sections then shall be placed.

2. Insure that the joints are fully extended after the rings are in place and prior to tightening the bolts. After the bolts have been inserted, the nuts shall be tightened until the housing sections are firmly in contact, as required by the manufacturer, without excessive bolt tension or strain on the pipe.

H. 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 inline items shall be isolated from testing pressures in excess of the rated pressure of the assembly.

3. Use Teflon tape on all screwed fittings.

I. Installation of unions

1. Use unions to allow dismantling of pipe, valves, and equipment.

J. Welding

1. Welding shall be in accordance with ANSI Standard B31 and AWS B3.0.

2. Install welding fittings on all welded lines. Make changes in direction and intersection of lines with welding fittings. Do not miter pipes to form elbows or notching of straight runs to form tees or any similar construction. Do not employ welder who has not been fully qualified in above specified procedure and so certified by approved welding bureau or similar locally recognized testing authority.

K. Installation of flanged Joints

1. Make flanged joints with bolts; bolt studs with nut on each end; or studs with nuts where one flange is tapped. Use number and size of bolts conforming to same ANSI Standard as flanges. Before flange pieces are assembled, remove rust resistant coating from machined surfaces, clean gaskets and smooth all burrs and other defects. Make up flanged joints tight, care being taken to prevent undue strain upon valves or other pieces of equipment.

3.02 TESTING

A. Test all pipelines for water/gas tightness as specified in the piping or system sections. Furnish all labor, testing plugs or caps, pressure pumps, pipe connections, gauges, and all other equipment required. All testing shall be performed in the presence of the Engineer.

B. Repair faulty joints or remove defective pipe and fittings and replace as approved by the Engineer and retest the piping.

END OF SECTION

SECTION 16000
ELECTRICAL WORK - GENERAL

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. In general, the work specified in this division of the specifications includes the furnishing of all labor, material, auxiliaries, and services necessary to install complete and properly operating electrical systems, including all fees, charges, and permits necessary.

B. The Contractor shall furnish and install all wire, cables, conduits, wiring, wiring devices, lighting fixtures, motor controllers, safety switches, relays, control equipment, and all other apparatus and accessories indicated, specified, or required for complete lighting, power, instrumentation and control systems for the project facilities.

C. The Contractor shall refer to every section of these specifications for installation and coordination requirements applicable to the work specified in this division. The Contractor shall furnish and install all wiring and connections to all electrical equipment furnished under other sections of these specifications, except where specified or indicated otherwise.

D. The Contractor shall coordinate all electrical work with other project construction trades, installation requirements, sequence of construction schedule, etc., including coordination and installation of required conduit sleeves and supporting devices.

E. The Contractor shall be required to coordinate all electrical system connections with each appropriate utility company and shall furnish and install all equipment or material necessary to provide complete electrical and communication services in accordance with all utility company requirements.

1.02 GENERAL REQUIREMENTS

A. Design drawings are diagrammatic and intended to show approximate installation and equipment locations. All dimensions shall be verified in the field and coordinated with shop drawings issued. Equipment schedules are intended to serve as a guide only and do not relieve the Contractor of the responsibility for the complete furnishing and installation of all wiring, cable, conduits, or additional apparatus required.

B. The Contractor shall furnish, install, maintain, and remove upon completion of the project, all temporary service required for construction and testing. The service shall be for general power and lighting and shall include distribution system, panelboards, grounding, branch circuits, general lighting, and receptacles as required.

C. The Contractor shall furnish and install reinforced concrete pads, for electrical equipment, of size as shown on the drawings or required. Unless noted otherwise, pads for indoor equipment shall be 4 inches high and exceed the equipment dimensions by 6 inches on all sides not flush to a wall; pads for outdoor equipment shall be a minimum of 12 inches thick and exceed the equipment dimensions by 2-1/2 feet on sides equipped with door access and 6 inches on all remaining sides. Motor control centers, switchboards, etc., located indoors and equipped with a

wireway at the base, shall be centered on a continuous reinforced concrete curb, minimum 6 inches high and 8 inches wide.

D. The Contractor shall furnish a covered, weather-protected facility, providing a clean, dry, non-corrosive environment for storage of all electrical and instrumentation equipment incorporated into this project in accordance with the provisions of the General Conditions.

E. The Contractor shall furnish and install a system of engraved, laminated nameplates (black lettering on a white background), designed to identify each major piece of equipment.

F. Motors will be furnished with the equipment they drive unless indicated otherwise. Motors shall be premium efficiency design. Motors located outdoors or within corrosive environments shall be severe duty construction.

1.03 SUBMITTALS

A. For each individual section of this division, there shall be submitted for approval a single, complete shop drawing submission. All elementary and schematic diagrams shall be provided with indication of system coordination and complete description of sequence of operation. Deviations from the contract documents shall be clearly identified. One copy of each shop drawing submittal shall be provided in PDF format.

B. Complete operation and maintenance instruction manuals, including system schematics which reflect "as-built" modifications, shall be provided. All wire terminations shall be numbered and identified on as-built drawings included as part of the operations and maintenance manuals. All drawings included within the operation and maintenance manuals shall be reduced to a maximum dimension of 17 inches x 11 inches, and shall be legible and reproducible. Special maintenance requirements particular to the system shall be clearly defined along with special calibration and test procedures. One copy of each operation and maintenance manual submittal shall be provided in PDF format.

C. Following approval of the operation and maintenance instruction manual submittals, an electronic copy of all as-built electrical apparatus drawings, schematic diagrams, control wiring diagrams, instrumentation drawings, etc. shall be provided. A drawing index, identifying each electronic drawing file name and a description of the contents, shall be included within the operation and maintenance instruction manuals.

1. Unless otherwise approved prior to submittal, all electronic drawings shall be provided on compact disk in both PDF and AutoCAD 2010 format.

D. One complete set of design drawings shall be neatly marked daily as a record of job progression and "as-built" installation. The drawings shall reflect the actual installed locations of all equipment and indicate the exact routing and elevations of all concealed conduits. Upon completion of the project, the drawings shall be coordinated with the as-built drawings and submitted to the Engineer. One copy of the final as-built drawings shall be provided in PDF format.

E. The Contractor shall maintain a record of all construction documentation including construction survey data, inspection reports, test reports, startup logs, etc. Upon completion of

the project, copies of all construction documentation shall be submitted to the engineer. One copy of the final construction documentation shall be provided in PDF format.

PART 2 PRODUCTS

2.01 MATERIALS

A. All material shall be new and shall conform with the standards of the Underwriter's Laboratories, Inc., American National Standards Institute, National Electrical Manufacturers' Association, Insulated Power Cable Engineers Association, and Institute of Electrical and Electronic Engineers in every case where such a standard has been established for the particular type of materials in question.

B. The use of a manufacturer's trade name and catalog number is not intended to indicate preference but only the type and quality of the product desired. Products of reputable manufacturers of equal quality and functional type will be acceptable. Substitutes which tend to lower the quality of the work will not be permitted.

C. Acceptance of alternate equipment does not relieve the Contractor of the responsibility of compliance with the performance and accuracy requirements of these specifications. Where such substitutions alter the design or space requirements indicated on the Contract Drawings, detailed drawings shall be prepared and submitted by the Contractor delineating any changes in or additions to the work shown on the Contract Drawings, and such drawings and changes or additions to the work shall be made by the Contractor at no additional expense to the Owner. In all cases, the burden of proof that the material or equipment offered for substitution is equal in construction, efficiency, and service to that named on the Contract Drawings and in these Contract Documents shall rest on the Contractor and, unless the proof is satisfactory to the Engineer, the substitution will not be approved.

D. Wherever possible, equipment items having the same or similar rated capacity or function shall be identical.

E. All equipment and apparatus shall be the manufacturer’s latest proven design, neither presently scheduled for obsolescence nor developmental prototype.

F. All electrical apparatus and lighting equipment shall be in compliance with the Federal Energy Policy Act of 1992, including all subsequent updates, revisions, and replacements.

2.02 RACEWAYS

A. Metallic Conduit (Aluminum): All conduit shall be heavy wall rigid aluminum of standard pipe weight unless noted otherwise.

1. Couplings, conduit unions, conduit fittings, etc., shall be aluminum, shall have conventional trade dimensions, and shall be internally threaded with a tapered thread at each end to fit the tapered thread specified for the corresponding size conduit. Conduit outlet body covers shall be cast construction.

2. All conduits, couplings, and fittings run exposed to corrosive atmospheres, and all conduit elbows and risers within concrete encasement, shall have a gray or black factory-applied

PVC coating, or field applied heat shrink jacket, of not less than 20 mils thickness. Damaged PVC coatings shall be repaired with an approved compound. Conduit supports, channels, and mounting apparatus shall be 316 stainless steel.

B. Flexible Conduit: All flexible conduit shall be Type UA liquid-tight flexible metal conduit made with galvanized steel flexible conduit covered with an extruded PVC jacket, unless noted otherwise. Fittings shall be the type specifically designed for flexible conduit use and shall form watertight connections. Flexible conduit fittings shall be aluminum construction.

1. Flexible conduit shall only be used for connections from conduits, junction boxes, or motor controllers to mechanical equipment or where the location of the connection is such that it is impractical to make a rigid conduit connection, where vibration isolation is required, or where specifically called for on the drawings. Flexible conduit shall be used for connection to all motors.

C. Non-Metallic Conduit: Non-metallic conduit, couplings, and fittings shall be Schedule 40 PVC unless noted otherwise. All PVC conduit joints shall be solvent-welded in accordance with the manufacturer's recommendations.

1. Underground conduits and conduit embedded within slabs on grade shall be non-metallic; however, conversion shall be made to rigid metallic conduit before conduit runs exit encasement. Conversion elbows, fittings and risers within the concrete encasement shall be PVC coated rigid metallic conduit.

2. Underground conduits shall be installed not less than 24 inches below grade.

3. Underground pull boxes shall be provided for all miscellaneous underground conduit runs over 200 feet long.

4. A minimum 3-inch wide polyethylene warning tape, yellow for electrical and orange for telephone, with imprinted legend, shall be installed in the backfill above all underground conduits. Warning Tape shall be Allen Terra Tape, or equal and shall be guaranteed not to discolor. Unless indicated otherwise, the tape shall be 12 inches below the finished ground grade.

2.03 WIRES AND CABLE

A. Low Voltage Cable: Low voltage wire and cable shall be 600 volt, single-conductor copper, rated 90 degrees C dry and 75 degrees C wet. Unless indicated otherwise, low voltage building wire shall have XHHW-2 insulation.

1. Low voltage multi-conductor power and control cable shall be 600 volt, Type XHHW copper conductors with an overall neoprene jacket, rated 90 degrees C dry and 75 degrees C wet and shall be suitable for cable tray installation.

B. VFD Cable: VFD power cables shall be shielded, flexible motor supply cable for variable speed drives subject to non-linear power distortions. VFD cable shall be used to interconnect AC variable frequency drives or control systems, to compatible AC motors. VFD cables shall be 1000V rated UL flexible motor supply cable, 3 stranded tinned copper circuit conductors with XLPE insulation, 1 stranded tinned copper ground wire with PVC insulation, overall

combination tinned copper braid and foil shield, and black PVC jacket; Belden VFD cable, or equal.

1. VFD cables are subject to a harsh operating environment characterized by high voltage spikes, high noise levels and adverse environmental conditions. VFD cables shall be specifically designed to overcome the shortcomings of single conductor lead wire installed in conduit, unshielded tray cables, or continuously welded armored cable typically used for this application.

C. Instrumentation Cable: Instrumentation cable shall be single twisted pair, 600 volt, stranded, tinned copper conductors with cross-linked polyethylene primary insulation, overall foil shield with tinned copper braid, and chlorinated polyethylene jacket; Belden 3072F.

D. Inner Panel Wiring: Wiring for instrumentation and control panels shall be single conductor, 600 volt, 125 °C rated UL Type AWM stranded tinned copper conductors with cross-linked polyethylene insulation, Belden 356 series.

E. Profibus Cable: Profibus cable shall be type FC (Fast Connect) 2 wire shielded cable specifically designed for rapid installation, with flame retardant foam polyethylene insulation, foil/braid shield, and sunlight resistant PVC jacket; Siemens 6XV1830.

2.04 TERMINAL BLOCKS AND WIRE MARKING

A. Terminal blocks for power conductors shall be 600 volt, three pole unit construction type with high pressure solderless connectors, headless socket screws, and ampere rating equal to or greater than the ampacity of the maximum conductor size to be terminated; Square D Type LBC, or equal.

B. Terminal blocks for control and instrumentation conductors shall be 600 volt, sectional rail mounted terminal blocks with plastic pre-printed terminal numbering markers on both the inside and outside tracks, and provisions for center terminal bridge jumper cross connections with no loss of space on terminal or rail; Siemens 8WA1 011-1DF11, or equal. Terminal blocks for general control connections shall be feed-through terminal blocks; terminal blocks for instrumentation signal circuits shall be knife type test/disconnect terminal blocks; and terminal blocks for cable shield termination and grounding shall be ground blocks.

C. Cable and conductor markers shall be heat shrinkable sleeve markers with permanent legible machine printed markings.

2.05 BOXES

A. General: Boxes shall be installed at all locations necessary to facilitate proper installation and equipment connection, including each conduit/cable transition.

1. Minimum dimensions of boxes shall not be less than NEC requirements and shall be increased if necessary for practical reasons or where required to suit job condition.

2. Boxes shall have only the holes necessary to accommodate the conduits at point of installation. All boxes shall have lugs or ears to secure covers.

3. All boxes shall be rigidly secured in position.

B. Outlet Boxes: The location of outlets as shown on the drawings will be considered as approximate only. It shall be the work of this section to study all plans with relation to spaces surrounding each outlet in order that the work may fit and that when fixtures or other fittings are installed they shall be symmetrically located to best suit each condition. All outlets shall be coordinated with the work of other sections of these specifications to prevent outlets or fixtures from being covered by pipe, duct, etc.

1. Outlet boxes shall be cast aluminum one piece hub type standard gang boxes with rubber gaskets.
   a. Wiring device boxes shall be equipped with cast screw-type covers; Crouse-Hinds Series FS or equal.

C. Pull Boxes: Pull boxes, including junction boxes and terminal boxes, shall be installed at all necessary points, whether indicated or not, to prevent injury to the insulation or other damage that might result from pulling resistance or other reasons during installation.

1. Unless indicated otherwise, pull boxes shall be NEMA 12 construction with gasketed screw covers and gray baked enamel over a rust-inhibiting primer finish. Pull boxes installed outdoors or in corrosive atmospheres shall be NEMA 4X aluminum or 316 stainless.

2. Branch circuit pull boxes shall be appropriate outlet boxes with blank covers.

D. Underground Pull Boxes: Underground pull boxes shall be minimum 24-inch x 14-inch x 18-inch deep composolite service boxes constructed of reinforced polymer concrete suitable for light traffic loading, with locking cover and molded logo; Quazite Composolite, or equal.

1. Unless otherwise indicated underground pull boxes shall have solid bottoms. Where open bottom pull boxes are indicated or approved for installation, a bed of gravel, minimum 12" thick and exceeding the pull box footprint by 6" on all sides, shall be placed beneath each open bottom pull box.

2.06 WIRING DEVICES

A. Wall Switches: Wall switches shall be specification grade, totally-enclosed, toggle switches rated 20 ampere, 120/277 volt. Switches shall be single pole, double-pole, 3-way, or 4-way as indicated; GE-5951 through 5954, Hubbell 1221 through 1224, Leviton 1221 through 1224, or equal.

1. Wall switches shall be furnished with suitable plates. The material, colors, and finishes of switch plates shall be as directed to harmonize with the surroundings. In general, standard switches shall be brown with Sierra S-1N, Hubbell S-1N, or equal, 302 stainless steel plates.

2. Unless specified otherwise, wall switches installed outdoors or in corrosive atmospheres shall be weatherproof and vapor-tight. Weatherproof and vapor-tight switches shall consist of standard wall switches as previously specified, enclosed in Series FS condulets

equipped with vapor-tight gasketed covers; Crouse-Hinds Series DS128, Appleton Series FSK-1VTS, or equal.

B. Receptacles: Receptacles shall be specification grade, grounding type, totally-enclosed, duplex receptacles rated 20 ampere, 125 volt; GE 8300-9, Hubbell 5362-GRY, Leviton 5362-GY, or equal.

1. Each receptacle shall be provided with a single gang plate for flush mounting. The materials, colors, and finishes of the plates shall be as directed to harmonize with the surroundings. In general, receptacles shall be gray with Hubbell S-8N, Sierra S-8N, or equal, 302 stainless steel plates.

2. Unless specified otherwise, receptacles installed outdoors or in corrosive atmospheres shall be weatherproof. Weatherproof receptacles shall each consist of standard duplex receptacles as previously specified, enclosed in Series FS condulet equipped with a weatherproof cover; Crouse-Hinds WLRD or equal. Outdoor receptacles installed on circuits without ground fault protection shall be type GFCI.

3. The Contractor shall connect the grounding terminal in each receptacle to the inside of the metal enclosure.

2.07 SUPPORT SYSTEMS

A. Groups of two or more conduits, and all boxes and equipment, shall be mounted on a system of minimum 1-5/8-inch x 1-5/8-inch heavy wall aluminum or 316 stainless steel channel with a minimum of 25% unused capacity.

B. Overhead conduits shall be supported on trapeze hangers from approved concrete inserts and shall be grouped with pipes wherever possible.

C. Support system hardware, including hanger rods, shall be aluminum or stainless steel.

2.08 LIGHTING FIXTURES

A. Lighting fixtures shall be of specification grade and listed or labeled by Underwriters Laboratories (UL) or an approved Nationally Recognized Testing Laboratory (NRTL).

B. LED fixtures shall comply with the following:

1. UL Standard 8750 “Light Emitting Diode Equipment for Use in Lighting Products”

2. IES Standard LM-79 “Electrical and Photometric Measurements of Solid-State Lighting Products”

3. IES Standard LM-80 “Measuring Lumen Maintenance of LED Light Sources”

4. IES Standard TM-21 “Projecting Long Term Lumen Maintenance of LED Light Sources”.

5. ANSI C78.377 “Specifications for the Chromaticity of Solid State Lighting Products” with LEDs binned within a maximum three-step MacAdam Ellipse to ensure color consistency amongst luminaries of the same type.

C. For LED fixtures, lamps, drivers, and components, provide a complete warranty for parts and labor for a minimum of five years from the date of Substantial Completion.

D. Provide only LED fixtures with a Design Lights Consortium (DLC) listing, a U.S. Department of Energy (DOE) "LED Lighting Facts" label, or a U.S. Environmental Protection Agency (EPA) ENERGY STAR label, which have demonstrated third-party testing verification.

E. LED fixtures shall be modular and allow for separate replacement of LED lamps and drivers. User serviceable LED lamps and drivers shall be replaceable from the room side.

F. Unless otherwise indicated, LED lamps shall have a color temperature of 3500 degrees K, a CRI of 80 minimum, and a lumen maintenance L70 rating of 50,000 hours minimum.

G. LED drivers shall be electronic-type, labeled as compliant with radio frequency interference (RFI) requirements of FCC Title 47 Part 15, and comply with NEMA SSL 1 "Electronic Drivers for LED Devices, Arrays, or Systems". LED drivers shall have a sound rating of "A", have a minimum efficiency of 85%, and be rated for a THD of less than 20 percent at all input voltages.

2.09 GROUNDING

A. The project's grounding system shall consist of a grounding electrode system in accordance with NEC specifications, bonded to a main ground bus interconnecting all power distribution equipment. Ground rods shall be located at each service connection, transformer pad, generator pad, outdoor electrical equipment pad, and as indicated or required, and shall be bonded to the main ground bus. Ground rod sections shall be coupled and driven to establish a maximum resistance to remote earth of 5 ohms throughout the grounding system.

B. Ground rods shall be minimum 10 feet long, 3/4-inch diameter, copper-clad steel sections.

C. Main ground bus cable shall be minimum No. 4/0, 19 strand bare copper. Bonding jumpers shall be minimum No. 2. Unless noted otherwise, all grounding conductors shall be insulated and shall have green colored insulation.

D. All grounding hardware such as clamps, connectors, couplings, lugs, bolts, nuts, and washers shall be of silicone bronze.

2.10 SURGE PROTECTION

A. The Contractor shall furnish and install UL 1449 (latest edition) listed surge protection devices (SPD) for the protection of all AC electrical circuits from the effects of lightning-induced currents, substation switching transients, and internally-generated transients from inductive and/or capacitive load switching.

B. Each SPD unit shall be marked with a short circuit current rating and shall not be installed at a point on the system where the available fault current is in excess of that rating.

C. Complete UL 1449 performance ratings, including the fault current rating and VPR rating, shall be posted on the UL label of each SPD.

D. Submit copies of the UL Standard 1449 Listing documentation for each proposed SPD.

E. AC power surge protection devices (SPD), formally transient voltage surge suppressors (TVSS), shall utilize heavy duty 'large block' MOVs, each exceeding 30mm diameter, with redundant modules per phase. SPD equipment shall provide suppression elements between all phases and each phase conductor and the system neutral. AC power surge protection equipment shall be APT, or equal.

F. SPD shall be UL labeled as Type 1, intended for use without need for external or supplemental overcurrent controls. Every suppression component of every mode, including N-G, shall be protected by internal overcurrent and thermal overtemperature controls. SPDs relying upon external or supplementary installed safety disconnectors do not meet the intent of this specification.

G. SPD shall be UL labeled with 200kA Short Circuit Current Rating (SCCR). Fuse ratings shall not be considered in lieu of demonstrated withstand testing of SPD, per NEC 285.6.

H. SPD shall be UL labeled with 20kA Inominal (I-n) for compliance to UL 96A Lightning Protection Master Label and NFPA 780.

I. Minimum surge current capability (single pulse rated) per phase shall be:

Service Entrance Equipment:	300kA
Power Distribution Equipment:	200kA
Panelboards & Control Panels:	100kA

J. SPD shall provide surge current paths for all modes of protection: L-N, L-G, and N-G for Wye systems; L-L, L-G in Delta and impedance grounded Wye systems.

K. UL 1449 Listed Voltage Protection Ratings (VPRs) shall not exceed the following:

System Voltage	L-N	L-G	L-L	N-G
208Y/120	700V	700V	1200V	700V
480Y/277	1200V	1200V	1800V	1200V

Numerically lower is allowed/preferred; old-style Suppressed Voltage Ratings (SVRs) shall not be submitted, nor evaluated due to outdated less-strenuous testing)

L. UL 1449 Listed Maximum Continuous Operating Voltage (MCOV):

System Voltage	Allowable Voltage Fluctuation (%)	MCOV
208Y/120	25%	150V
480Y/277	15%	320V

M. SPD shall have UL 1283 EMI/RFI filtering with minimum attenuation of -50dB at 100kHz.

N. SPD shall include visual LED diagnostics including a minimum of one green LED indicator per phase, and one red service LED. SPD shall include an audible alarm with on/off silence function and diagnostic test function (excluding branch).

O. Warranty – Each SPD shall have a warranty period of not less than 10 years, incorporating unlimited replacements of suppressor parts if they are destroyed by transients during the warranty period.

2.11 COMMUNICATION NETWORKS

A. All Profibus installations must comply with the Profibus User Organization. More information can be found at “www.Profibus.com”.

1. Reference “Profibus Design Guideline” order number 8.012.

2. Reference “Profibus Assembling Guideline” order number 8.022.

3. ALL recommendations from the Profibus User Organization must be followed, such as using fiber optic cable instead of copper when leaving a building.

4. Profibus cable shall be type FC (Fast Connect) 2 wire shielded cable specifically designed for rapid installation; Siemens 6XV1830.

5. Profibus connectors shall be made with metal housing and have Power, Transmit, Termination and Error indicating LED’s. Connectors shall be Brad Harrison MA9D00-42 and MA9D01-42 type or equal.

6. Only Diagnostic Repeaters shall be used where repeaters are required. Standard repeaters shall not be accepted. Repeaters shall be Siemens Diagnostic repeater 6ES7 972-0AB01-0XA0.

7. Provide an active termination resistor on the last device in the segment. Termination resistor shall be Procentec 101-00211A.

8. For fiber optic communications use the Siemens OLM G12 Part # 6GK1503-3CB00.

B. All Ethernet installation must comply with the Profinet User Organization. More information can be found at “WWW.Profinet.com”.

1. Reference “Profinet Installation Guideline for Cabling and Assembly” order number 8.072.

2. All recommendations from the Profinet User Organization must be followed such as using fiber optic cable when leaving a building.

3. Ethernet connectors shall be made with metal housing. Connectors shall be Siemens 6GK1901-1BB10-2AA0 type or equal.

4. All switches shall have the capability to be managed. Switches shall be of type Siemens Scalance X212-2 at minimum.

PART 3 EXECUTION

3.01 CODES, PERMITS, AND INSPECTIONS

A. The installations shall be in accordance with the regulations of the latest editions of the National Electrical Code, National Electrical Safety Code, applicable city, state, and local codes and regulations and other applicable codes, including utility company codes.

B. All permits required by state or local ordinances shall be obtained and after completion of the work, a certificate of final inspection and approval from the electrical inspector shall be furnished to the Owner. All permits for installation, inspections, connections, etc., shall be taken out and paid for as part of the work under this section.

3.02 CONDUIT INSTALLATION

A. Conduit Installation: All conduits shall be run in such a manner as to cause the least interference with other trades. Conduits shall be joined by means of couplings or 3-piece coupling type conduit unions. Joints shall be set up tight. Runs shall be straight and true; elbows, offsets, and bends shall be uniform and symmetrical. Installation workmanship shall be of the best quality and skill.

B. Conduits shall be of sizes required to accommodate the number of conductors in accordance with the tables given in the current edition of National Electrical Code or as noted on the drawings. The minimum size of conduit shall be 3/4-inch.

C. Conduit runs shall terminate below the particular section of the motor control center or equipment to which their respective circuits run. Concealed conduits shall be run in as direct a line as possible. Exposed conduits shall be run parallel to or at right angles with the lines of the building. All bends shall be made with standard conduit ells, conduit bent to not less than the same radius, or malleable iron conduit outlet bodies with gasketed cast iron covers. Adjacent conduit runs shall be installed with concentric bends. All bends shall be free from dents or flattenings. Not more than the equivalent of four quarter bends shall be used in any one run between terminals at cabinets, outlets, and junction or pull boxes. Boxes shall be located in accessible locations.

D. Conduit shall be continuous from outlet to outlet and from outlets to cabinets, junctions, or pull boxes and shall enter and be secured to all boxes in such a manner that each system shall be electrically continuous from point of service to all outlets. Insulated grounding bushings shall be used on all metallic conduit. Terminals of all conduits shall be plugged with an approved cap to prevent the entrance of foreign materials when exposed during construction.

E. As far as practicable, all exposed conduits shall be run without traps. Where dips are unavoidable, a pull box or approved conduit outlet body shall be placed at each low point. Conduit systems shall be completed before conductors are drawn in. Where conduits must be run exposed, except as indicated in the drawings, locations of the runs shall be subject to approval.

F. Where exposed conduit needs clamping to the structures, clamps shall consist of galvanized malleable iron 1-hole pipe straps and pipe spacers, galvanized steel bolts of appropriate size to fill the holes in the straps and spacers, and approved expansion shields. Clamps used with

aluminum conduit, and clamps located outdoors or in "corrosive atmospheres", shall be PVC coated, aluminum or 316 stainless steel. Clamps shall be bolted to the structure or where necessary to intermediate galvanized steel brackets. Spacing between conduit supports shall not exceed the recommendations published by the National Electrical Code. No deformed, split, or otherwise defective conduit or fitting shall be installed. Conduit shall be installed with a minimum number of joints.

G. Where conduit has been cut in the field, it shall be cut square using a hand or power hacksaw or approved pipe cutter using cutting knives. The use of pipe cutters with cutterwheels will not be permitted. The cut ends of the field-cut conduit shall be reamed to remove burrs and sharp edges. Where threads have to be cut on conduit, the threads shall have the same effective length and shall have the same thread dimensions and taper as specified for factory-cut threads on conduit. Conduits installed in the work with threads not complying with these requirements shall be removed and replaced.

H. All conduit shall be cleaned, prior to pulling in wire and cable, by pulling a stiff wire brush of the size of the conduit through it. This cleaning shall remove all foreign matter, including water, from the conduit. All boxes in which the conduit terminates shall be cleaned of all concrete, mortar, or other foreign matter and all threads in boxes shall be left clean and true upon completion of the work.

J. All spare, future, or empty conduits shall be equipped with a pull wire prior to capping.

3.03 WIRE AND CABLE INSTALLATION

A. The installation of wires and cables includes all splicing of these wires and cables to each other and connecting them to receptacles, switches, control boxes, lighting fixtures, motors, and all other electrical apparatus installed under this Contract. All cable installation methods shall correspond to manufacturer's recommendations.

B. Wire and cable shall be suitably protected from weather or damage during storage and handling and it shall be first-class condition when installed.

C. The minimum size of wire or cable conductor shall be No.12, unless indicated otherwise on the drawings. Wire sizes No. 8 and larger, and all wire sizes utilized for control or instrumentation, shall be stranded. All sizes called for in the specifications or shown on the drawings are American Wire Gauge sizes.

1. No wire smaller than No.12 shall be used for any branch circuit unless noted otherwise on the drawings. Larger sizes shall be used where required or indicated on the drawings. If the single distance from the panelboard to the first device exceeds 50 feet, the minimum size for this run shall be No. 10 AWG with the minimum between devices as No. 12 AWG.

D. All sizes of wire and cable furnished and installed under these specifications shall be color-coded with a separate color for each phase and neutral used consistently throughout. Each conductor shall have factory color-coded insulation. As an alternative, wire sizes No.8 and larger shall have black insulation and shall be color-coded with waterproof phasing tape at each termination, junction box, pull box, etc. All 277/480 volt wiring shall be color-coded yellow, brown, and orange for hot legs (Phase A, B, and C, respectively). All 120/208-240 volt wiring shall be color-coded black, blue, and red for hot legs (Phase A, B, and C, respectively). The

grounded neutral conductor of each circuit shall be color-coded white. Grounding conductors shall be color-coded green.

E. All wires and cables shall, as far as practicable in the judgment of the Engineer, be continuous from origin to destination without running splices in intermediate pull boxes, junction boxes, or wireways. At the ends of these wires and cables, only sufficient slack shall be left as may be required for making proper connections. There shall be no unnecessary slack.

F. In connecting wires and cables to apparatus, various methods shall be used depending upon the local conditions as detailed on the drawings. In general, solderless pressure connectors shall be used for terminals, taps, and splices for all wires and cables. Solderless pressure connectors or vinyl-covered steel spring-type connectors shall be securely fastened and shall not loosen under vibration or normal strain. All connections shall be in accordance with manufacturer's recommendations and shall be with connectors approved for the particular connection conditions.

G. Where wires and cables are connected to metallic surfaces, the coated surfaces of the metal shall be polished before installing the mechanical connector. The lacquer coating of the conduits shall be removed where a ground clamp is to be installed.

H. All soldered joints shall be made mechanically strong before soldering and shall be carefully soldered without the use of acid and shall be taped with insulating tape to a thickness equal to that of the insulation.

I. The installation of wires and cables shall include the furnishing and installing of all hangers, racks, cable cleats, and supports that may be necessary to make a neat and substantial wiring installation in all pull boxes, wireways, cable channels, and in such other locations as may be required. Plastic ties shall be used to hold the wires and cables together and to the racks or supports.

J. Each junction box, terminal box, control cabinet, or other terminal location containing a total of 4 or more conductor terminations or splices, shall be equipped with 1 or more terminal boards, as required, for connecting each wire including the spare wires. Each wire terminal shall be permanently marked throughout the entire system using, wherever possible, the notation of the wires given on the manufacturer's wiring diagrams. Sufficient terminal blocks shall be provided to terminate all wires routed to the enclosure including all spare conductors. In addition, the greater of 20 percent or four unused spare terminals shall be provided. All connections for future functions shall be wired to numbered terminal blocks, grouped separate from the terminal blocks in use. Terminal blocks shall be grouped to isolate power conductors from control conductors and to separate AC circuits from DC circuits.

K. Each control, instrumentation, and power cable and conductor shall be marked with the proper feeder symbol or termination number in each manhole, handhole, pull box, wireway, terminal cabinet, panelboard, switchboard and all additional locations required to provide positive identification. Each conductor shall be marked at each point of termination following final installation.

L. The electrical installation shall maintain suitable isolation between power, control and instrumentation conductors. Approved isolation barriers shall be provided within each pull box, terminal box, wireway, cable tray, handhole, manhole, etc.

3.04 GROUNDING

A. The concrete-encased steel reinforcement within the foundation of each structure shall be grounded, with a minimum of one 20-foot ground rod, at each corner column and at intermediate columns at distances not to exceed 60 feet. The main ground bus shall be interconnected to each ground rod throughout the structural grounding system with a continuous bare copper cable loop, minimum No. 4/0 (19 strand), buried 30 inches below grade and 24 inches outside the structural footing.

B. A minimum of one 20-foot ground rod shall be located within each manhole and handhole. The main ground bus shall be interconnected to each ground rod throughout the underground ductbank system with a continuous bare copper cable, minimum No. 4/0 (19 strand), encased within the ductbank concrete envelope.

C. All grounding connections shall be made in the same manner as current carrying connections are made with bolted clamps and solderless connectors. All underground grounding system connections, cable-to-cable, cable-to-ground rod, etc., shall be made with exothermic-fused connections. Contact surfaces shall be equal in area to those of current carrying connectors. All contact surfaces shall be thoroughly cleaned before connections are made.

D. All ground connections shall be made with connectors or lugs approved for the specific type of connection.

E. Insulated-type grounding bushings shall be used for all metallic conduit terminations.

F. Permanent and effective ground connections shall be provided for transformer secondary neutrals.

G. The metallic frame of each motor, generator, transformer, panelboard, lighting fixture, outlet box, control equipment enclosure, etc. shall be grounded to the ground bus of the power distribution equipment with an insulated grounding conductor included in the feeder or branch circuit conduit.

H. The base of each street or area lighting standard shall be grounded to a ground rod driven into the ground near the base of the standard and to a separate ground wire run with the feeder. Ground rods shall be driven so that the top is 6 inches below finished ground grade. When the foundation is placed, a suitable ground wire shall be embedded in the concrete to facilitate connection to the base on the inside.

I. Installed ground cables shall be protected from subsequent mechanical damage. Sleeves shall be provided in foundation walls and in floors to facilitate installation of ground cables. Where ground cables enter buildings through sleeves, the sleeves shall be sealed with jute packing and

3.05 SURGE PROTECTION

A. Service Entrance - Each SPD installed on service entrance equipment shall be replaceable modular construction. A UL approved disconnect switch shall be provided as a means of servicing disconnect if a 60A breaker is not available.

B. Power Distribution - Each SPD installed on switchboards or motor control centers shall be replaceable modular construction. Each SPD shall have an independent means of servicing disconnect such that the protected power distribution equipment remains energized. A 30A breaker (or larger) may serve this function.

C. Sub Panels - Each SPD installed on power distribution panelboards, lighting panelboards, control panels, unit equipment, etc. shall be encapsulated construction.

D. SPD equipment shall be installed per manufacturer's installation instructions with lead lengths as short (less than 24") and straight as possible. Gently twist conductors together.

E. Installer may reasonably rearrange breaker locations to ensure short & straightest possible leads to SPDs.

F. SPD shall be installed on the load side of the main service disconnect.

G. Before energizing, installer shall verify service and separately derived system Neutral to Ground bonding jumpers per NEC.

H. Status indication pilot lights for each SPD shall be remote mounted and shall be visible from the front of the protected equipment enclosure.

3.06 TESTING

A. Upon completion, the Contractor shall provide all necessary instruments and special apparatus to thoroughly test the complete installation and shall conduct all tests that may be required to insure system is free of all improper grounds and short circuits, and that all the feeders are properly balanced. All electrical equipment shall be tested to determine proper polarity, phasing, relay settings, and operation. System shall be checked for quality and completeness in accordance with the provisions of the General Conditions. Any objectionable noise, heating, voltage drop, or excessive current draw, after in operation, shall be identified and corrected.

B. Prior to energization, the electrical system ground resistance shall be tested. Additionally, the insulation resistance of all conductors, electrical gear, and electric motors shall be megger tested. Upon completion of all corrective measures required, certified acceptance reports, including tabulations of all initial and final resistance measurements, shall be submitted for approval in accordance with the provisions of the General Conditions.

C. Each motor starter overload element, and each motor circuit protector, shall be selected and adjusted to coordinate with the nameplate full-load current and service factor of the actual motors installed. Improper units shall be replaced. Upon completion of all corrective measures required, certified compliance reports, including tabulation of the actual full load current and voltage measurements for each phase of each motor, together with the nameplate current rating, overload element rating, and motor circuit protector setting, shall be submitted for approval in accordance with the provisions of the General Conditions.

D. System testing shall include complete circuit breaker tests for each power circuit breaker and complete thermal surveys of all new and existing electrical apparatus. Upon completion of all corrective measures required, certified acceptance reports, including satisfactory infrared photographs, shall be submitted for approval.

3.07 SPARE PARTS

A. The Contractor shall furnish, upon completion of the project, one year's supply of all consumable parts utilized within the electrical system, including pilot lights (minimum 12 of each type), fuses (minimum 12 of each type below 100 amps and 6 of each type 100 amps and above), recorder charts, ink tips, etc.

B. A spare lamp supply consisting of a minimum of 24 of each size incandescent, 12 of each size fluorescent, and 6 of each size H.I.D. lamp utilized shall be provided.

3.08 GUARANTEES

A. All materials and workmanship shall be guaranteed to be free from defects. Any part of the system considered defective by the Engineer within the guarantee period shall be immediately replaced or corrected to the Engineer's satisfaction without further expense to the Owner.

B. Upon final completion, the Contractor shall furnish certification from each equipment manufacturer that all equipment has been installed in accordance with the requirements of these specifications, is ready for permanent operation, and that nothing in the installation shall render the warranty null and void.

END OF SECTION

SECTION 16150
ELECTRIC MOTORS

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. In general, the work specified in this section of the specifications includes the furnishing of all labor, material, and services necessary for the installation and placing in operation of all electric motors indicated or required for the proper operation of all mechanical equipment installed.

1.02 SUBMITTALS

A. Motor manufacturers' product literature, nameplate data, and outline drawings shall be incorporated into the appropriate shop drawing submittals of all associated equipment. Additionally, manufacturers' test reports shall be provided for each motor 100 hp and above.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. All electric motors shall be built in accordance with current NEMA, IEEE, ANSI, and AFBMA Standards where applicable. Each motor shall be of the type and quality described by these specifications and/or as indicated on the drawings, fully capable of performing in accordance with the manufacturer's nameplate rating and free from defective material and workmanship.

B. Electric motors shall be of sufficient capacity to operate the driven equipment, under all load and operating conditions, without exceeding 85% of the motor's nameplate horsepower rating with service factor, and with-out exceeding its rated temperature limits.

C. Electric motors for variable speed applications shall be designed for operation at the rated maximum speed and at reduced speeds throughout the variable range, without overloading. Each variable speed motor shall be compatible with all associated control equipment and operating conditions including increased electromagnetic noise (harmonics).

1. Each motor for variable speed operation shall be equipped with internal temperature detectors, in addition to all accessory equipment recommended by the variable speed equipment manufacturer.

2. Electric motors for variable frequency drive applications shall be inverter duty rated in accordance with NEMA MG1 Part 31, and shall be capable of being continuously pulsed at the motor terminals with a voltage of 1600 VAC.

D. Unless indicated otherwise or required by the specific application, all electric motors shall be suitable for continuous operation at maximum load and required starting duty, in a 40°C ambient temperature, at an altitude not to exceed 3,300', in a moist and corrosive atmosphere.

E. Where indicated, or necessary to meet noise level requirements, electric motors shall be designed for quiet operation. Unless indicated otherwise, when operated at nameplate voltage

and frequency the average overall sound pressure level on the A scale shall not exceed 85 ±3 decibels 5' from the motor, as measured in accordance with NEMA Standards.

F. All motors shall be furnished with permanent, highly visible stainless steel nameplates. Nameplates shall include all motor ratings, special features, and accessories.

G. All motors shall be furnished with oversize main terminal boxes. Motor terminal boxes shall be gasketed and shall allow rotation to accommodate conduit entrance. Motor terminal boxes shall be equipped with grounding lugs.

H. All motors shall be equipped with lifting lugs. All motor enclosures shall be equipped with stainless steel screens for all openings in accordance with NEMA Standards for guarded construction.

I. Motor output shafts shall be suitable for connection as required. Vertical hollow-shaft motors shall be equipped with non-reverse ratchets to prevent backspin.

J. Unless indicated otherwise, AC induction motors shall be manufactured by Nidec, U.S. Motors, or pre-approved equal.

2.02 SQUIRREL-CAGE INDUCTION MOTORS

A. General:

1. These specifications are intended to cover the functional requirements, features, and general construction of induction motors of the squirrel-cage, horizontal, vertical solid-shaft, vertical hollow-shaft, normal thrust, and high thrust type.

2. Each motor shall be IEEE-tested, NEMA-rated, premium efficiency energy-saving design, incorporating increased active electrical material and optimum electrical and mechanical design, to provide maximum operating efficiency and power factor. All motors shall be premium efficiency.

B. Rating:

1. When operated at nameplate voltage and frequency, squirrel-cage induction motors shall be rated normal or high starting torque, as required, low starting current not to exceed 600% full load current, low slip, 1.15 service factor, premium efficiency, and continuous duty at rated horsepower and rpm, with open drip-proof, weather-protected Type 1, totally-enclosed, fan-cooled, or explosion-proof construction, as indicated. Temperature rise shall be in accordance with NEMA Standards for the design employed.

2. Unless otherwise indicated, single speed, three phase squirrel-cage induction motors less than 50 HP shall be 200-230/460 volt, 3 phase, 60 hertz. Multi-speed motors, and motors 50 HP and larger shall be single voltage, as required.

3. Single phase squirrel-cage induction motors shall be split-phase or capacitor-start, rated 115/230-208 volt, 1 phase, 60 hertz.

C. Electrical Characteristics:

1. Each motor shall be suitable for full voltage starting and non-injurious heating when operated on power systems with a variation in voltage of not more than ±10% nameplate rating and a variation in frequency of not more than ±5% nameplate rating.

2. Locked rotor torque shall be at least 125% full load torque at 100% rated voltage. Output torque shall exceed the maximum full load torque requirements of the driven equipment by at least 20% throughout the full operating range of the driven equipment, from start to full load. Locked rotor torque, breakdown torque, and locked rotor currents shall be in accordance with NEMA Standards for the design employed.

3. Open drip-proof motors shall have a non-hydroscopic Class B insulation system treated with a minimum of 2 extra dips and bakes using 100% solid epoxy varnish.

4. WP-1, WP-2, TEFC, and explosion-proof motors shall have a non-hydroscopic Class F insulation system and shall operate with a Class B temperature rise.

D. Mechanical Characteristics:

1. Motors, frames, and end shields shall be cast iron or heavy fabricated steel of such design and proportions as to hold all motor components rigidly in proper position and provide adequate protection for the type of enclosure employed. TEFC and explosion-proof motors shall be severe duty, all cast iron construction.

2. Windings shall be adequately insulated and securely braced to resist failure due to electrical stresses and vibrations. Winding and insulating materials shall consist of one or more of the following as dictated by the motor design: silicone rubber, polyester film, synthetic varnish, or glass cloth.

3. The shaft shall be made of high grade machine steel, or steel forging, of size and design adequate to withstand the load stresses normally encountered in motors of the particular rating. Bearing journals shall be ground and polished.

4. Rotors shall be made from high grade steel laminations adequately fastened together and to the shaft. Rotor squirrel-cage windings may be cast aluminum or bar type construction with brazed end rings.

5. Motors shall be equipped with vacuum degassed anti-friction bearings made to AFBMA Standards and be of ample capacity for the motor rating. The bearing housing shall be large enough to hold sufficient lubricant to minimize the need for frequent lubrication, but facilities shall be provided for adding new lubricant and draining out old lubricant without motor disassembly. The bearing housing shall have long, tight running fits, or rotating seals to protect against the entrance of foreign matter into the bearings or leakage of lubricant out of the bearing cavity. Thrust bearings shall be of ample capacity to carry the maximum thrust load of the driven equipment and the total weight of all revolving parts. Bearings of high thrust motors will be locked for momentary upthrust of 30% downthrust. All bearings shall have a minimum life rating of 5 years in accordance with AFBMA life and thrust values.

a. For motor speeds 1800 rpm and below, double sealed bearings shall be used. The grease fitting shall be removed and a plug inserted so that the motor does not get inadvertently greased.
b. For motor speeds above 1800 rpm, single shielded bearings shall be installed with the shields facing the outboard (grease supply) side and open on the inboard (stator) side. Zert fittings shall be installed at the 12 o'clock position when viewed axially. Grease escape valve or purge plug shall be installed at the 6 o'clock position.
c. The entry and exit paths for new and purged grease, respectively, shall enter and leave the bearing cavity on the outboard (shielded) side of the bearing (termed *conventional* grease flow design).
d. The motor manufacturer shall provide a procedure for initial greasing and for re-greasing the motor bearings. Specific intervals with a specified quantity of grease per the bearing manufacturer's recommendations are required.

E. Accessories:

1. Each motor shall be equipped with all necessary accessories as recommended by the manufacturer for the intended service.

2. Each motor shall be equipped with space heaters. Motor space heaters shall be low voltage, 120 volt, single phase, with the leads brought out to the motor conduit box.

3. Each motor shall be equipped with thermal winding protection. Motor shall be equipped with two normally closed automatic reset thermostats imbedded in the stator winding, between phases, and connected in series. The two leads shall be brought to the motor conduit box.

PART 3 EXECUTION

3.01 GENERAL

A. Electric motors shall be supplied with the driven equipment, unless specified otherwise.

B. All fittings, bolts, nuts, and screws shall be plated to resist corrosion. Bolts and nuts shall have hex heads. All machined surfaces shall be coated with rust-inhibitor for easy disassembly.

C. The entire surface of each motor shall be treated with a final coating of chemical-resistant, corrosion- and fungus-protective epoxy enamel, over a red primer.

3.02 INSTALLATION

A. Motor Connections:

1. All motors shall be connected to the conduit system by means of a short section (18" minimum) of liquid tight flexible metallic conduit.

2. All motor feeders shall include a grounding conductor installed within the motor feeder conductor raceway, continuous from the motor starter to the motor conduit box. The motor feeder grounding conductors shall be properly terminated on each end with approved ground lugs and clamps.

3. Insulated mechanical Polaris connectors shall be used for all motor feeder conductor connections to the motor leads. Connectors shall be UV rated, abrasion and chemical resistant, and specifically designed for the conductor material, stranding, etc.

3.03 TESTING

A. All motors shall be tested prior to shipment in accordance with the standard short commercial test procedures to include the following: no-load current, check-current balance, winding resistance, measure air gap, high potential, and bearing inspections.

B. Upon completion, the Contractor shall provide all necessary instruments and special apparatus to thoroughly test the complete installation and shall conduct all tests that may be required to insure system is free of all improper grounds and short circuits. All electrical equipment shall be tested to determine proper polarity, phasing, relay settings, and operation.

C. Prior to energization, the insulation resistance of each motor shall be tested in accordance with the motor manufacturer's recommendations. Upon completion of all corrective measures required, certified acceptance reports, including tabulations of all initial and final resistance measurements, shall be submitted for approval.

D. Each motor starter overload element, and each motor circuit protector, shall be selected and adjusted to coordinate with the nameplate full-load current and service factor of the actual motors installed. Improper units shall be replaced. Upon completion of all corrective measures required, certified compliance reports, including tabulation of the actual full load current and voltage measurements for each phase of each motor, together with the nameplate current rating, overload element rating, and motor circuit protector setting, shall be submitted for approval.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 16400
ELECTRICAL APPARATUS

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. In general, the work specified in this section of the specifications includes the furnishing of all labor, material, and services necessary to install the following material, including all fees, charges, and permits necessary.

1.02 SYSTEM RESPONSIBILITY

A. All major components of the electrical system shall be the product of one manufacturer. To insure coordination, compatibility, and the maximum interchangeability of equipment items, the remaining components shall be provided by the major equipment manufacturer.

B. The manufacturer shall maintain a recognized engineering, servicing, and repair facility in the project locality.

1.03 SUBMITTALS

A. Complete wiring diagrams including coordination with instrumentation systems, generation systems, auxiliary control systems, etc., shall be approved prior to manufacture. Drawings shall be clear and carefully prepared to facilitate interconnections with other equipment. Standard drawings revised to indicate applicability shall not be acceptable.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. All factory wiring shall be permanently numbered every 12 inches.

B. In accordance with the JEA Approved Equipment Standards, the electrical apparatus shall be as manufactured by Eaton Cutler-Hammer or Square-D Company.

C. Alternate equipment that has been pre-qualified by the JEA, and is included within the JEA Approved Equipment Standards, shall be furnished complete with all accessory equipment, custom modifications, installation adjustments, etc., as required to meet the basis of design criteria, and at no additional cost to the JEA.

D. Auxiliaries, including fans, that are required for rated load operation at maximum ambient temperature, shall be 100 percent redundant.

E. Corrosion protection shall be provided for circuit boards and critical electrical components. Varnished or epoxy encapsulated circuit boards and tropicalized contactors suitable for corrosive environments shall be furnished where the equipment is not located in climate controlled areas.

F. Electrical equipment construction and installation shall be provided as specified in the section of these specifications entitled ELECTRICAL WORK – GENERAL. Control components shall

be provided as specified in the section of these specifications entitled INSTRUMENTATION AND CONTROL.

2.02 MOTOR CONTROL CENTERS

A. Unless indicated otherwise motor control centers (MCC) shall be NEMA Class II, Type B, provided in NEMA 12 enclosures with open bottom panels and shall be UL-approved for use as service entrance equipment. Units located outdoors shall be NEMA 3R non-walk-in construction. Each lineup shall consist of vertical sections nominally 90" high, 20" deep, and 20" wide. Each lineup shall be equipped with 120/1/60 space heaters and shall be provided with starter units, feeder units, main breakers, transfer switches, transformers, panelboards, control equipment, etc., as indicated on the drawings. Control equipment shall be provided as specified in the section of these specifications entitled INSTRUMENTATION AND CONTROLS.

B. Each vertical section shall be fabricated of code gauge steel, reinforced and bolted together to form a rigid, free-standing, completely enclosed assembly. Each section shall have a gray baked enamel final coat over a rust-inhibiting prime coat. Enclosure finish shall be suitably touched up, following installation, with a manufacturer's supplied spray. Unless approved otherwise, the final coat shall be ANSI 61 Light Gray.

C. Each vertical section shall be provided with a separate vertical wire trough door, a 12" horizontal wireway at the bottom, and a 6" horizontal wireway at the top. Each section shall have flange-formed covers on the rear and flange-formed doors with concealed hinges and quick release quarter-turn latches in the front. Unless approved otherwise, each vertical section shall be front-mounted only, completely front-accessible, and suitable for mounting against the wall. Each lineup shall be provided with continuous lifting angle and floor sills.

D. Power shall be distributed throughout the lineup by means of a 3-conductor, bolt-connected, edgewise-mounted, tin-plated copper bus bar system. Cable shall not be used on the load side of the main. Each lineup shall be provided with a continuous ground bus and, if indicated, a continuous neutral bus. Each bus shall be braced, and the entire motor control center rated, for the maximum available short-circuit fault current, minimum 65,000 amperes RMS symmetrical. The main horizontal bus shall be enclosed in an isolating compartment at the top of each vertical section. The main bus shall be rated as indicated on the drawings and shall not be rated less than 600 amperes. The vertical bus sections shall be sized for the total connected load and shall not be rated less than 300 amperes. The main horizontal bus, transfer switch bus, cable lugs, etc., and the full height of the vertical bus shall be isolated providing a complete, dead-front installation with glass-reinforced polyester barriers equipped with shutter mechanisms for stab openings. Each ground bus shall be rated for the total capacity of the lineup and shall not be rated less than 300 amperes. When provided, each neutral bus shall have 50% of the full capacity of the main horizontal bus and shall be connected to the ground bus by a removable link.

E. A separate control power source, independent of any single control circuit, starter unit, etc., shall be provided for all control components (control relays, annunciators, level controllers, etc.), integral to multiple control circuits or system operations, or actuated by remote field devices. Where practical, all control components connected to the separate control power source shall be located in a common compartment.

F. Each unit compartment shall be provided with an individual front door, interlocked mechanically with the unit disconnect device to prevent opening the door with the unit energized, or energizing the unit with the door open. Unit disconnect device handles shall indicate the ON, OFF, TRIPPED, and RESET positions and shall be provided with means for padlocking in the OFF or ON positions. Each unit compartment, including door, shall be individually removable without disturbing adjacent units. Unless approved otherwise, all units shall be of drawout construction with a positive guidance system to insure positive stabbing into the vertical bus. Unit stabs shall be tin-plated copper. Each unit compartment shall be provided with a door-mounted engraved nameplate attached with removable fasteners.

G. Each motor starter unit shall be the combination type complete with molded case motor circuit protector; magnetic starter; manual resetting, 3-pole, bi-metallic thermal overload relay; individual 120 volt control power transformer; door-mounted pilot control devices, indicators, and instruments; and required accessory control relays, alternators, etc.

1. Each motor starter or contactor coil shall be equipped with a transient suppressor to limit high voltage transients.

2. Overload element ratings shall be individually selected and adjusted in the field to coordinate with the equipment connected.

3. Motor starters for submersible motors shall be equipped with ambient-compensated, bi-metallic, quick-trip type overloads.

4. Control power transformers shall be fused on both primary leads and one secondary lead with the remaining lead grounded and shall be sized for the entire control circuit, including motor space heaters and all additional remote auxiliary devices.

5. Motor circuit protectors shall be quick-make, quick-break, molded case air circuit breakers with adjustable instantaneous trip. Instantaneous trip settings shall be individually adjusted in the field to coordinate with the equipment connected.

6. Each unit shall be provided with 2-piece draw-out terminal boards, for load and control terminals. The field terminal board component shall be mounted adjacent to the wiring trough.

7. As indicated on the drawings, starters shall be full voltage, across-the-line type, or solid state reduced voltage type, unless noted otherwise. Starters shall be reversing or non-reversing as indicated.

8. Multi-speed starters shall have compelling relays which require starting at lowest speed, and prevent instantaneous transition between speeds.

9. Starter unit size and ratings shall be coordinated with the equipment supplied. Units of the same size shall be interchangeable.

10. In addition to contacts required, all starter units shall be provided with 2 spare N.O. and N.C. auxiliary contacts.

H. Solid-state reduced voltage motor starters shall consist of three sets of two inverse-parallel connected SCR's with a complete microprocessor based electronics package to provide soft start and smooth stepless acceleration to full speed. Unless otherwise indicated, or required by the application, each solid-state reduced voltage starter shall provide individually adjustable acceleration and deceleration control (0 - 120 seconds). Each starter shall be equipped with voltage transient protection (thermostat, MOV, and RC protection of each pole), shorted SCR protection, and single phase protection. Each starter shall be equipped with a 3 phase temperature-compensated solid-state motor overload protection relay. Each starter shall be fan-cooled and shall be rated 115% FLA continuous duty and 300% FLA for a minimum of 30 seconds. Each starter shall be equipped with a fault indication pilot light and auxiliary contact for remote indication of fault condition. Unless indicated otherwise, each solid-state motor starter shall include fully rated isolation contactor and bypass shorting contactor. Each solid-state motor starter shall automatically resume normal operation following a power outage.

I. Feeder units shall be equipped with molded case air circuit breakers, unless indicated otherwise. Breakers shall be quick-make, quick-break, with trip-free operation, incorporating an internal trip bar and a single external handle. Breakers shall be thermal magnetic type rated not less than 35,000 amperes RMS symmetrical. Breakers rated above 150 amperes shall be provided with interchangeable trips. Breakers shall be provided with control accessories, such as shunt trip, auxiliary contacts, etc., as indicated or required for proper interlocking and operation.

J. Unless specified otherwise, main breakers shall be as specified for feeder breakers; however, main breakers shall be shall be 100% rated, UL-approved for use as service entrance equipment, and shall be fully rated for the maximum fault current, without the use of current limiters. Each main breaker shall be equipped with a completely self-contained temperature insensitive automatic trip unit with selective tripping characteristics including adjustable long time setting, adjustable long time delay setting, adjustable short time setting, adjustable short time delay setting, adjustable instantaneous setting, and ground fault protection systems. Each main breaker shall be equipped with auxiliary contacts for remote indication of breaker status and overcurrent trip.

K. Power monitoring units shall be complete microprocessor-based circuit monitors for each incoming line, and selected feeders as indicated. Power circuit monitors shall be equipped with data communications port, communications interface modules, protocol converters, etc. as required for remote monitoring from the Owner’s standard monitoring system. Power circuit monitors shall continuously monitor and display 3 phase current, voltage, power factor, frequency, watthours, varhours, demand current, and demand power, and shall store historical maximum and minimum data for each parameter monitored.

2.03 VARIABLE FREQUENCY DRIVES

A. Variable frequency drives shall be JEA standard pre-approved drives, PROFIDRIVE, PROFINET, and PROFIBUS compliant, and shall be designed for flange mounting placing the heat sinks outside the control panel enclosure.

B. Variable frequency drives shall control the speed of standard squirrel-cage induction motors by controlling the frequency applied to the motor. Each variable frequency drive shall convert incoming 60 hertz, 3 phase AC power to variable frequency AC by use of a 3 phase insulated gate bipolar transistor power module inverter with sine-coded pulse width modulated output.

Each drive shall operate with a minimum of 0.98 primary power factor and a minimum efficiency rating of 0.96. Each drive shall have a continuous overload current rating of 110%, and 120% for 60 seconds.

C. Each drive shall be designed to operate from a local enclosure door mounted digital keypad, and from a remote automatic speed reference signal. Each drive shall be flange mounted within a non-ventilated enclosure.

D. Each drive shall be equipped with input circuit breaker,3 phase temperature-compensated solid-state motor overload protection, and fault protection and indication as follows:

1. Softstall
2. Current limit
3. Overcurrent
4. Overvoltage
5. Short-circuit at load
6. Load-side ground fault
7. Undervoltage
8. Momentary power failure
9. Electronic thermal overload protection
10. Overtemperature
11. Overfrequency

E. Each drive shall be equipped with the following system interfaces:

1. Auxiliary dry contacts for indication of drive operation
2. Auxiliary dry contacts for indication of drive fault
3. Drive speed control input (4-20mA)
4. Drive speed report back output (4-20mA)
5. Digital diagnostic display for indication of drive diagnostic information
6. Profibus communications link to allow drive programming, monitoring, and control

F. Each drive shall provide independently adjustable acceleration (0.1-6000 seconds) and deceleration (0.1-6000 seconds) with choice of linear, S or C curves; adjustable starting frequency (0-10Hz) and maximum frequency (25-400Hz; adjustable voltage boost (0-300%); adjustable soft stall (10-150%); adjustable PWM carrier frequency (0.5-10KHz); and individually adjustable torque and current limits. All programmable parameters shall be adjustable from the door-mounted digital operator keypad.

G. Each drive shall be capable of PID set point control; a minimum of three critical frequency jump points with individual bandwidth; a minimum of eight digital inputs selectable for drive enable, reset, forward/reverse direction, start/stop control, preset speed points, etc. ; and a minimum of three relay outputs selectable for run indication, fault, speed reach, low speed, etc.

H. Each drive shall automatically restart and resume normal operation following a power outage. Each drive shall have an adjustable retry function after a fault (1-10 attempts, 1-10 seconds).

I. Each variable speed drive to be controlled by a remote instrumentation signal shall be equipped with all necessary logic and control apparatus to provide the intended automatic mode of operation.

2.04 POWER SYSTEMS STUDY

A. The Contractor shall furnish bound copies of a power system report which shall include the following:

1. Arc Flash Study in accordance with IEEE Standard 1584 and NFPA 70E. The study shall calculate the incident energy and flash protection boundary at all locations within the electrical distribution system (motor control centers, automatic transfer switches, panelboards, etc.).

2. Short Circuit Study, in accordance with ANSI C37.010-latest, should 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.

3. Protective Device Coordination Study, with coordination plots of key or limiting devices, plus tabulated data including ratings or settings selected. In the study, a professional engineering balance shall be achieved 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.

4. Motor Starting Study, for each large motor and for the largest motor served from each motor control center, to determine voltage dip or power inrush limitations at selected locations due to motor starting.

B. The Contractor shall warrant the exercise of professional competence in the performance of the specified studies to be provided by the major equipment manufacturer or a qualified expert. The Contractor shall obtain and verify all information necessary to perform the specified studies including utility company service data, generating equipment service data, motor data, existing equipment ratings, etc.

C. Upon completion, the Contractor shall provide written verification of final relay and trip settings as recommended by the system studies or otherwise approved.

D. The major equipment manufacturer shall provide 4 x 6 inch machine printed, UV resistant thermal transfer type labels of high adhesion polyester for each location identified in the arc flash study, for field installation by the Contractor.

PART 3 EXECUTION

3.01 SERVICE AND TRAINING

A. The major equipment manufacturer shall provide support and technical direction of installation, energization, and operation of the electrical equipment. Experienced field service engineering personnel shall be available at the job site, as needed, to provide the following factory service:

1. Recommended procedures for checks and tests.

2. Assist in solving erection problems by making critical checks and necessary adjustments.

3. Supervise necessary operational tests, verify, and document test results.

4. Perform final inspection of installed equipment.

5. Participate in initial energization.

6. Check and test all relays for proper operation. Contractor shall set relays as directed by the Engineer and shall submit a list of "as-left" settings.

7. Provide revised factory drawings on an "as-built" basis.

8. Conduct complete operation and maintenance training program (minimum 1/2 days' duration) at the job site for a minimum of 4 Owner-selected operating personnel, prior to startup.

B. Upon completion, final approved as-built wiring diagrams shall be permanently fastened inside the enclosure doors of each SWB section, MCC cubicle, etc. Wiring diagrams shall include all local and remote interconnections, in detail.

C. Each training program shall be scheduled a minimum of 14 days in advance. Proposed dates shall be submitted in writing for approval. The Owner may exercise the option to audio- or video-tape each entire training program without restriction.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 16900
INSTRUMENTATION AND CONTROL

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. In general, the work specified in this section of the specifications includes the furnishing of all labor, material, and services necessary to install the instrumentation, control and monitoring systems, including all fees, charges, and permits necessary.

B. As specified in the section of these specifications entitled ELECTRICAL WORK - GENERAL, the Contractor shall furnish and install conduit, wiring, and connections for equipment and devices furnished under other sections of the specifications or under other contracts. The Contractor shall also install motor starters, switches, and other electrical equipment furnished under other sections or under other contracts.

C. The Contractor should refer to the mechanical specifications and drawings for locations of pressure-operated control switches, float switches, solenoid-operated valves, limit switches, alarm actuating contacts, and other devices requiring wiring.

D. The Contractor shall make all interconnections required between transmitters, receivers, recorders, indicating instruments, control panels, and miscellaneous devices, and shall provide for electrical supply to metering and signal systems.

E. All conduit and wiring between electrical and instrumentation panels, all field-mounted devices, and power sources shall be furnished and installed as required for a complete operable system.

F. Unless otherwise indicated, all electrical equipment and installation shall be in accordance with the section of these specifications entitled ELECTRICAL WORK - GENERAL.

G. In accordance with Owner's standards, instrumentation equipment shall be as manufactured by Rosemount.

1.02 SYSTEM RESPONSIBILITY

A. To insure coordinated control systems, to properly achieve the indicated functions, and to provide a maximum interchangeability of equipment items and parts, the complete instrument and control system shall be furnished by a single instrumentation system contractor/supplier who shall be responsible for the satisfactory operation of the system.

B. The system contractor/supplier shall maintain permanent in-house system engineering and fabrication facilities including a quality assurance organization with the capability to perform complete system checkout and simulation in the shop prior to shipment.

C. The system contractor/supplier shall maintain a permanent field service engineer for maintenance service.

D. The system contractor/supplier shall perform all system engineering, prepare all necessary internal and external wiring and piping drawings, and assume full responsibility with the

performance requirements of these specifications, and as required for a complete and operable facility.

E. The instrumentation equipment locations and conduit drawings are diagrammatic to show the general scope and route of instrumentation system conduit. The instrumentation system contractor/supplier shall provide all conduit and wiring necessary for his specific requirements, in accordance with these specifications, and without additional cost to the Owner.

1.03 SUBMITTALS

A. The Contractor's attention is directed to the requirements of the section of these specifications entitled ELECTRICAL WORK – GENERAL, and the GENERAL REQUIREMENTS. In order to facilitate review and approval of the proposed system, shop drawing submittals shall be made in two steps. The first submittal shall include all in-line devices such as flow meters, control valves, etc., to be supplied or coordinated with the instrumentation system. The second submittal shall include complete details of the instrumentation system.

B. Shop drawing submittals shall include the following:

1. Complete Bill of Materials, front panel view with component locations, subpanel view with component locations, and electrical schematics.

2. Functional description of the entire system including individual loop diagram descriptions.

3. Detail loop diagrams showing both piping and wiring requirements for each analog instrument loop in the system.

4. Component drawing for each component showing dimensions, mounting, and external connection details.

5. Detail layout, dimensions, fabrication, piping, and wiring schematic, connection, and interconnection drawings for each instrumentation panel, graphic display, termination cabinet, etc.

6. Component manufacturing data sheet for each component indicating pertinent data and identifying each component by item number and nomenclature as indicated on the drawings and in these specifications.

7. Testing plan description, sample test reports, and proposed testing schedule.

8. Training plan description, listing of training materials to be provided, and proposed training schedule.

C. Shop drawings shall conform to the Owner’s standard drawing/schematics. References to the Bill of Materials shall be located for each component.

D. Operation and maintenance manuals, in accordance with the provisions of the section of these specifications entitled ELECTRICAL WORK – GENERAL, and the GENERAL REQUIREMENTS, shall also be supplied. Operating instructions shall incorporate an updated functional description of the entire system including the system schematics which reflect as-

built modifications. Special maintenance requirements particular to the system shall be clearly defined along with special calibration and test procedures.

1. A complete set of "as-built" wiring, fabrication, and interconnection drawings shall be included with the manuals. In addition, an electronic copy of all drawings shall be submitted to the Owner.

2. Electronic drawing files shall be AutoCAD 2010 format.

PART 2 PRODUCTS

2.01 GENERAL CRITERIA

A. All of the equipment shall be the manufacturer's latest and proven design. Specifications and drawings call attention to certain features but do not purport to cover all details entering into the design of the instrumentation system. The completed system shall be compatible with the functions required and the equipment furnished by the Contractor and shall include all necessary control relays, contacts, and additional devices required for a complete, coordinated, operable facility.

B. Electrical control equipment, starters, contactors, etc., shall be full NEMA rated.

C. All contacts for control of electrically operated equipment shall be rated not less than 10 amperes on 120 volts.

D. All electrical components of the instrumentation and control system shall operate on 120/1/60 power, except as noted otherwise in the specifications.

E. Where control equipment is not within sight of the motor, a safety lockout station with position indication, which shall prevent application of current to the motor, shall be located near the motor. Where the driven equipment is located on a different level than their driving motors, a safety lockout station shall be provided on each level.

F. Programmable controllers shall be utilized for standard relay and control functions within motor control centers, control panels, etc., only where specifically approved. In general, conventional control equipment shall be provided.

G. All controls for remote electrically-operated or motor-driven equipment shall be complete, including all necessary auxiliary relays so as to require only wiring and connections to the equipment control circuit. All contacts for control of remote motor-operated or electrically-operated equipment shall be rated not less than 10 amperes on 120 volts unless specified otherwise herein.

H. All remote motor-operated or electrically-operated equipment shall have a separate 120 volt control circuit, except as indicated otherwise.

I. All necessary fuses or switches required by the instrumentation manufacturer for his equipment shall be provided with the equipment. All instruments requiring an internal power supply shall have an internal ON-OFF switch.

J. The drawings and specifications indicate the energy sources that will be provided. Any other devices (isolation transformers, power supplies, lightning arresters, etc.) necessary to obtain proper operation and protection of the instrumentation system shall be furnished with the instrumentation system.

K. Individually adjustable alarm modules shall be provided to generate all required alarm or interlocking contacts from analog signals.

L. Signal isolators shall be provided for all analog signals to auxiliary equipment remote from instrumentation panels.

M. Signal isolators and analog alarm modules shall be individual self-contained units.

N. All printed circuit boards throughout the instrumentation system shall have a protective coating to prevent corrosion.

O. All components shall be tagged with the item number and nomenclature given in the specifications and component tabulation lists.

P. Each field mounted transmitter shall be installed within a NEMA 12/3R aluminum or stainless steel enclosure for weather protection. Enclosures shall exceed the dimensions of the enclosed transmitter by a minimum of six inches on all sides and shall permit full unobstructed access to the enclosed transmitter. Enclosures shall be equipped with a continuous hinged access door with 3-point latching handle. Ventilation louvers shall be provided at top and bottom of both sides to promote convection cooling.

2.02 CONTROL DEVICES

A. Control Stations - Control stations shall be heavy-duty, oil-tight, complete with NEMA 13 cast aluminum enclosures; Cutler-Hammer Type T, General Electric, or equal.

1. Safety lockout stations (SAFE-OFF) shall be equipped with 316 stainless steel padlock devices for padlocking in the de-energized position.

2. Unless specified otherwise, control stations installed outdoors, or in corrosive atmospheres, shall have watertight, NEMA 4X cast aluminum enclosures.

B. Limit Switches - Where required for control system operation, heavy-duty, modular plug-in limit switches shall be provided; Square D Type B, Cutler Hammer E50, or equal. Limit switches shall be oil-tight and watertight cast aluminum or stainless steel construction with adjustable mode precision operating heads. Contacts shall be DPDT rated 10 amps at 120 VAC.

2.03 CONTROL COMPONENTS

A. General - Where indicated on the drawings, or required by the functions specified, control components shall be furnished and installed with-in control panels, motor control center, or other approved locations. Suitable nameplates shall be provided for all panel door or surface-mounted control devices. All component terminals, including auxiliary contacts, shall be wired to master terminal boards.

B. Instruments - Instruments shall be of standard size not less than 5-1/2" in width and they shall present a uniform appearance when mounted upon the panels. Instruments shall have scales 5" in length and shall be accurate within 1% of full scale. Instrument scales shall be selected with full-load readings at 75% of the scale range, unless specified otherwise or approved.

C. Pilot Devices - Selector switches, pushbuttons, indicating pilot lights, and additional pilot devices as required, shall be 600 volt rated heavy-duty, oil-tight, 30mm pilot devices as manufactured by Eaton Cutler-Hammer, Square-D, or equal.

1. Pushbuttons shall be standard type with anodized aluminum rings and colored buttons.

2. Selector switches shall be standard handle type with anodized aluminum rings and handles.

3. Pilot lights shall be full brightness LED type.

4. All pilot devices shall have appropriate nameplates and locking means for locking in the de-energized mode, and shall be color coded (red - start, on, open, up; green - stop, off, close, down; black - test, silence, miscellaneous).

D. Timers - Where required for control system operation, multifunction programmable timing modules shall be provided. Timers shall have timing modes and cycle times as indicated, shall be provided for operation at voltage indicated, and shall have DPDT contacts; Potter & Brumfield CNS-35-96, or equal.

E. Control Relays - Where required for control system operation, control relays shall be 3P3T, 11 pin octal type, with 10 amp contacts, internal LED, test button, and large ice cube style case; Cutler-Hammer D3PF3AA, D3PF3AT1, or equal.

1. Time delay relays shall be potentiometer adjustable time setting, 1.0% repeatability, 2PDT plug-in type time delay relays with, 10 amp contacts, 8-pin square sockets and hold-down springs. Delay on de-energize mode shall not require input power during the timing; Potter & Brumfield CK Series, or equal.

2.04 FIELD INSTRUMENTS

A. All field instruments shall be Owner's latest standardized equipment as indicated on the drawings. Power and signal line surge protection shall be provided for each instrument signal. Each instrument shall include all mounting systems, fittings, etc. for a complete and proper installation in accordance with all manufacturers' requirements.

B. Well Level Meters:

1. Well level metering system shall consist of a submersible pressure sensor/transmitter, vented cable termination dry box, and digital display field meter.

2. Well level sensor/transmitters shall be specifically designed for depth and level measurements of groundwater, where space is very limited. Sensor housing shall be titanium construction with a maximum diameter of 0.39 inches. Sensors shall be provided with a 5-year warranty against corrosion. Sensor cable shall be polyurethane molded

vented cable construction with Kevlar reinforcement to avoid elongation. Sensor accuracy shall be 0.1%. Well level sensor/transmitters shall be PMC Model MTM3213.

3. Each level sensor shall be provided with a NEMA 4X dry box termination enclosure for proper termination of the vented cable: PMC Model TE-11.

4. Each well level meter shall be provided with a digital display field meter with loop power supply and analog output. The field meter display shall be user-configurable dot matrix display range for bar graph, units and tag name: Endress Hauser RIA-46-A1-A-1-B-B1.

C. Well Conductivity Meters:

1. Each conductivity meter shall consist of a digital transmitter, digital sensor, mounting system, and all required interconnecting cable to provide a continuous conductivity measurement.

2. Each transmitter shall monitor single or dual sensor inputs, and shall provide a 4-20mA isolated analog output signal for each sensor. Transmitters shall be equipped with an integral LED digital output meter, alarm setpoint indicators, adjustable alarm contacts and all necessary controls internally mounted in a NEMA 4X corrosion-resistant enclosure.

4. Conductivity sensors shall measure electrolytic conductivity using the inductive or toroidal method. Sensors shall be equipped with integral RTDs to allow temperature compensated conductivity measurements.

5. Each sensor shall be provided with a 316 stainless steel insertion/retraction assembly. Each sensor shall be provided with sufficient cable length as required for the installation as indicated.

6. Conductivity meters shall be Rosemount Analytical Model 1056 transmitters with Model 228 sensors.

D. Venturi Flow Meters:

1. Venturi flow meters shall be of the differential-producing design utilizing differential pressure to produce an output signal directly proportional to flow. Venturi flow meters shall consist of a primary flow element and differential pressure flow transmitter.

2. The primary flow element for each venturi flow meter shall be a cast iron Venturi tube with Type 316 stainless steel throat liner and pressure tap bushings, and ANSI 150# flange end connections. The entire flow meter, except the throat liner, pressure tap bushings, and flange faces, shall be coated with epoxy paint that meets EPA requirements and is approved for potable water applications.

3. The inlet section of each flow tube shall be comprised of a cylindrical section, of similar diameter as the pipe, in which the high pressure tap is installed and shall incorporate a hydraulic shape employing at least two vena contractae to condition the flow pattern before it enters the throat tap section. The throat section shall be cylindrical in shape for a minimum length of one-half of the throat diameter. The low pressure tap shall be installed in this section. The outlet cone shall be truncated having an included angle of 10°. Drain

and vent ports shall be included in the entrance section on a 90 degree plane to the metering taps. An inspection opening shall be provided downstream from the throat.

4. Devices amplifying the differential by causing change in the direction of the flow at the cross-sections where inlet and/or throat static pressure is sensed shall not be considered. Tube coefficient shall be constant for pipe Reynolds number of 50,000 and greater and independent of Beta ratio and line size.

5. Each venturi flow meter pressure sensor connections shall be 316 stainless steel and shall be sloped down to the differential pressure flow transmitter. The differential pressure transmitter shall be equipped with a 316 stainless steel integral 3 valve mainifold.

6. Flow transmitters shall be variable capacitance type for use with the primary element indicated. Transmitters shall incorporate temperature-compensated, solid-state electronic construction and shall produce an analog signal linear with respect flow.

7. Transmitter electronics shall be mounted in a low-copper aluminum NEMA 4 housing. Transmitters shall be equipped with externally adjustable span and zero adjustments. Transmitters shall be provided with 316 stainless steel diaphragm, body, and flange materials. Transmitters shall be provided with all required accessories for installation as indicated.

8. Venturi flow meter accuracy shall be ±0.5% of actual flow rate for the ranges indicated. Venturi flow meters shall be Primary Flow Signal Model HVT-CI/Rosemount 3051CD, BIF-UVT/Rosemount or BIF-UVT/Rosemount 3051CD.

9. Each venturi flow meter shall be provided with a digital display field meter with loop power supply and analog output. The field meter display shall be user-configurable dot matrix display range for bar graph, units and tag name: Endress Hauser RIA-46-A1-A-1-B-B1.

PART 3 EXECUTION

3.01 SYSTEM DESCRIPTIONS

A. General - The general arrangement of the analog instrument and control system is shown on the drawings.

1. No attempt has been made to detail on the drawings all accessories and devices required for the complete system. The system contractor/supplier shall be responsible for the preparation of all detail installation drawings showing wiring, piping, mounting, etc.

2. The system contractor/supplier shall be responsible for furnishing all devices required for a complete functioning system.

3.02 CONTROL PANELS

A. Where indicated on the drawings, specified, or required by the functions specified, control panels, including all necessary accessories, shall be provided for control of the associated equipment.

B. Control panels shall be constructed in accordance with the requirements of Section 433 of the *JEA Water & Sewer Standards*, and shall be manufactured by an Owner-approved manufacturer.

C. Control panels shall be constructed in accordance with UL 508A requirements for enclosed industrial control panels and shall bear the UL508A serialized label.

D. All components shall be mounted using stainless steel machine screws. All holes shall be drilled and tapped. The uses of self-tapping screws are unacceptable.

3.03 ELECTRICAL TRANSIENT AND SURGE PROTECTION

A. All components of the control and instrumentation system shall be equipped with suitable surge arresting devices to protect the equipment from damage due to electrical transients, including lightning induced electrical power surges.

B. All power and signal circuits of each field instrument shall be protected with surge and transient protectors.

1. Protectors for 120 volt power circuits shall be Citel DS40-120.

2. Protectors for signal circuits shall be Citel DLAW-24D3.

C. Surge and transient protectors shall be connected to the electrical system ground. Supplemental grounding shall be provided in accordance with the protection equipment manufacturer's recommendations.

3.04 FIELD CALIBRATION AND TRAINING

A. Prior to initiation of preliminary instrumentation and control system startup, the Contractor must submit a certified statement from his installation subcontractor confirming that all field wiring is complete, has been terminated and marked in accordance with the latest set of approved shop drawings, and has been tested for improper grounds, short circuits, and continuity.

B. The complete instrumentation and control system shall be systematically calibrated and proper performance demonstrated in the presence of the Owner’s Representative and Engineer.

1. Process calibration, such as volumetric drawdown tests on flow and level measurements, shall be conducted on all measuring systems as required by the Owner’s Representative.

2. Performance demonstrations shall be provided individually for each complete instrumentation and control loop. Successful performance shall depend on proper performance of each and every component associated with the loop.

3. The Contractor shall submit certified calibration and performance reports from his system contractor/supplier confirming that the entire instrumentation system is complete and operating properly.

C. All calibration, testing, demonstrations, training, etc., shall be at no additional cost to the OWNER.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

Jacksonville
Where Florida Begins.

| W |__|__| |__|__|__|__|__|__|—|0|0|0|
Year Permit Number

CITY OF JACKSONVILLE, FLORIDA
DEVELOPMENT SERVICES DIVISION

RIGHT OF WAY PERMIT APPLICATION

ID/Overview

PAYMENT METHOD

■ Cash/Check/Credit Card

☐ Fee Exempt
- ☐ Franchise Utility
- ☐ Municipal Agency*
- ☐ Other: _____

* City, State, or Federal Agencies—The municipal agency must be the entity performing the proposed work. Private contractors will be charged a fee.

PROJECT CONTACT

NAME Ioannis M. Polematidis
PHONE (904) 527-6722
FAX (904) 519-7090
E-MAIL polematidisim@cdmsmith.com

CUSTOMER (BOND HOLDER) INFORMATION

BID CITY ID NO. _____ UNDERGROUND UTILITY LIC. (If Applicable) _____

COMPANY NAME (Name on BID account) _____

MISC. PROJECT INFORMATION

ASSO. BUILDING PERMIT | B |__|__|__|__|__|__|__|__|—|__|__|__| (If Applicable)

REVOCABLE PERMIT O.R. BOOK _____ PAGE _____ (If Applicable)

Notes / Description of Work:

As part of the compliance with the Consumptive Use Permit (CUP), JEA is in the process of implementing the Total Water Management Plan projects. These projects will transfer finished water from JEA's North Grid to its South Grid through transmission pipelines crossing the St. Johns River. Finished water will be pumped from the Main Street Water Treatment Plant (WTP). The new Well No.15 will be located on the northwest corner of East 2nd Street and Clark Street in downtown Jacksonville, Florida. This project consists of construction of a well facility and associated raw water pipeline for the production well, designated Well No. 15, located at JEA-owned property (Parcels 072673-0000, 072674-0000, 072675-0000, 072677-0000, 072677-0010, and 072678-0000) at the corner of East 2nd Street and Clark Street in Jacksonville, Florida. The work continues south from within parcels, crossing East 2nd Street before terminating at an existing 12-inch raw water main near existing abandoned Well No. 8. This project is located within the City of Jacksonville (COJ) rights-of-way.

Property

PERMIT ADDRESS

ADDRESS East 2nd Street in downtown Jacksonville, FL

BETWEEN Ionia Street AND Clark Street

CITY DEVELOPMENT NUMBER _____ (If Applicable)

Jacksonville
Where Florida Begins.

| W |__|__| |__|__|__|__|__|__|__|—| 0 | 0 | 0 |

Year Permit Number

Specifications (Permit Activities)	
ANNUAL UTILITY MAINTENANCE	
☐ Annual Maintenance (AM) - (Do not select any other activity if this is selected)	
PAVING	
☐ Residential Driveway (RD)	■ Commercial Driveway (CD)
☐ Residential Sidewalk (RD)	■ Commercial Sidewalk (CD)
☐ Residential Curb & Gutter (RD)	■ Commercial Curb & Gutter (CD)
☐ Residential Pavement (RD)	■ Commercial Pavement (CD)
☐ Residential R/W Restoration (RD)	☐ Commercial R/W Restoration (CD)
DRAINAGE	
☐ Residential Culvert (<32') (RD)	☐ Commercial Culvert (<32') (CD)
☐ Residential Drainage Structure (RD)	☐ Commercial Drainage Structure (CD)
☐ Residential Ditch/Swale (RD)	☐ Commercial Ditch/Swale (CD)
☐ Residential Ditch Paving (RD)	☐ Commercial Ditch Paving (CD)
MISC.	
☐ Residential Landscape (RD)	☐ Commercial Landscape (CD)
☐ Residential Tree Removal (RD)	■ Commercial Tree Removal (CD)
☐ Residential Irrigation (RD)	☐ Commercial Irrigation (CD)
☐ Object In R/W or Easement (Residential Area) (RD)	☐ Object In R/W or Easement (Commercial Area) (CD)

UTILITIES (Requires an Underground Utility License)

	Trenchless Length (TU) (Directional Bore)	Open Cut Length (OU) (Trenching, bore and Jack, etc.)	Misc. Utilities (No Length Required)
■ Water	________	________	☐ Cable Aerial (OH)
☐ Sanitary/Storm Sewer	________	________	☐ Monitoring Well (TU)
☐ Gas	________	________	☐ Soil/Pavement Borings (TU)
☐ Cable/Conduit	________	________	

Official Use Only

Prerequisites			Requirements		
AGENCY APPROVALS (Required before processing of permit)			**PERMIT APPROVALS** (Required before inspections can be scheduled)		
AGENCY	APPROVAL	DATE	AGENCY	APPROVAL	DATE
☐ JEDC	________	________	☐ Field review	________	________
☐ Historical	________	________	☐ Plans included?		

| W |___|___| |___|___|___|___|___|___|___|—| 0 | 0 | 0 |

Year Permit Number

GENERAL CONDITIONS

(conditions under which permit is issued)

The receiver of a right of way permit expressly agrees to do all work subject to approval of the Department of Public Works, in accordance with City Standards and in accordance with conditions and regulations hereon. When accompanied by plat, blue print or acceptable sketch, the same is to be strictly adhered to and subject to endorsements contained therein. Any unapproved deviation from the approved drawings or standards will be sufficient cause to have work stopped or reconstructed at the expense of the party or parties to whom the permit is issued. A copy of the permit is required on the job site at all times.

Plans must be filed in this office showing existing and proposed locations (dimensions) and elevations of ALL drainage structures, pipes, and ditches; utility mains, lines, structures, valves and, appurtenances; pavement; and curb and gutter in the vicinity of and affecting issuance of this permit. Upon completion of work, "As Built" Drawings must be filed with construction inspector showing whatever changes were made from original plan. All excavations remaining open after sundown must be marked with lights, and a list showing location and number sent to the inspector before 8:30 a.m. the following day. All extra or surplus material and earth must be removed from the street within 24 hours after completion of work. Any violation of these conditions will be deemed sufficient cause to refuse further permits to party or parties violating same, and all repairs deemed necessary will be made by the City. The costs of the repairs will be charged to the party or parties to whom the permit was issued, and all further applications for permits will be refused until payment of these charges is received.

IN PAVEMENT OR SIDEWALK: One half of the roadway must be kept open to traffic at all times and under all conditions unless otherwise approved by the City Traffic Engineer. Any pavement removed will be temporarily restored immediately, in accordance with standard paving repair detail, and permanently repaved within ten (10) days by the person, or persons making the opening. All repairs are subject to approval of the Engineering Division.

SHEET PILING: When required, sheet piling shall be used where excavations exceed three feet in depth in public space. Before said sheet piling is removed, backfill is to be thoroughly wet down and tamped to within 6" of surface.

IN PARKING: All grass, lawns and shrubbery must be carefully removed and upon completion of work shall be replaced to the satisfaction of the Department of Public Works.

EMERGENCY: In case of emergency where opening must be made, due discretion must be exercised. Application for a permit must be obtained at the earliest possible time after such opening is made.

WARRANTY OF WORKMANSHIP AND MATERIALS: The Permit holder shall be responsible for any failure(s) of workmanship and/or materials for a period of one (1) year from the date of completion of all work performed under this permit.

LOCATE REQUIREMENTS: In order to reduce the disruption and cost of utility damages occurring in the City's right of way and easements, the permit holder shall prevent damages to existing utilities caused by his work through field verification of the existing utilities. In the case of open excavation, verification may be performed during the permit holder's work. In the case of directional drilling, verification shall take place prior to mobilization of the drilling equipment.

The permit holder shall verify the location of existing utilities as needed to avoid conflict. Existing utilities shall be exposed using detection equipment or other acceptable means. Such methods may include but shall not be limited to "soft dig" equipment and ground penetrating radar (GPR). The excavator shall be held liable for damages caused to the City's infrastructure and the existing facilities of other utility companies.

UTILITY RELOCATION: In the event that a utility relocation is required as contemplated in Ch. 337 F.S., or should the City, including its departments and agencies, hereinafter the "CITY", require relocation to accommodate any improvements or construction in or involving the right of way, the permit holder and the utility owner shall indemnify and hold harmless the CITY from any claim, expense or damage of any kind, including delay damages, that arises from the non-removal, placement, identification, or misidentification of utility lines, connections, etc., which are placed in the right of way pursuant to this permit. The permit holder and utility owner shall cooperate fully with the CITY in an relocation notice by the CITY and shall provide all information and perform all relocation in an expeditious manner so as to avoid any delay to the CITY or the project impacted by the permit holder's utility placement.

I, the undersigned, am authorized to sign for the bond holder and hereby agree to abide by these GENERAL CONDITIONS and do all work in accordance with City Standards.

Signature: ______________________________

Print Name: PRINT OR TYPE PLEASE ______________________________

CDM Smith®

cdmsmith.com