SPECIFICATIONS FOR
440 QUARRY IMPROVEMENTS
PRV ASSEMBLIES

March 2024

PAPE-DAWSON ENGINEERS

Transportation | Water Resources | Land Development | Surveying | Environmental

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San Antonio Water System – Specifications Section – Provided by SAWS
www.saws.org/business_center/specs

City of San Antonio – Specification Sections – Provided by CoSA www.SanAntonio.gov/TCI/Current-ventor-Resources/standard specifications and details

The technical and material specifications for this project are published by SAWS and TCEQ. Reference to those documents shall apply as if the entire specification was reproduced herein. Applicable modifications to this document and additional specifications are included herein.

SPECIAL CONSTRUCTION CONDITIONS

SC-1.0 Except where bid items are specifically provided in the Proposal, payment to the CONTRACTOR to accommodate the requirements specified herein shall be considered subsidiary to the various items of work under this contract and no direct payment will be made.

SC-2.0 The CONTRACTOR shall perform all work necessary for the proper installation and functioning of the various types and sizes of pipe, equipment and associated appurtenances at the locations shown on the plans.

SC-3.0 The CONTRACTOR shall obtain all necessary permits that are required for the project. Any fees required for the obtaining of permits will be considered subsidiary and no additional direct payment will be made to the CONTRACTOR.

SC-4.0 The use of explosives of any kind for this project is strictly prohibited.

SC-5.0 The CONTRACTOR, at his/her own expense, is responsible for performing quality control inspection and testing to assure compliance with all Contract Documents. All observation/inspection of the work, and quality assurance testing performed by SAWS or by Owner's Consultant and/or Engineer is for the sole benefit of Owner and CONTRACTOR agrees not to rely thereon for any reason.

SC-6.0 Trench protection will be required on this project. The CONTRACTOR will be required to provide the Owner and Engineer copies of a trench protection plan that meets the more stringent rules of SAWS, TCEQ, OSHA or other applicable agency. The CONTRACTOR shall be solely responsible for the development of a Site Safety and Health Plan for the project. Neither the professional activities of the Consultant, nor the presence of the Consultant or its employees and subconsultants at a construction/project site, shall relieve the CONTRACTOR of its obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending and coordinating the Work in accordance with the contract documents and any health or safety precautions required by any regulatory agencies. The Consultant and its personnel have no authority to exercise any control over any construction contractor or its employees in connection with their work or any health or safety programs or procedures. The Owner agrees that the CONTRACTOR shall be solely responsible for jobsite safety and warrants that this intent shall be carried out in the Owner's contract with the CONTRACTOR.

SC-7.0 All valve assemblies, including gate valves, pressure reducing valves, and air release valves shall be furnished complete and adequate for the specified or shown purpose, and shall include all essential components of equipment, together with all mountings and other appurtenances normal and necessary for proper installation and operation, whether shown or not.

SC-8.0 It is understood and agreed that CONTRACTOR has, by careful examination, satisfied himself/herself as to the nature and location of the Work, the conformation of the ground, the character, quality and quantity of the materials to be encountered, the character of equipment and facilities needed preliminary to and during the prosecution of the Work, the general and local conditions, and all other matters which can in any way affect the Work under this Agreement. No verbal agreement or conversation with any officer, agent, or employee of Owner either before or after the execution of this Agreement shall affect or modify any of the terms or obligations herein contained.

SC-9.0 CONTRACTOR shall be solely responsible for coordinating and/or negotiating with the property owner as necessary to secure an area for the staging and storing of materials and equipment. Any cost or expense associated with securing a staging and storage area shall be the CONTRACTOR's sole responsibility.

SC-10.0 The SAWS Inspection staff and Consultants shall note deficiencies during construction observation and provide a report to the Contractor.

SECTION 01010

SUMMARY OF WORK

PART 1 - GENERAL

1.01 GENERAL

A. The work of this Contract comprises the construction of two pressure reducing valve assemblies, structural slabs, associated piping and electrical work as shown on the plans.

B. All work done under this Contract shall conform to local ordinances. CONTRACTOR shall arrange and pay all cost of permits and inspection fees and shall confine his operations to the limits set by law.

C. It is the intent of the Owner to award this project to one CONTRACTOR.

D. Portions of this project may be subject to review and acceptance by various agencies. The CONTRACTOR will be required to coordinate with these agencies for such items as issuance of permits or work orders, inspections during construction, final acceptance, etc. The agencies for this project that may require coordination include, but are not limited to, the following:

1. San Antonio Water System (SAWS)
2. Texas Commission on Environmental Quality (TCEQ)
3. Bexar County
4. CPS Energy (CPS)

E. All work shall be performed in accordance with, but not limited to, the following agencies:

1. San Antonio Water System (SAWS) Design & Construction Guidelines
2. Texas Commission on Environmental Quality (TCEQ)
3. Bexar County
4. CPS Energy (CPS)

1.02 EXISTING CONDITIONS

A. Locate and protect all existing utilities.

B. Protect all existing public and private aboveground fixtures.

1.03 WORK SEQUENCE

Coordinate the construction schedule and operations with the Owner's Representatives.

1.04 CONTRACTOR'S USE OF PREMISES

A. CONTRACTOR shall limit his use of the premises for Work and storage, to allow for work by other CONTRACTORS.

B. Assume full responsibility for the protection and safekeeping of products under this Contract, stored on the site.

C. Move any stored products, under CONTRACTOR's control, which may interfere with operations of the Owner or separate CONTRACTOR.

D. Obtain and pay for the use of additional storage or work areas needed for operations.

END OF SECTION

SECTION 01300

SUBMITTALS

PART 1- GENERAL

1.01 DESCRIPTION OF WORK:

This section describes the requirements for preparing and presenting submittals that are necessary for the execution of this contract. Requirements within the following subject areas are included:

A. Definitions

B. Procedures

C. Product Data

D. Shop drawings

E. Samples

F. Manufacturer's certificates

1.02 DEFINITIONS:

A. Product Data and Shop Drawing, General Definition

Drawings, diagrams, illustrations, brochures, schedules, bills of materials and other data prepared by the CONTRACTOR, his subcontractors, suppliers or distributors, or equipment manufacturers and fabricators, illustrating the manufacture, fabrication, construction, or installation of the Work or a portion thereof.

B. Shop Drawings

Assembly and fabrication drawings, bills of materials for items shop fabricated exclusively for this project. In addition, shop drawings should show fabrication details of each part, the assembly of each part and how each part and/ or assembly is integrated into the project including existing parts or assemblies.

C. Manufacturer's Representative

A representative from the manufacturer's plant with 5 years of experience in the actual problems of manufacturing, installing, and operating the particular product. Sales representatives or agents of the manufacturer will not be acceptable.

D. Working Drawings

CONTRACTOR-prepared plans for temporary structures and facilities. Working drawings for elements of work that may affect the safety and health of persons or property will be certified by an engineer licensed in the state of Texas. Calculations, as necessary, will accompany working drawings.

1.03 PROCEDURES

A. CONTRACTOR’s Responsibilities

1. Submit a schedule of specified submittals for all materials to be installed for the Project to the Engineer within 14 calendar days of receipt of the notice to proceed.
2. Submissions will be made to the Engineer’s office. Data and correspondence that originates with subcontractors and suppliers must be submitted to the Engineer through the CONTRACTOR. CONTRACTOR to approve all submittals prior to submission.

3. The CONTRACTOR will submit dimensional and layout drawings and product data, certified correct for construction, for review by the Engineer.
4. Submit shop drawings and product data in accordance with the approved submittal schedule. Also submit shop drawings to the Engineer for review prior to their need in the Work, allowing sufficient time for the Engineer's review and response.
    a. The CONTRACTOR shall limit each submittal to only one item of material or equipment for review by the Engineer.
5. The CONTRACTOR will make specific mention of those items that vary from the requirements of the Plans and Specifications in the letter of transmittal.
6. Submit shop drawings and product data covering related items of equipment or material or integrated systems of equipment or material at the same time. Partial submissions will not be accepted.
7. The CONTRACTOR will coordinate shop drawings and product data with drawings previously submitted, with drawings being prepared, and with drawings and data previously approved. All such coordination shall be indicated by reference.
8. The CONTRACTOR will assign a sequential number to each submittal (1, 2, 3, etc.). The CONTRACTOR shall assign each piece of material or equipment its own submittal number. Multiple items under the same submittal number will not be accepted. Re-submittals will be identified with their original number followed by a sequential letter (A, B, C, etc.). For example, submittal 12-C is the third submittal of the twelfth item for the project.

    The CONTRACTOR will not deliver to the site, storage, or incorporate into the Work, any materials or equipment for which approved submittals have not been obtained.

B. Engineer's Review:
1. The Engineer will conduct a review after its receipt in the Engineer's office so as not to create delay. This review will be for general conformance, subject to the requirements of the Contract Documents, and will be an effort to assist the CONTRACTOR to discover errors and omissions in submittals.
2. Engineer's review or other appropriate action regarding CONTRACTOR's submissions will be only to check conformity with the design concept of the Project and for compliance with the information contained in the Contract Documents and shall not extend to means, methods, techniques, sequences or procedures of construction (except where a specific means, method, technique, sequence or procedure of construction is indicated in or required by the Plans and Specifications) or to safety precautions or programs incident thereto. The review and approval of a separate component item will not indicate approval of the assembly into which the item is functionally integrated. CONTRACTOR shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings to the Engineer. CONTRACTOR may be required to resubmit as required revised Shop Drawings or Samples for further review and approval. CONTRACTOR shall direct specific attention in writing to any new revisions not specified by CONTRACTOR on previous CONTRACTOR submissions.
3. The Engineer's review does not relieve the CONTRACTOR of the obligation and responsibility to coordinate the Work and plan the details of the Work.

4. The Engineer reserves the right to require written confirmation from the CONTRACTOR that the comments placed on submittals stamped "Reviewed" will be implemented.
5. Review by SAWS or Engineer will not be construed as relieving the CONTRACTOR of the responsibility for the accuracy, proper fit, functioning, or performance of the Work.

1.04 PRODUCT DATA:

A. Product data, including materials reproduced from manufacturer's product catalogs, will not be larger than 8½" by 11" in size.

B. Catalog data will be explicit regarding the name of the manufacturer and to the details of the products being furnished. It will also be complete enough to enable the Engineer to determine that the products being submitted conform to the requirements of the specifications.

C. For submittals with more than one style or size of a product on a sheet, the CONTRACTOR will clearly indicate which product is being submitted for review.

D. The CONTRACTOR will submit one (1) electronic copy to the Engineer.

1.05 SHOP DRAWINGS:

A. The CONTRACTOR shall reasonably check and verify all field measurements and will submit to the Engineer for review and approval. These shop drawings will bear a stamp from the CONTRACTOR that indicates that the CONTRACTOR has reviewed the shop drawings and that the submittal is complete and in compliance with Contract Documents.

B. The CONTRACTOR will submit detailed drawings and descriptions of proposed deviations from details or component arrangement indicated on the Plans.

C. Single line drawings will not be acceptable. Copies of the Plans will not be accepted for submission as drawings, nor will catalog numbers alone of materials or equipment.

D. The CONTRACTOR will submit one (1) electronic copy of each shop drawing to the Engineer for review.

1.06 SAMPLES

The CONTRACTOR will furnish samples of items and materials as required. Samples shall be submitted to the Engineer in duplicate. Each sample will be properly labeled and identified by providing the following:

A. Date

B. Job name for which it is offered

C. Specification section and paragraph

D. CONTRACTOR’s name

E. Supplier and trade name

F. Other data indicating conformance to specifications.

1.07 MANUFACTURER'S CERTIFICATES AND AFFIDAVITS:

Where specified in the Plans and Specifications that a certificate and affidavit shall be submitted to the Engineer for review of a particular product, or component of a product, such submittals shall be made in accordance with the following:

A. A certificate submitted for a product, or component of a product, indicates test results

proving that product, or component of a product, meets the requirements of the standard specified in the Plans and Specifications.

B. An affidavit consisting of a sworn statement by an official of the company manufacturing the product indicating that the information on the certificate is true and accurate shall accompany the certificate.

C. A statement from the CONTRACTOR, or his subcontractors, suppliers, or other agent which indicates that a particular item of equipment, or product, or component of a product, meets the requirements of the Plans and Specifications shall not be considered as certificate and will not be approved.

1.08 MANUFACTURER'S REPRESENTATIVE

The CONTRACTOR will include in the contract price the cost of furnishing competent and experienced manufacturer's representatives to represent the manufacturer on all products furnished and to assist the CONTRACTOR to install the products in conformity with the Plans and Specifications.

1.09 MISCELLANEOUS SUBMISSIONS:

A. Work plans - Submit 2 copies

B. Accident reports - 2 copies

C. Inspection and test reports - 2 copies

D. Guarantees and Warranties - 2 copies (Originals)

E. Operation and Maintenance Manuals - 2 copies

F. Course of Action Plan (Fuel Spill or Other Substances)

1. The CONTRACTOR must submit the Course of Action Plan (Fuel Spill or Other Substances) to the Owner prior to start of construction.
2. Regarding the accidental spill of fuel, the Plan must address the procedures required by applicable regulations and laws.

PART 2 - PRODUCTS (Not used)

PART 3 - EXECUTION (Not used)

END OF SECTION

SECTION 01511

TEMPORARY UTILITIES

PART 1 - GENERAL

1.01 SUMMARY

A. Provide connections as necessary for temporary utilities.

1.02 TESTING

A. All power, water, light, ventilation, or heat required for completion and testing of the work shall be paid for by the CONTRACTOR.

B. All collection and disposal of refuse, debris, garbage, and temporary sanitary sewer facilities from the work area shall be paid for by the CONTRACTOR.

C. Comply with Federal, State, and local codes and regulations and with utility company requirements.

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL

A. Materials and equipment may be new or used but must be adequate in capacity for the required usage, must not create unsafe conditions, and must not violate requirements of applicable codes and standards.

2.02 TEMPORARY ELECTRICITY AND LIGHTING

A. Provide connections as necessary, size and provide service required for power and lighting. CONTRACTOR to pay the costs of power used.

B. Install circuit and branch wiring, with area distribution boxes located so that power and lighting is available throughout the construction using construction-type power cords.

C. Provide adequate artificial lighting for all areas of work when natural light is not adequate for work, and for areas accessible to the public.

D. CONTRACTOR shall provide for his extension cords and any additional lighting that may be required to complete his work.

E. Prior to final inspection remove temporary lamps and install new lamps if permanent fixtures were used for temporary lighting.

2.03 TEMPORARY HEAT AND VENTILATION

A. Provide temporary heat and ventilation as required to maintain adequate environmental conditions to facilitate progress of the Work, to meet specified minimum conditions for the installation of materials, and to protect materials and finishes from damage due to temperature or humidity.

B. Provide adequate forced ventilation of enclosed areas for curing of installed materials, to disperse humidity, and to prevent hazardous accumulations of dust, fumes, vapors, or gases.

C. Portable heaters shall be units meeting applicable codes complete with controls. Pay all costs of installations, maintenance, operation, and removal, and for fuel consumed.

D. Provide connections as necessary; extend and supplement with temporary units as required to comply with requirements. Pay all costs of installation, maintenance, operation, and removal. CONTRACTOR to pay costs of fuel used from the existing system.

2.04 TEMPORARY TELEPHONE SERVICE (NOT USED)

2.05 TEMPORARY WATER

A. Make connections to existing facilities, provide water for construction purposes. CONTRACTOR to pay costs of water used.

B. Install branch piping with taps located so that water is available throughout the construction using hoses. Protect piping and fittings against freezing.

C. CONTRACTOR shall provide distribution hoses as required to complete his work.

2.06 TEMPORARY SANITARY FACILITIES

A. Provide and maintain adequate temporary outdoor toilet facilities for use of persons working at the Site.

B. Keep toilets clean and in sanitary condition. Provide toilet tissue in suitable holders. Comply with applicable legal and health requirements.

C. Remove temporary toilets when construction is completed.

D. Existing plumbing facilities shall not be used by construction personnel.

2.07 TEMPORARY FIRE PROTECTION

A. Observe and enforce throughout the work during the whole period of construction all requirements of the local City Fire Marshal and Insurance Authorities to minimize the fire hazard during the progress of the work.

B. Make connections to existing facilities, provide water for fire protection purposes; CONTRACTOR to pay costs of water used.

C. Install branch piping with taps located so that water is available throughout the construction using hoses. Protect piping and fittings against freezing.

PART 3 - EXECUTION

3.01 GENERAL

A. Maintain and operate systems to assure continuous service.

B. Modify and extend systems as work progress requires.

C. CONTRACTOR shall be responsible for coordinating material storage, parking and fencing with the Owner.

D. CONTRACTOR shall be solely responsible for providing temporary security systems to protect equipment, materials, etc. in the construction area.

3.02 REMOVAL

A. Completely remove temporary materials and equipment when their use is no longer required.

B. Clean and repair damage caused by temporary installations or use of temporary facilities.

C. Restore existing facilities used for temporary services to specified, or original condition.

END OF SECTION

SECTION 02110

SITE CLEARING

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope: CONTRACTOR shall furnish all labor, materials, equipment, and incidentals required to perform all clearing and grubbing as shown and specified.

B. The work covered by this Section consists of removing and disposing of trees, stumps, brush, roots, shrubs, vegetation, logs, and rubbish, including the removal of selective vegetation; removal of all poisonous vegetation, obnoxious shrubs, and vines; protection of trees and plants designated to remain; and the removal of all trash and related materials and other objectionable material from the site as required to perform the work.

1.02 RELATED SECTIONS

A. Section 02221, Site Earthwork

1.03 QUALITY ASSURANCE

A. Codes and Standards

State and local laws and code requirements shall govern the hauling and disposal of trees, shrubs, stumps, roots, rubbish, debris, and other matter. Nothing contained herein shall be construed as permitting work that is contrary to such rules, regulations, and codes.

1.04 JOB CONDITIONS

A. Protection:

1. Streets, roads, adjacent property and other works and structures shall be protected throughout the entire project. CONTRACTOR, at his expense, shall restore to original condition, satisfactory to the Engineer, damaged facilities caused by the CONTRACTOR's operations.

2. Trees, shrubs, and grassed areas designated to remain shall be protected by fences, barricades, wrapping or other methods as specified in related Sections. Equipment, stockpiles, etc., shall not be permitted within tree branch spread. Trees shall not be removed without authorization of the Engineer unless shown or specified.

1.05 GUARANTEE

A. CONTRACTOR shall guarantee that work performed under this Section will not permanently damage trees, shrubs, turf, or plants designated to remain, or other adjacent work or facilities. If damage resulting from CONTRACTOR's operations appears during the period up to eighteen (18) months after completion of the project, the CONTRACTOR shall replace damaged items at no cost to the Owner.

PART 2 - PRODUCTS (omitted)

PART 3 - EXECUTION

3.01 CLEARING AND GRUBBING

A. Limits of clearing shall be all areas shown on the plans where proposed construction is to occur and as directed by the Engineer. These areas may include proposed street rights-of-way, and drainage and utility easements. Trees to be removed or relocated within the site shall be designated by the Engineer prior to commencement of clearing operations. The CONTRACTOR

shall be required to survey, and layout all proposed improvements within the Project area and notify the Engineer prior to any tree removal necessary for the execution of the work.

B. Except as noted in Paragraph 3.01.A of this Section, CONTRACTOR shall remove from the site and satisfactorily dispose of all trees, shrubs, stumps, roots, brush, masonry, rubbish, scrap, debris, pavement, curbs, fences, and miscellaneous other structures not covered under other Sections as shown, specified, or otherwise required to permit construction of the new work.

C. Burning on site shall not be allowed unless allowed by authorities having jurisdiction, and the Owner. If allowed, on-site burning shall be in complete accordance with rules and regulations of local authorities having jurisdiction, and the Owner.

D. Trees and shrubs shall be trimmed when doing so will avoid removal or damage. Trimmed or damaged trees shall be treated and repaired by persons with experience in this specialty who are acceptable to the Engineer. Trees and shrubs which are intended to remain, and which are damaged beyond repair, or removed, shall be replaced by the CONTRACTOR at no cost to the Owner.

E. Air pollution caused by dust and dirt shall be controlled and comply with governing regulations.

END OF SECTION

SECTION 02200

SITE PREPARATION

PART 1 - GENERAL

1.01 DEFINITIONS

A. Interfering or Objectionable Material: Trash, rubbish, and junk; vegetation and other organic matter, whether alive, dead, or decaying; topsoil.

B. Clearing: Removal of interfering or objectionable material lying on or protruding above ground surface.

C. Grubbing: Removal of vegetation and other organic matter including stumps, buried logs, and roots greater than 2 inches caliper to a depth of 6 inches below subgrade.

D. Scalping: Removal of sod without removing more than upper 3 inches of topsoil.

E. Stripping: Removal of topsoil remaining after applicable scalping is completed.

F. Project Limits: Areas, as shown or specified, within which Work is to be performed.

1.02 SUBMITTALS

A. Shop Drawings: Drawings clearly showing clearing, grubbing, and stripping limits.

1.03 QUALITY ASSURANCE

A. Obtain Owner's approval of staked clearing, grubbing, and stripping limits, prior to commencing clearing, grubbing, and stripping.

1.04 SCHEDULING AND SEQUENCING

A. Prepare site only after adequate erosion and sediment controls are in place. Limit areas exposed uncontrolled to erosion during installation of temporary erosion and sediment controls.

1.05 RELATED WORK

Related work not included in this section can be found in the following sections.

A. Section 02221, Site Earthwork.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 GENERAL

A. Clear, grub, and strip areas needed for staging area or site improvements within limits shown or specified.

B. Do not injure or deface vegetation that is not designated for removal.

3.02 LIMITS

A. As follows, but not to extend beyond Project limits.

1. Excavation Including Trenches: 5 feet beyond top of cut slopes.
2. Fill:
    a. Clearing and Grubbing: 5 feet beyond toe of permanent fill.
    b. Stripping and Scalping: 5 feet beyond toe of permanent fill.
3. Staging Area:

a. Clearing: 5 feet beyond perimeter.
b. Scalping and Stripping: Not required.
c. Grubbing: Around perimeter as necessary for neat, finished appearance.

B. Remove rubbish, trash, and junk from entire area within Project limits.

3.03 CLEARING

A. Clear areas within limits of construction.
B. Fell trees so that they fall away from facilities and vegetation not designated for removal.
C. Cut stumps not designated for grubbing flush with ground surface.
D. Cut off shrubs, brush, weeds, and grasses to within 2 inches of ground surface.

3.04 GRUBBING

A. Grub areas within limits of construction.

3.05 SCALPING

A. Do not remove sod until after clearing and grubbing is completed and resulting debris is removed.
B. Scalp areas within project limits.

3.06 STRIPPING

A. Do not remove topsoil until after scalping is completed.
B. Strip areas within project limits to minimum depths. Do not remove subsoil with topsoil.

3.07 TREE REMOVAL OUTSIDE CLEARING LIMITS

A. Remove Trees Within Project Limits:
1. Dead, dying, leaning, or otherwise unsound trees that may strike and damage Project facilities in falling.
2. Trees designated by Owner.
B. Cut stumps off flush with ground, remove debris, and if disturbed, restore surrounding area to its original condition.

3.08 PRUNING

A. Remove branches below the following heights: 20 feet above roadways and shoulders.
B. Prune as specified in local ordinances.

3.09 SALVAGE

A. Saleable logs timber may be sold to CONTRACTOR’s benefit. Promptly remove from Project site.
B. Sod with commercial value may be sold to CONTRACTOR’s benefit. Promptly remove from Project site.

3.10 DISPOSAL

A. Clearing and Grubbing Debris:
1. Dispose of debris offsite.
2. Burning of debris onsite will not be allowed.

3. Woody debris may be chipped. Chips may be sold to CONTRACTOR's benefit or used for landscaping onsite as mulch or uniformly mixed with topsoil, provided that resulting mix will be fertile and not support combustion. Maximum dimensions of chipped material used onsite shall be 1/4-inch by 2-inch. Dispose of chips that are unsaleable or unsuitable for landscaping or other uses with unchipped debris.
4. Limit offsite disposal of clearing and grubbing debris to locations that are approved by federal, state, and local authorities, and that will not be visible from Project.

B. Scalpings: As specified for clearing and grubbing debris.

C. Strippings:

1. Dispose of strippings that are unsuitable for topsoil or that exceed quantity required for topsoil offsite.
2. Stockpile topsoil in sufficient quantity to meet Project needs. Dispose of excess strippings as specified for clearing and grubbing.

END OF SECTION

SECTION 02221

SITE EARTHWORK

PART 1 - GENERAL

1.01 SUMMARY

A. CONTRACTOR shall furnish all labor, materials, equipment, and incidentals as shown, specified and necessary to complete the work of site preparation, erosion control, surface drainage, ground water control, construction of compacted fills, excavations, trenching, and backfilling of concrete foundations and structures, installation and removal of sheeting and bracing, backfilling and final site grading.

B. This Section also includes providing backfill materials for all excavations including select backfill, backfill, fill, granular embedment, and the satisfactory disposal of surplus and unacceptable materials.

C. No classification of excavated materials will be made. Excavation includes all materials regardless of type, character, composition, moisture, or condition thereof.

D. The CONTRACTOR shall perform all earthwork as specified in this Section. All trenching shall conform to the requirements of SAWS Specification Section 550, "Trench Excavation Safety Protection".

1.02 RELATED SECTIONS:

A. Section 01300, Submittals

B. Section 02200, Site Preparation

1.03 REFERENCE STANDARDS

The CONTRACTOR shall comply with applicable provisions and recommendations of the most recent versions following:

A. ASTM A 36, Structural Steel.

B. ASTM D 422, Particle-size Analysis of Soils.

C. ASTM D 423, Liquid Limit of Soils.

D. ASTM D 424, Plastic Limit & Plasticity Index of Soils.

E. ASTM D 427, Shrinkage Factors of Soils.

F. ASTM D 698, Moisture-Density Relations of Soils, using 5.5 lb. (2.5 kg) Rammer and 12-inch (304.8 mm) Drop.

G. ASTM D 1140, Amount of Material in Soils Finer than the No. 200 Sieve.

H. TxDOT TEX-113-E, Moisture-Density Relations of Soils, using 5.5 lb. 2.5 kg) Rammer and 12-inch (304.8 mm) Drop.

I. ASTM D 2321, Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.

J. ASTM D 2922, Density of Soils and Soil-Aggregate in Place by Nuclear Methods.

K. Texas Department of Transportation (TxDOT) Standard Specifications for Construction of Highways, Streets and Bridges.

L. SAWS Specifications for Sewer and Water Construction.

1.04 SUBMITTALS

Provide the following in conformance with applicable requirements contained in Section 01300, Submittals.

A. Test Reports

The testing laboratory shall submit copies of the following reports directly to the CONTRACTOR, with copy to the Engineer:

1. Field Density (Compaction) Tests.
2. Optimum Moisture - maximum density curve for each soil used for backfilling.
3. Concrete Slump and 28-day compressive strength test.

B. Samples of all select backfill, backfill, fill, granular embedment, and drain gravel, shall be submitted by the CONTRACTOR to the Testing Laboratory. Samples of the proposed material shall be submitted at least fourteen (14) days in advance of its anticipated use.

C. The Project will not be accepted unless test reports are submitted to the Engineer and SAWS by the CONTRACTOR.

D. Testing frequency and intervals shall be in accordance with SAWS Specification Item 804 – "Excavation, Trenching, and Backfill."

1.05 QUALITY ASSURANCE

A. Testing Services

1. General:

Testing of materials, testing for moisture content during placement and compaction of fill materials, and of compaction requirements for compliance with technical requirements of the Specifications shall be performed by a testing laboratory.

2. Testing Services Include:

a. Test the CONTRACTOR's proposed materials in the laboratory and/or field for compliance with the Specifications.

b. Perform field moisture content and density tests to assure that the specified compaction of backfill materials has been obtained.

c. Report all test results to the CONTRACTOR and the Engineer.

1.06 SITE CONDITIONS

A. All traffic during construction shall confine their limits to an established "traffic route" submitted by the CONTRACTOR and reviewed by the Engineer.

1.07 COORDINATION

A. The CONTRACTOR shall expedite placement of compacted fills and embankments at the earliest practical time.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Backfill, Fill, Select Backfill

1. Materials used for backfilling, fill, and select backfill shall be in accordance with SAWS Specification Item 804 "Excavation, Trenching, and Backfill."

2. All material for use as backfill, fill, and select backfill shall be tested and verified by the Testing Laboratory.

PART 3 - EXECUTION

3.01 SITE PREPARATION

A. The portions of the site on which the work is to be constructed shall be cleared of all objectionable materials and debris. All materials and debris shall be disposed of off the project site in accordance with applicable regulations.

3.02 EROSION CONTROL, DEWATERING AND POLLUTION CONTROL

A. Erosion Control

1. In general, the construction procedures outlined herein shall be implemented to ensure minimum damage to the environment during construction.
2. Whenever possible, access roads shall be located and constructed to avoid environmental damage.
3. Temporary Measures shall be coordinated with the construction of permanent drainage facilities and other work to the extent practicable to assure economical, effective, and continuous erosion and siltation control.
4. The CONTRACTOR shall prevent blowing and movement of dust from exposed soil surfaces to reduce on and off-site damage and health hazards.

B. Dewatering

1. The CONTRACTOR shall provide and maintain adequate dewatering equipment to remove and dispose of all surface and groundwater entering excavations, trenches, or other parts of the Work. Each excavation shall be kept dry during subgrade preparation and continually thereafter until all backfill operations have been completed. All dewatering operations by the CONTRACTOR shall be at no additional cost to the Owner.
    a. The different working areas on the site shall be kept free of surface water at all times. The CONTRACTOR shall install drainage ditches and dikes and shall perform all pumping and other work necessary to divert or remove rainfall and all other accumulations of surface water from the excavations and fill areas. The diversion and removal of surface water shall be performed in a manner that will prevent the accumulation of water behind temporary structures or at any other locations within the construction area where it may be detrimental.
    b. Water used for working or processing, resulting from dewatering operations, or containing oils or sediments that will reduce the quality of the water downstream of the point of discharge shall not be directly discharged. Such waters shall be diverted through a settling basin or filter before being discharged.
    c. The CONTRACTOR will be held responsible for the condition of any pipe, conduit, or channel which he may use for drainage purposes and all such pipes, conduits or channels shall be left clean and free of sediment.
2. The CONTRACTOR shall provide, install, and operate sufficient trenches, sumps, pumps, hose, piping, wellpoints, deep wells, etc., necessary to depress and maintain the ground water level below the base of the excavations during all stages of construction operation. The ground water table shall be lowered in advance of excavation and maintained two feet below the lowest subgrade excavation made until the structure has

sufficient strength and weight to withstand horizontal and vertical soil and water pressures from natural groundwater. The system must be operated on a 24-hour basis and standby pumping facilities and personnel shall be provided to maintain the continued effectiveness of the system. If, in the opinion of the Engineer, the water levels are not being lowered or maintained as required by these Specifications, the CONTRACTOR shall install additional or alternate dewatering devices as necessary, at no additional cost to the Owner.

a. Elements of the system shall be located to allow a continuous dewatering operation without interfering with the construction of the permanent work. Where portions of the dewatering system are in the area of permanent construction, the CONTRACTOR shall submit details of the methods he proposes to construct the permanent work in this location for the review of the Engineer. Controls of groundwater shall continue until the permanent construction provides sufficient dead load to withstand the hydrostatic uplift of the normal ground water, until concrete has attained sufficient strength to withstand earth and hydrostatic loads, until all waterproofing work below normal ground water level has been completed, and until pipelines are properly jointed.

   Dispose of all water removed from the excavation in such a manner so as not to endanger any portion of the work under construction or completed. Convey water from the excavations in a closed conduit. Do not use trench excavations as temporary drainage ditches. Before discontinuing dewatering operations, or permanently permitting the rise of the ground water level, computations shall be made to show that any pipeline or structure affected by the water level rise is protected by backfill or other means to sustain uplift. Use safety factor of 1.25 when making these computations.

b. Dewatering operations shall not be discontinued without the prior authorization of the Engineer.

3.03 EXCAVATION

A. General

1. The CONTRACTOR shall excavate and backfill, in advance of the construction, test pits to determine conditions or location of the existing utilities. The CONTRACTOR shall perform all work required in connection with excavating, stockpiling, maintaining, sheeting, shoring, backfilling, and replacing pavements for the test pits.

   The CONTRACTOR shall be responsible for the definite location of each facility constructed by others involved within the area of his excavation for work under this contract. Care shall be exercised during such location work to avoid damaging and/or disrupting the affected facility. The CONTRACTOR shall be responsible for repairing, at his expense, damage to any structure, piping, or utility caused by his work.

   Blasting shall not be permitted.

2. Excavation of every description and of whatever substance encountered within the grading limits of the project shall be performed to the lines and grades indicated on the Drawings. All excavation shall be performed in the manner and sequence as required for the work.

a. Excavation work shall be performed in a safe and proper manner with appropriate precautions being taken against all hazards. Excavations shall provide adequate working space and clearances for the work to be performed therein and for installation and removal of concrete forms. In no case shall excavation faces be undercut for extended footings.

b. Subgrades for concrete pads, concrete foundations, and pavements shall be firm, dense, and thoroughly compacted.

c. Exposed soil after excavations have been made shall be protected against detrimental damage and change in condition from physical disturbance and rain. Wherever possible, concrete footings shall be done the same day the excavation is made. If this is not done, the footing excavations shall be properly protected.

3. All excavated materials that meet the requirements for backfill shall be stockpiled within the site (but not less than 25 feet from the surface borders of any excavation) for use as backfill, or for providing final site grades. All excavated materials which are not considered suitable for fill, and any surplus or excavated material which is not required for fill shall be disposed of off the site by the CONTRACTOR. Upon completion of the fill, all on-site waste and disposal areas shall be cleaned, and the debris removed from the site.

   Materials deposited off the site shall be transported and placed in accordance with all applicable rules and regulations of all authorities having jurisdiction thereof. No surplus or unacceptable excavated materials of any kind shall be deposited in any stream or water course or dumped on public property.

B. Excavations for Concrete Pads, Concrete Foundations and Pavements.

1. Excavations for the construction of concrete pads, and foundations shall be carefully made to the depths indicated on the plans. Bottoms for footings and slabs shall be level, clean, dry, and clear of loose material and the lower sections true to size. Footings and slab excavations shall be verified by the Testing Laboratory, and reviewed by the Structural Engineer, before concrete is placed thereon.

2. In excavations for structures where, in the opinion of the Testing Laboratory, the ground, not affected by high water level, is spongy or otherwise unsuitable for the contemplated foundation, the CONTRACTOR will be required to remove such unsuitable earth and replace it with suitable material in accordance with this Section.

3. Excavations for structures which have been carried below the depths indicated shall be refilled to the proper grade with select backfill material properly compacted, in accordance with this Section.

4. All structure excavations shall be hand-trimmed to permit the placing of full widths and lengths of footings on horizontal beds. Rounded and undercut edges will not be permitted.

5. Excavations shall be extended to the recommended dimensions shown in the plans for this project on each side of structures, footings, etc., unless otherwise shown or specified.

6. When the excavation has reached the design subgrade, the exposed subgrade shall be compacted, and moisture conditioned.

7. Pavement excavation shall consist of excavation for the pavement and driveway, in conformity with the typical sections shown on the plans, and to the lines and grades established by the Engineer, by the removal of existing material or addition of acceptable material. All unstable or otherwise objectionable material shall be removed from the subgrade and replaced with acceptable material. All holes, ruts, and depressions shall be filled with acceptable material. The surface of the subgrade shall be finished to the lines and grades as established and be in conformity with the typical sections shown on the plans. Any deviation in excess of one-half inch (1/2") in cross section, and in a length of sixteen feet (16'), measured longitudinally, shall be corrected by loosening, adding, or removing material, reshaping and compacting by sprinkling and rolling. Sufficient subgrade shall be prepared in advance to insure satisfactory prosecution of the work.

C. Excavation, Trenching and Backfill for Piping

1. All excavation, trenching and backfilling for pipe trenches shall conform to SAWS Specification Item No. 804 “Excavation, Trenching, and Backfill.”

3.04 UNAUTHORIZED EXCAVATION

All excavation outside the lines and grades shown, and which is not in conformance with the plans and specifications as determined by the Testing Laboratory, together with the removal and disposal of the associated material shall be at the CONTRACTOR's expense. The unauthorized excavation shall be filled and compacted as specified by the Testing Laboratory, with backfill in accordance with this Section by the CONTRACTOR at his expense.

3.05 PLACEMENT OF FILL, BACKFILL, AND SELECT BACKFILL

A. General

1. All select backfill, backfill and fill required for structures and pavements are required to be provided to the finished grades shown and as described herein shall be furnished, placed, and compacted by the CONTRACTOR.
2. Backfill excavations as promptly as work permits, but not until completion of the following:
   a. Observation by the Engineer of construction below finish grade.
   b. Observation, testing and recording of locations of underground piping and ductwork.
   c. Removal of concrete formwork.
   d. Removal of shoring and bracing, and backfilling of voids with satisfactory materials.
   e. Removal of trash and debris.
   f. Backfill against foundation walls, only after review by the Engineer. Do not damage waterproofing when placing backfill.
3. Fill containing organic materials or other unacceptable materials shall be removed and replaced with acceptable fill material.

B. Placement of Fill Materials, Backfill, and Select Backfill.

1. Placement of Fill, Backfill, and Select Backfill shall be in accordance with the Owner and SAWS guidelines.
2. Material shall be placed to the grades shown on the Drawings.

3. Backfill around and outside of structures and over select backfill shall be deposited in layers not to exceed eight inches (8") in uncompacted thickness and mechanically compacted, using platform type tampers. Compaction of structural backfill by rolling will be permitted provided the desired compaction is obtained and damage to the structure is prevented. Compaction of select backfill and/or backfill by inundation with water will not be permitted. All materials shall be deposited as specified herein and as shown on the Drawings.
4. No material shall be placed when free water is standing on the surface of the area where the material is to be placed. No compaction of material will be permitted with free water on any portion of the material to be compacted. No material shall be placed or compacted in a frozen condition or on top of frozen material. Any material containing organic materials or other unacceptable material previously described shall be removed and replaced with acceptable material prior to compaction.
5. Compaction shall be performed with equipment suitable for the type of material being placed. The contractor shall select equipment which can provide the minimum density required by these Specifications. The gross weight of compacting equipment shall not exceed 7,000 pounds within ten feet (10') from the wall of any existing structure or completed structure under this contract. Equipment shall be provided that can compact in restricted areas next to structures and around piping. The effectiveness of the equipment selected by the CONTRACTOR shall be tested at the commencement of compacted material work by construction of a small section of material within the area where material is to be placed. If tests on this section of backfill show that the specified compaction is not obtained, the CONTRACTOR shall increase the number of coverages, decrease the lift thicknesses, or obtain a different type of compactor.
6. Care shall be taken to compact structural backfill which will be beneath pipes, roads, or other surface construction or structures. In addition, wherever a trench passes through structure backfill, the structure backfill shall be placed and compacted to an elevation twelve inches (12") above the top of the pipe before the trench is excavated. Compacted areas, in each case, shall be adequate to support the item to be constructed or placed thereon.

C. Backfill in Pipe Trenches

1. All pipe trenches shall be excavated, prepared, and backfilled in accordance with SAWS Specification Item No. 804 Excavation, Trenching, and Backfilling.
2. Pipeline trenches may be backfilled prior to pressure testing but no structure shall be constructed over any pipeline until it has been tested.
3. The method of compaction and the equipment used shall be appropriate for the material to be compacted and shall not transmit damaging shocks to the pipe.

D. Compaction Density Requirements

1. Compaction, moisture conditioning and testing required for all non-pipeline trench types of fills shall be in accordance with Bexar County guidelines.
2. Compaction, moisture conditioning and testing for pipe trench backfilling, and backfilling around the wetwell shall be in accordance with SAWS Specification Item No. 804 Excavation, Trenching, and Backfilling.

3.06 FINAL GRADING AND EMBANKMENTS

A. To the extent available, backfill material from excavations shall be placed in accordance with this Section to final grades with a minimum compacted depth of twelve inches (12").

B. After other outside work has been finished, and backfilling and embankments completed and settled, all areas on the site of the work which are to be graded shall be brought to a subgrade suitable with the indicated elevations, slopes, and grades with suitable excess excavation material. Final grades shall be within 0.1 foot of the finished grades shown on the Drawings.

END OF SECTION

SECTION 02222

CONSTRUCTION BEST MANAGEMENT PRACTICES AND SEDIMENT AND EROSION CONTROL MEASURES

PART 1 - GENERAL

1.01 SUMMARY

A. A TPDES Stormwater Pollution Plan shall be prepared by the CONTRACTOR.

B. CONTRACTOR shall furnish all labor, materials, equipment, and incidentals as shown, specified and necessary to complete the work required for compliance with the TPDES Storm Water Regulations and any other related State, County or local requirements.

C. As a condition of the award of the Contract, the CONTRACTOR will be required to sign and submit a Certification as shown below:

"I certify under penalty of law that this document was prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, and accurate, and complete. I am aware there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

END OF SECTION

SECTION 09 80 50
PAINTING

1.0 GENERAL

1.1 WORK INCLUDED

A. Furnish labor, materials, equipment and incidentals necessary to apply protective coatings to material and equipment as specified herein, including the preparation of surfaces prior to application of coatings.

B. Protective coatings shall be applied to the following surfaces:

1. Proposed, above grade, interior and exterior piping and valves and modifications to existing groundwater storage tank.

C. The following shall not be coated and shall be protected from drips, overspray, etc. unless indicated otherwise

1. Stainless steel piping, materials and equipment
2. Galvanized steel piping, materials and equipment
3. Aluminum materials and equipment
4. Safety climb devices

D. Contain, treat, and dispose of any dust, spray, drainage, or spillage resulting from coating operations. It shall be the Contractor's responsibility to determine if the materials to be disposed of are classified as Hazardous Waste. Disposal of waste, hazardous or otherwise, shall be in accordance with applicable regulations. The Contractor shall be aware of and understand the regulations concerning disposal of waste generated by coating operations.

1.2 QUALITY ASSURANCE

A. Acceptable Manufacturers: Products which comply with the Contract Documents and are manufactured by the following companies will be acceptable. Products from other coating manufacturers shall not be submitted and will not be considered.

1. Tnemec Company, Inc.
2. Carboline.
3. The Sherwin-Williams Company.
4. PPG Industries.

B. Applicator's Qualifications: Applicators must be qualified in this line of work and have a minimum of 5 years' experience in the application of the protective coatings of the types specified herein. At the request of the ENGINEER submit a list of recent projects and names of references for those projects.

C. Applicator's Superintendent/Foreman shall have a minimum of 10 years' experience with installation of new piping and valves. Superintendent/Foreman shall be onsite at all times while work indicated within this specification is underway. At the request of the ENGINEER submit a list of recent projects and names of references for those projects.

D. The Contractor shall provide workers who perform professional and quality work and who

are experienced and knowledgeable in surface preparation, mixing and application of high performance coating systems, including 100% solids coatings.

E. The Contractor's painters that will be applying the 100% solids coating for this project must be trained and certified by the Coatings Manufacturer for the application of the 100% solids coatings. Certification shall occur at the project site, at the location where the coatings will be used and in the presence of the Owner's representative. Any new employees added to the crew will need to be certified separately per this procedure.

F. Product Quality:

1. Use only the coatings specified in this Section. Use only those thinners and solvents recommended by the manufacturer, only in the amounts necessary to produce the manufacturer's recommended spreading rate, and in amounts not exceeding the maximum quantities stated in the manufacturer's literature.

2. The coating material shall not show excessive settling in a freshly opened full can and shall be easily re-dispersed with a paddle to a smooth, homogeneous state. It shall show no curdling, livering, caking, or color separation and shall be free of lumps or skim surfaces.

G. Testing: Protective coatings shall be applied under quality control procedures, which include inspection of surface preparation and for each coat applied. Do not proceed with the next step until the Inspector/Engineer has approved the previous step. The Contractor shall be solely responsible for testing for this specification, at no further cost to the Owner. The Owner's Representative shall also make such tests, if it is considered necessary. Cooperate with the Owner, providing equipment, and other equipment as requested by the Owner's Representative.

H. Testing Equipment: Furnish the testing apparatus necessary for testing coatings, including the following:

1. One set of U.S. Department of Commerce thickness calibration plates, certified by the National Bureau of Standards, to test dry film thickness.

2. Wet-film thickness gauges. Provide two to Owner's Representative. Each painter shall keep one to test paint as it is applied.

3. One dry-film thickness gauge, Mikrotest III, 0 - 40 mils with calibration standard approved by the Bureau of Standards.

I. The Contractor shall schedule a construction conference prior to any field work being completed. The meeting will be onsite and will include the Owner, Contractor, painting superintendent, Engineer, Owner's Representative and Coating Manufacturer's Representative. At this meeting the coating plan and schedule will be reviewed in detail.

1.3 FIELD QUALITY CONTROL

A. Wet Film and Dry Film Thickness Testing

1. Provide wet film tests during painting operations to assure proper thicknesses of coating are being applied.

2. After each coat has been applied, test the paint film thickness with a nondestructive, magnetic type thickness gauge.

3. The total dry-film thickness for each coat shall be tested and be in conformance with SSPC-PA-2 with a Type 2 Electronic Gauge. Apply additional coats until the specified thickness is reached or exceeded.

B. All work, including observations, shall be recorded daily by the Contractor. A copy of each daily report/log shall be placed in a file kept on the job site and submitted to the Owner at the end of each day. The reports shall include the following:

1. Date
2. Project Manager's Name
3. Contractor and Subcontractor name (where applicable)
4. Contractor's and or Owner's Representatives name (where applicable)
5. Project Name
6. Work Identification including:
    a. Type of work performed
    b. Location of work performed, indicated on generalized drawings, drawings shall include estimated ft^2 area blasted and/or painted and approximate percentage of total ft^2 area of surface being prepared and painted. Generalized drawings shall include:
        a. Plan view
        b. Profile view
        c. Plate location
        d. North arrow
        e. Any other drawings that will help to indicate location of work performed.
7. Time of day each portion of the work was started and finished.
8. Weather conditions, including corresponding time of day, before during and after work begins including:
    a. Temperature (air and surface)
    b. Humidity/dew point
    c. Wind velocity/direction
    d. Remarks and results of work
9. QC results for completed work, including:
    a. Compressed air blotter test performed at the start of each day and every four hours per ASTM D 4285.
    b. Surface preparation visual checks.
    c. Profile checks utilizing replica tape.
    d. Documentation of DFT's and areas tested per SSPC PA-2, Type 2 Gauge.
    e. Locations of holidays, repairs and touchups required, including documentation of the repair completion.
10. Contractor signature

C. Owner's Representative Field Quality Assurance Coordination

Contractor shall provide a schedule for anticipated coating and blasting processes. Contractor shall notify the Owner's Representative at least seven (7) days prior to any required inspections and confirmed twenty-four (24) hours prior to inspection. Prior to scheduling an

inspection, Contractor is responsible for reviewing work and verifying it is ready for inspection.

D. Field Quality Assurance

1. Observations shall be conducted by the Owner's Representative and a third party inspection company retained by the Owner. Final observations shall be performed in the presence of the Owner or their Representative and the Contractor's superintendent. All materials and equipment used in the accomplishment of testing are subject to observation at any time by the Owner's Representative. Periodic observation times will be agreed upon by the Owner's Representative and Contractor, and approved by the Owner.
2. The Owner may conduct the tests and observations to verify the Coating Manufacturer's data. If the coating testing results fall below the test requirements or visual observation, the Owner reserves the right to have the Contractor change coating materials and/or Coating Manufacturers to a coating that will meet all the stated requirements in this Specification.
3. All steps of the coating system will be subject to observation prior to progression to succeeding steps. Phases of observation shall include, but not limited to:
    a. Pre-cleaning (before surface preparation) survey of facilities to be primed.
    b. During surface preparation and prior to coating application.
    c. During and immediately after each coating application.
    d. Final coating observation.
    e. Substantial Completion / Pre-disinfection.
4. The Contractor shall not move or remove scaffolding, ladders or other fixtures necessary to provide proper observation until such work has been observed and approved by the Owner's Representative.
5. Any work found to be deficient, damaged, or otherwise unacceptable shall be repaired in accordance with the Coating Manufacturer's latest written repair recommendations at no additional cost to the Owner.
6. Owner's Representative will make every attempt to minimize damage to newly coated areas during observation activities, but any damage caused, regardless of by whom, shall be repaired by the Contractor at no additional cost to the Owner.
7. Observation and/or acceptance of Contractor's work by Owner's Representative(s) in no way releases Contractor from any of the terms and conditions of the Contract Agreement.
8. The following test and observations will be performed during coating operations:
    a. Surfaces of all steel shall first be cleaned and observed by the Contractor's Superintendent to ensure that all grease, oil, and other foreign materials have been removed before coating. Any area found to be improperly cleaned, shall be redone to the Owner's Representative's satisfaction. Final surface preparation shall be as outlined in SSPC-SP1 through SP11 as specified. Prior to observation of all interior and exterior surfaces by Owner's Representative, Contractor's Superintendent shall observe and confirm readiness for inspection.
    b. The pattern depth of the abrasive blasted surface shall be as specified by the Coating Manufacturer's written surface profile recommendations. The profile shall be measured by a Testex Replica Tape. SSPC-VIS 1 and/or SSPC-VIS 3 shall serve as guides and in arbitration to determine the degree of surface preparation.

c. Before and/or during blasting and coating operations, a field observation and possibly a field test of ventilation flow-rates may be performed by the Owner to verify that the ventilation requirements are being provided.

d. Measurement of the dry film thickness shall be made in accordance with SSPC-PA2, Coating Thickness Restriction Level 2, with a Type 2 Electronic Gauge. Measurements of the actual dry film thickness of the various coating layers applied shall be made by the Owner's Representative with assistance from the Contractor. Final film thickness measurements shall be made at such locations as designated by the Owner and/or Owner's Representative.

e. Holiday testing shall be conducted by the Contractor and observed by the Owner's Representative. At a minimum, holiday testing shall include the affected area of the Work and the tank floor.

f. All coatings submitted shall pass a 7-day chemical spot test to the following chemicals with no cracking, blistering or delamination.

a. 1,1,1 Trichloroethane

b. Methyl Ethyl Keytone (MK)

c. Ethanol

9. On days when blasting and/or coating is being performed, the Owner's Representative shall monitor and record ambient climatic conditions, as follows:

a. Air temperature, steel surface temperature, humidity and dew point shall be measured and recorded by the Contractor prior to beginning of blasting and prior to application of coating, daily.

b. Surface temperature shall be measured using a surface thermometer.

c. The dew point shall be measured by use of a sling psychrometer in conjunction with U.S. Department of Commerce Weather Bureau Psychometric Tables.

10. The Owner's Representative shall use a form approved by the Owner for recording this data. The completed forms shall be kept on the job site at all times from the time surface preparation is initiated until the coating system is complete. The forms shall be submitted as record data on a weekly basis until coating is complete.

1.4 SUBMITTALS

A. Submittals shall be in accordance with the General Conditions.

B. The following Record Data is due prior to ordering the materials:

1. Products and Manufacturer's Information:

a. Coating Manufacturer's color selection literature for coating materials and caulk.

b. Sample warranty document for products.

c. Provide certification from the manufacturer that all coatings will not contain more than 0.06% by weight of lead in the cured coating for each coat applied.

d. Coating Manufacturer's Product Information and Safety Data Sheets (SDS) for each coating and caulk material. Product Information shall include the following:

1) The Manufacturer's published instructions for use in specifying and applying all proposed coatings.

2) Application instructions written and published by the Coating Manufacturer.

3) Documentation of Coating Manufacturer approved geotextile fabric and backer rod to be used in accordance with Section 3.04.

4) All limitations, precautions and requirements that may adversely affect the coating, that may cause unsatisfactory results after the application or that may cause the coating not to serve the purpose for which it was intended, shall be clearly and completely stated in the instructions. Limitations and requirements shall include, but are not necessarily limited to the following:

a) Surface preparation

b) Method(s) of application

c) Thickness of each coat (maximum and minimum DFT)

d) Drying and curing time of each coat. These must include a graduated scale or curve, produced by the Coating Manufacturer, with curing characteristics and recommendations specific to the recoat window and cure times over the range of application temperatures approved by the manufacturer.

e) Time (minimum and maximum) allowed between coats

f) Thinner and use of thinner

g) Proper mixing of coating before application

h) Weather limitations during and after application (temperature and humidity, time weighted)

i) Physical properties of coating, including percent solids content by volume

j) Equipment settings (air cap, fluid tip, equipment pressure settings, etc.)

k) Pot life at various temperature and humidity conditions.

C. The following Samples are required prior to ordering the materials:

Three (3) samples of selected coating colors for approval on 6” x 6” swatches. Label each swatch with the manufacturer’s name, coating name/type, color name and number.

D. The following Record Data is required prior to coating work:

1. Coating Plan:

a. Anticipated coating process schedule by date, including dates when hold-point inspections are anticipated. Schedule shall indicate detailed activities on a daily basis.

b. Detailed procedures and schedule for all pre-cleaning, surface preparation and application of coating, including touch-up and repair procedures for all coating systems.

c. Recoat schedule on the submitted coating materials.

d. Data sheets complete with a graduated scale or curve, produced by the Coating Manufacturer, with curing characteristics and recommendations regarding complete coating curing. The data sheets and scales or curves shall include specific cure times over a wide range of temperatures and humidity.

e. Provide a written plan documenting how spent cleaning debris and/or paint over spray or droplets will be contained/confined to the jobsite during the surface preparation and coating application operations. Reasonable care shall be exercised by the Contractor to prevent damage, nuisance, or hazardous conditions to adjacent

or nearby property Owners. Include all materials and method to be used for protection of exterior surfaces, and allow for recovery and disposal of paint scraps and blast media.

f. Provide written plan documenting how paint and/or abrasive damage to automobiles and property will be addressed, including a process for quick removal of the paint or abrasive, and how the work will be accomplished. (This shall not relieve the Contractor from the responsibility of setting claims for damage, but is intended to expedite and minimize said claims.)

2. Provide documentation on proposed containment system for blasting and coating operations.

3. Provide documentation on heating, dehumidification and ventilation and filtration systems for each application, including but not limited to the exterior shrouding and work in the groundwater storage tank:

   a. Site layout for equipment

   b. Calculations for dehumidification and ventilation requirements

   c. Fans and their locations

   d. Dimensions of equipment

   e. Maximum capacities of equipment

   f. Emission control devices

   g. EMD- continuous electronic monitoring device

4. The Contractor shall submit evidence of notification of the appropriate office of the Texas Commission on Environmental Quality (TCEQ) prior to abrasive blasting as required. Submit copies of any obtained permits.

5. Coating Manifest - Within 48 hours of coating delivery to the job site, the Contractor shall record the batch number stamped on each coating container and submit a typed list to the Owner's Representative. Minimum information required is listed below.

   a. Date of delivery to job site

   b. Name and signature of Superintendent recording the data

   c. List of batch number including corresponding coating identification, color, date of manufacture and volume of each container.

6. Submit written inventory and documentation of locations of signs/nameplates/labels/pipe insulation, etc. by photograph.

E. The following Certified Test Report(s) are required prior to coating work:

1. Atomic absorption testing for lead, chromium, cadmium, and arsenic if recycled ferrous metal abrasives are to be used. Multiple tests may be required for shop and field blasting operations.

2. SDS sheets for all abrasives to be used on the project.

F. Provide the following Record Data during the construction of the project:

1. On a weekly basis, submit Contractor's Daily Reports.

2. Provide submittal for piping and valves coating record decal.

G. Provide the following materials to the Owner prior to final completion:

Liquid cleaner for removal of graffiti from treated surfaces.

1.5 STANDARDS

A. The applicable provisions of the following standards shall apply as if written here in their entirety. Adhere to the latest standards and codes published by the following organizations.

1. ANSI (American National Standards Institute)

ANSI/NSF Standard 61	Drinking Water Components
ANSI A13.1	Scheme for Identification of Piping Systems
ANSI Z535.1	Safety Color Code

2. ASTM (American Society for Testing and Materials)

ASTM D 16	Terminology for Paint, Related Coatings, Materials and Applications.
ASTM D 2200	Pictoral Surface Preparation Standards for Painting Steel Surfaces.
ASTM D 4262	Testing Method for pH of Chemically Cleaned or Etched Concrete Surfaces.
ASTM D 4263	Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.
ASTM D 4541	Test Methods for Pull-Off Strength of Coatings Using Portable Adhesion-Testers.
ASTM E 329	Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.

3. Consumer Product Safety Act, Part 1303

4. NACE International (National Association of Corrosion Engineers)

NACE TPC2	Coating and Lining for Immersion Service: Chapter Safety, Chapter 2 Surface Preparation, Chapter 3 Curing, and Chapter 4 Inspection
NACE RP0178	Plastic Weld Comparator
NACE RP0188	Discontinuity (Holiday) Testing of Protective Coatings on Conductive Substrates
NACE RP0287	Field Measurement of Surface Profile of Abrasive Blast Cleaned Steel Surfaces Using a Replica Tape

5. OSHA (Occupational Safety & Health Administration)

1915.35 Standards - 29CFR	Painting

6. SSPC (Society for Protective Coatings)

SSPC-VIS 1	Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning
SSPC-VIS 3	Guide and Reference Photographs for Steel Surfaces Prepared by Power and Hand Tool Cleaning
SSPC Vol. 1	Good Painting Practices
SSPC-AB1	Mineral and Slag Abrasives

SSPC-AB2	Cleanliness of Recycled Ferrous Metallic Abrasives
SSPC-AB3	Ferrous Metallic Abrasives
SSPC-SP1	Solvent Cleaning
SSPC-SP2	Hand Tool Cleaning
SSPC-SP3	Power Tool Cleaning
SSPC-SP5	White Metal Blast Cleaning
SSPC-SP6	Commercial Blast Cleaning
SSPC-SP7	Brush - Off Blast Cleaning
SSPC-SP10	Near - White Metal Blast Cleaning
SSPC-SP11	Power Tool Cleaning to Bare Metal
SSPC-PA-1	Shop, Field and Maintenance Painting
SSPC-PA-2	Measurement of Dry Film Thickness with Magnetic Gages
SSPC-PA-3	Guide to Safety in Paint Application
SSPC-Guide 6 (CON)	Guide for Containing Surface Preparation Debris Generated During Paint Removal Operations
SSPC-Guide 12	Guide for Illumination of Industrial Painting
SSPC-VIS 4	Guide and Reference Photographs for Steel Surfaces Prepared by Waterjetting
SSPC-SP13	Surface Preparation of Concrete
SSPC-SP WJ-1	Low-Pressure Water Cleaning (LP WC) water performed at pressures less than 34 MPa (5,000 psig)
SSPC-SP WJ-2	High-Pressure Water Cleaning (HP WC) performed at pressures from 34 to 70 MPa (5,000 to 10,000 psig)
SSPC-SP WJ-3	High-Pressure Waterjetting (HP WJ) performed at pressures from 70 to 210 MPa (10,000 to 30,000 psig)
SSPC-SP WJ-4	Ultra High-Pressure Waterjetting (UHP WJ) performed at pressures greater than 210 MPa (30,000 psig)

7. Texas Commission on Environmental Quality (TCEQ)

30 TAC Chapter 290 Subchapter D	Rules and Regulations for Public Water Systems

B. In the event of a conflict between the published standards, codes, and this Section, the more stringent requirement shall govern.

1.6 DELIVERY AND STORAGE

A. Deliver coating products to the Site in original unopened containers, with manufacturer's label and batch number attached. Do not apply products until the Owner's field representative has approved the product for use.

B. Use one location at each site for the storage of coating products. Protect the floor from spills and other damage. Protect the products from extreme heat or cold. Keep containers covered. Keep the storage rooms clean of trash and debris. Dispose of oily or used rags daily. Take precautions to prevent fires. The storage of flammable liquids shall comply with the City, State, or other fire codes.

1.7 ENVIRONMENTAL CONTROL CONDITIONS:

A. Do not apply coatings under conditions that are unsuitable for the production of good results. Do not begin application of coatings in areas where other trades are working, or where construction activities result in airborne dust or other debris. Do not apply

coatings in conditions which do not conform to the recommendations of the coatings manufacturer.

B. Coatings shall only be applied when conditions fall within the parameters listed in the manufacturer's printed data.

C. Do not apply any coatings when weather conditions are unfavorable. In the event that climatic conditions are not conducive for best results, postpone application of coatings until conditions conform to the manufacturer's recommendations and the provisions of this Section.

D. Do not apply coatings to a wet or damp surface in wet or damp weather conditions, or when there is dust in the air. Surfaces exposed to direct sunlight shall be shaded by awnings or other protective devices while coatings are being applied. When necessary, provide temporary heating devices of a type that produces no fumes which will discolor the paint system.

E. Private residences and public areas exist within 500 feet of the project site. Emissions from abrasive blasting operations shall be controlled as required by TAC 30, Chapter 111, Subchapter A, Division 3.

F. Contractor shall comply with manufacturer's published requirements.

G. Working Conditions:

1. Provide adequate lighting at any location that coatings are being applied or testing is performed. Illumination shall be of sufficient intensity to achieve good results. Provide explosion-proof lighting when required.

2. Temporary ladders shall conform to applicable safety requirements. Provide ladders during testing procedures.

1.8 GUARANTEES

A. Protective coating shall be guaranteed for a period of 2 years from the date of the Owner's acceptance of the Project.

B. Coating Manufacturer shall issue to the Owner, 2-year warranty for materials.

C. A warranty inspection shall be conducted in the eleventh month following the project substantial completion date. Any defective work discovered at this date shall be corrected by the Contractor in accordance with the Contract Documents at no additional cost to the Owner. Other corrective measures may be required during the 2-year warranty period and the Owner may request corrective measures any time during the warranty period. Owner is only required to contact Contractor to initiate warranty work.

2.0 PRODUCTS

2.1 GENERAL COATING REQUIREMENTS

A. All coatings shall be free of heavy metals such as arsenic, barium, chromium, selenium, silver, lead, mercury and cadmium.

B. All coatings shall be applied in strict conformance with the Coating Manufacturer's published specifications and with this specification.

C. To insure coating compatibility, Contractor shall use products of a single Coating Manufacturer for all coatings, unless prior approvals are obtained in writing from the Owner and the Coating Manufacturer.

D. All materials shall be delivered to the job site in original sealed containers with the date of manufacture and batch number stamped thereon by the Coating Manufacturer. Materials shall be subject to random observations by the Owner's Representative at the job site.

E. No coating submitted or used on this project shall have a VOC (volatile organic content) in excess of 360 grams/liter or 3.0 lbs./gal.

Primers factory-applied shall be those specified. Notify manufacturers which shop prime coats will be required in order to be compatible with field-applied finish coats. Where equipment is purchased which has the manufacturer's standard primer or a factory finish which is other than as specified in this section, remove the factory-applied paint system or apply passivators or other special coatings as required to make the surface compatible with the finish coat specified.

2.2 COATING SCHEDULES

A. Interior/Exterior Equipment, Valves and Piping

1. Maximum and minimum DFT shall be per the supplied Coating Manufacturer's printed requirements and as required by this specification.
2. Finish Coat Colors:
   a. Potable water piping and valves - Pantone #284C
   b. Interior – glass lining (Porcelain Enamel) white
   c. Valve hand wheels – Red.
   d. Finish coat shall be high gloss.
3. Surface Preparation:
   a. Uncoated Pipe - NACE No. 3/SSPC-SP 6 – Commercial Blast Cleaning.
   b. Prime coat over shop applied primers: Prepare per the coating manufacturer's written directions.
   c. Existing Pipe and valves:
      1) Prior to surface preparation, Contractor must take an inventory and document the locations of signs/nameplates/labels/pipe insulation, etc. by photograph and replace items after coating operations are completed. Each photograph must be clearly labeled to define the location of each item. No surface preparation will be allowed prior to approval of inventory documentation.
      2) SSPC SP1 "Solvent Cleaning" – Solvent Clean and High-Pressure Water Wash prior to abrasive blasting or coating removal. All oil, grease and other contaminants must be completely removed prior to existing coating removal. Protect electrical, vents, equipment, motors, etc. from water, solvent and spray. Damage to equipment will be the Contractor's responsibility.
      3) SSPC-SP3 "Power Tool Cleaning" & SSPC-SP6 "Commercial Blast Cleaning" – Contractor to remove existing coatings by a combination of the methods indicated with vacuum attachments. Care around glands, electrical equipment, fittings, and other critical or fragile areas that may be damaged by abrasives must be cleaned by Method SP3. Alternative surface preparation methods must be approved by the Owner prior to use. Protect electrical, vents, equipment, motors, etc. from abrasives, debris, etc. Damage to equipment will be the Contractor's responsibility.

d. Surface profile shall be in accordance with coating manufacturer's printed requirements.

e. Weld profiles shall conform to NACE RP0178, Profile 'D'.

4. Application Method(s): Spray or brush. Brush shall be used for touch up and stripe coating.

5. Three-coat system to be one of the following and of the same Manufacturer of all other coating products used on this project:

a. Sherwin-Williams

Coat	Product	DFT (mils)	Color
Prime Coat:	Epoxy Mastic II	5 –10 mils	Aluminum
Stripe Coat:	Macropoxy 646		Beige
Intermediate Coat:	Macropoxy 646	5 – 10 mils	Beige
Finish Coat:	Hi-Solids Polyurethane	3 – 5 mils	Per 2.02.C.2
Minimum and Maximum DFT for System		13 – 25 mils	

b. Carboline

Coat	Product	DFT (mils)	Color
Prime Coat:	Carbomastic 15	4 – 6 mils	Aluminum
Stripe Coat:	Carboguard 60		Beige
Intermediate Coat:	Carboguard 60	4 – 6 mils	Beige
Finish Coat:	Carbothane 134HG	2 - 4 mils	Per 2.02.C.2
Minimum and Maximum DFT for System		10 – 16 mils	

c. PPG

Coat	Product	DFT (mils)	Color
Prime Coat:	Amerlock 2/400 AL	5 – 6 mils	Aluminum
Stripe Coat:			Beige
Intermediate Coat:	Amerlock 2/400	5 – 6 mils	Beige
Finish Coat:	Amercoat 450HS	2 – 3 mils	Per 2.02.C.2
Minimum and Maximum DFT for System		12 – 15 mils	

d. Tnemec

Coat	Product	DFT (mils)	Color
Prime Coat:	Chembuild Series 135	4 – 6 mils	Aluminum
Stripe Coat:	N69 Hi-Build Epoxoline II		Beige
Intermediate Coat:	N69 Hi-Build Epoxoline II	4 – 6 mils	Beige
Finish Coat:	1074 Endura-Shield II	2 - 5 mils	Per 2.02.C.2
Minimum and Maximum DFT for System		10 – 17 mils	

2.3 COLOR SELECTION

A. Contractor shall submit drawdowns for Owner's review and approval of final color selection

for all exterior coating systems.

B. Use a multi-color system coating for any surface receiving more than one coat. Each coat shall be tinted differently from the preceding coat in a manner that will allow the various coats to be easily distinguished. Colors shall generally be from light to dark shades, but the Contractor may have the option to select tint shades to insure coats will receive adequate coverage without bleeding or otherwise showing through the preceding coat.

C. Piping and equipment shall be color coded in accordance with the requirements of the Texas Commission on Environmental Quality (TCEQ) or as indicated above.

2.4 ABRASIVE MATERIALS

A. Expendable abrasives must meet the minimum requirements of SSPC-AB 1 and all abrasives shall meet the requirements of Class A for silica content (less than 1% crystalline silica by weight before blasting.)

B. The abrasive shall be free from contaminates, such as excessive fine particles, regulated heavy metals, paint, earth, oil, clay, moisture, or chlorides, which can cause premature coating failures.

C. The abrasive blasting of the interior surfaces shall be done with a commercially available, non-metallic, expendable abrasive or a re-usable abrasive (steel grit).

D. The abrasive blasting of the exterior surfaces shall be done by shrouded abrasive blasting with a commercially available, non-metallic, expendable abrasive, or vacuum blasting with a reusable abrasive (steel grit).

E. Abrasive materials used shall be non-carcinogenic when properly used, properly graded, be sharp, have proper angularity, and be clean and free of contaminants including lead, chromium, cadmium, arsenic, chlorides, dirt, oil, etc., such as steel grit or approved equal.

F. Steel grit used on this project shall meet SSPC-AB 3. Steel grit must be sampled before use by the Owner's Representative and the Contractor. Samples must be taken from every container. Contractor shall have the samples sent to a laboratory for atomic absorption testing for total lead, cadmium, chromium and arsenic. The steel grit shall not be used until the results of the atomic absorption testing are submitted to the Owner and indicate that the total lead levels are less than 1000 ppm (<0.1%). Test shall be used for abrasives used in both shop and field blasting.

G. The grade shall be of such size as to achieve an acceptable anchor pattern or surface profile as required by the Coating Manufacturer.

H. Silica sand shall not be used as a blast abrasive.

3.0 EXECUTION

3.1 GENERAL

A. All materials shall be handled and applied in accordance with the Coating Manufacturer's recommendations.

B. All coating material for the exterior topcoat shall be mixed from one batch number. Batching should occur so that the shelf life extends beyond the end of the project.

C. All blasting and coating equipment shall be in first class condition and comply with all recommendations of the Coating Manufacturer and these specifications. The Owner reserves the right to have the Contractor immediately repair, modify or remove equipment functioning poorly or creating a nuisance as determined by the Owner.

D. Do not apply any coating to machinery, piping, or other surfaces before testing has been completed and systems approved. Any damage to coatings resulting from subsequent corrective procedures shall be stripped back to bare metal and repainted with the appropriate paint system as directed by the Owner.

E. Surfaces which will be inaccessible after installation shall be coated prior to installation, or shall be coated and approved in stages as the work is installed.

F. At least seven (7) days shall be allowed for drying of finished surfaces before any machinery can be placed into service.

G. Do not apply coating over nameplates or other identification plaques. Mask such plates and keep protected. Remove tape and polish nameplates after painting is complete.

H. Coating application procedures shall conform to the standards of craftsmanship as discussed in the Steel Structures Painting Manual, Volume 1 "Good Painting Practice".

I. All thinning shall be as per the Coating Manufacturer's recommendations. Use only those thinners expressly approved by the Manufacturer for the coatings used on this project. All thinners used with interior surface coatings shall be those tested and approved by NSF in conjunction with the NSF approved coating materials. Do not allow thinners to be stored in unmarked containers at any time.

J. Proper illumination equipment shall be provided by the Contractor in accordance with SSPC Guide 12. Explosion-proof lights and electrical equipment shall be provided. Whenever required by the Owner's Representative and/or Owner, the Contractor shall provide additional illumination and necessary supports to cover all areas to be inspected. The level of illumination for inspection purposes shall be determined by the Owner's Representative or Owner. Project lighting shall not interfere with existing residences or schools. Complaints from adjacent residential neighbors or school administration shall require Contractor to modify lighting plan to aleve complaint. Project lighting is considered subsidiary work relating to various bid items of the Contract.

K. The Owners Representative shall approve surfaces for application of coatings at each stage. Any material that is coated prior to the Owner's approval shall be stripped back to bear metal and repainted.

L. Cleaning and coating shall be scheduled such that dust and other materials from adjoining work will not contaminate wet or newly coated surfaces.

3.2 PREPARATION

A. Shop Surface Preparation

Clean and degrease surfaces prior to abrasive blasting per SSPC-SP 1. Proposed method shall be documented in the coating plan. Prepare surfaces by abrasive blasting as specified and apply shop prime coat. Shop primed steel plates shall not have primer extended within 4-inches along all edges to be welded. All primer within 4-inches of an area to be welded shall be removed prior to welding. Welding of painted services will not be allowed.

B. Field Surface Preparation

After erection and prior to touch-up priming, remove all surface contamination including dirt, dust, oil, and other foreign matter per SSPC-SP 1. All weld slag, spatter, rough welds and other sharp or rough areas shall be removed. All rusted, abraded and unpainted areas shall be abrasive blast cleaned as specified. Touch up prime coat with primer as specified.

C. All applicable equipment shall be electrically grounded as required and shall have clean operating gauges, moisture traps, etc.

D. Effective oil and water separators combined with after coolers or deliquescent dryers shall be used in compressed air lines serving abrasive blasting operations to remove detrimental oil and moisture from the air. Compressors may be tested periodically by the Owner's Representative for oil and water contamination of compressed air per ASTM D 4285. All compressor units found to produce unacceptable amounts of oil and or water shall be replaced with a compressor that is acceptable.

E. If the following conditions exist or are prevalent, surface preparation and coating shall be delayed or postponed until conditions are favorable. Each day's coating shall be completed in time to permit the film sufficient drying time prior to damage by atmospheric conditions or changes. No surface preparation shall begin or coating applied:

1. When the surface, air or material is below or above the Manufacturer's printed instructions.
2. When surfaces are wet or damp.
3. During weather conditions of rain, snow, fog or mist.
4. When the air and steel temperature is less-than or equal to 5° F above the dew point temperature.
5. If the relative humidity is above 85%.
6. When it is expected that the air and/or surface temperature will be below or above the Coating Manufacturer's recommended temperatures within four (4) hours after applications of coating, minimum. Coating manufacturer may require additional time between application and temperature and weather changes.

F. All pre-assembled shop primed items shall be prepared in accordance with these specifications and inspected by the Owner's Representative before and after priming.

G. For both immersion and non-immersion service, all burrs, sharp edges, corners, welds and general rough areas shall be ground smooth to a rounded contour and all weld splatter shall be removed prior to abrasive blasting.

H. Abrasive Blasting

1. Shrouding or recovery of all blast material will be mandatory during all exterior blasting.

   All work shall be performed in accordance with these regulations and are hereby made part of this specification by reference. Questions and information regarding these regulations should be addressed to:

   Texas Commission on Environmental Quality
   P.O. Box 13087
   Austin, Texas 78711-3087
   (512) 908-1000

2. The Contractor shall contain all waste and process discharge in accordance with the accepted methods for the process and materials that are in abatement.
3. Air filtration/dust collectors shall be used in conjunction with the dehumidification and/or ventilation equipment during blasting operations.
4. Where abrasive blast cleaning will not remove or properly prepare metal surfaces, hand and/or power tool cleaning shall be used to remove such conditions as weld splatter, laminations and radius-sharp edges. Hand tool or power tool shall be used on areas less than two (2) foot diameter or smaller.
5. All abrasive blast equipment shall be equipped with, including but not limited to the

following:

a. Noise reducing devices

b. Hose coupling safety devices

c. Electrical grounding devices

d. Moisture traps and filters

e. Fresh air hoods for all blasters

f. ”Dead Man” switches on all blast hoses

g. Air Dryers

I. The adequacy of the preparation of surfaces shall be determined by comparing the surface with SSPC VIS 1, SSPC VIS 3 and NACE RP0178.

3.3 APPLICATION

A. After abrasive blast cleaning, dust and spent abrasive shall be removed from the surfaces by air blasting and brush sweeping. The prime coat shall be applied as soon as possible after the blasting and surface cleaning is completed, inspected and approved by the Inspector.

B. Blasted surfaces shall be coated before rust forms on the surface. All blasted surfaces shall be coated to within 6 inches of the edge of a blasted area. No visible rust shall be coated under any circumstances, including rust bloom or if discoloration has occurred, regardless of elapsed time between blasting and coating.

C. Provide mist coat as recommended by the Coating Manufacturer.

The Contractor shall apply each coat at the rate and in the manner specified by the Coating Manufacturer, except as may be modified herein. If material has thickened or must be diluted for application, coating shall be built up to the same dry film thickness as specified for each coat of the complete system.

D. No coating shall be used which has an expired shelf or pot life.

E. Coating shall be applied by skilled workmen and shall be brushed out or sprayed evenly, without runs, crazing, sags, or other blemishes.

F. Sand between coats to remove over spray and dry fall.

G. Apply the first coat to the surface, including cutting in around edges, before the second coat is applied. The second coat and any successive coats shall not to be applied before notifying the Owner’s field representative and obtaining approval. Each coat shall be tested before the successive coat is applied.

H. The coating curing period shall be adjusted to compensate for less than adequate weather conditions, as recommended by the Coating Manufacturer, for complete curing of the entire coating system. The full drying time recommended by the manufacturer shall be allowed.

I. Coating shall be continuous and shall be accomplished in an orderly manner to facilitate proper inspection control.

J. Where a roller or brush is used to apply the coating, additional coats may be necessary to achieve the recommended dry film thickness and/or to achieve total coverage of the underlying surface. Coated surfaces shall be totally free of all roller nap, roller marks, brush bristles and brush marks.

K. When using conventional coating spray equipment for coating operations, effective oil and water separators combined with after coolers or deliquescent dryers shall be used in

compressed air lines to remove detrimental oil and moisture from the air. Separators shall be placed as far as practical from the compressor. Compressors may be tested periodically by the Owner's Representative for oil and water contamination of compressed air. Testing shall follow ASTM D4285 "Standard Test Method of Indicating Oil and Water in Compressed Air". All compressor units found to produce unacceptable amounts of oil and or water, as determined by results of ASTM D4285 test data and interpretation of data by the Owner's Representative shall be replaced with a compressor that is acceptable.

L. Protect adjacent materials from damage, including over spray or spillage. Provide drop cloths or other protective tarps to cover floors, equipment or other adjacent materials.

3.4 STRIPE COAT

A. Stipe coat shall be applied by brush and thinned according to written Coating Manufacturer's recommendations and applied to all welds, weld seams, tack welds (new and old), edges, bolts, rivets, ladder rails and rungs, seamed corners, joints of any kind and locations where brackets, lugs and other difficult to coat surfaces exist. Stripe coat on all welds and weld seams shall extend two (2) inches minimum above, below and beyond all welded sections.

B. Stripe coat shall occur in coating system layering as stated in Coating Schedule.

C. Stripe coat is accomplished by moving the brush back and forth in a scrubbing motion working primer into all crevices. Stripe coat shall be performed with a high quality bristle brush using primer that has been thinned according to manufacturer's instructions. Bristles left on the surface shall be removed before the coating dries. If bristles are discovered after the coating has dried, the bristle shall be removed, the coating removed, and the area correctly re-coated at no additional cost to the Owner

D. Stripe coating shall be tinted such that it can be easily distinguished from the other coats.

3.5 FINISH COAT

All prime, intermediate and finish coats shall be inspected visually and shall be free of ALL sags, runs, bubbles, drips, waves, laps, unnecessary brush marks, over spray, environmental contaminants or other physical defects, including shadows, and be uniform in color, texture and gloss. All coatings shall be applied in a professional manner to achieve the specified dry film thickness (DFT) leaving a smooth and uniform coating. Sand between coats to remove over spray and dry fall.

3.6 PROTECTION OF EXISTING STRUCTURES

A. If, in the opinion of the Owner's Representative, modifications or repairs are necessary to the shroud or ground cover apparatus to provide improved containment of blasting or coating operations, blasting and coating operations shall stop until the Owner's Representative indicates to the Contractor that adequate repairs are complete.

B. The Contractor is responsible for complete cleanup of any and all areas contaminated by blast debris.

C. The Contractor is responsible for any and all damages to on-site facilities, residences, vehicles and/or public health, including any fines or penalties resulting from improper containment during blasting or coating.

D. If present at the site, all security equipment (light poles, camera poles, microwave beam poles, etc.) shall be protected by construction of temporary fences or barricades around aboveground devices. Four feet shall remain clear of construction materials and activities around all security equipment devices.

3.7 CLEAN AND ADJUST

A. Promptly remove trash and debris resulting from painting operation from the Site. Remove drop cloths, masking tapes and other protective coverings. Remove paint spills, splatters, overlap of paint from adjacent material and other defects. Spot paint nicks and other defects.

B. Remove paint containers and waste products. Thoroughly clean paint storage rooms, removing spilled paint from walls and floors.

END OF SECTION

SECTION 09 96 00.01

HIGH-PERFORMANCE COATINGS

1.00 GENERAL

1.01 WORK INCLUDED

A. Furnish labor, materials, equipment and incidentals necessary to apply protective coatings to material and equipment as specified herein, including the preparation of surfaces prior to application of coatings.

B. Protective coatings are special coatings to be used at specific locations or on specific surfaces as indicated herein and are complementary to the coating surfaces specified in Section 09 80 50 "Painting" in that every surface of every description, except those which are specifically noted not to receive a coating finish, must be covered by a paint system as specified in this Section or in Section 09 80 50 "Painting."

C. All exposed or above-grade piping shall be lined and coated with NSF 61 certified epoxy as specified in this Section and in SAWS Standard Specification 816: "Steel Pipe Installation" unless specifically specified otherwise.

D. All below-grade pressure reducing valve assembly piping shall be epoxy lined and polyurethane coated as specified in this Section unless specifically specified otherwise.

E. Protective coatings must be applied to the following surfaces:

1. Metal surfaces located outside of buildings and other structures anywhere on the Site.
2. New piping:
    a. Above-Grade Pressure Reducing Valve Assembly Piping
3. Concrete surfaces at the following locations:
    a. Concrete Equipment Pads and Supports.

F. The following must not be coated and must be protected from drips, overspray, etc. unless indicated otherwise

1. Stainless steel piping, materials and equipment
2. Galvanized steel piping, materials and equipment unless specifically indicated to be coated.
3. Interior electrical items

G. Special applications for painting include the following:

1. Buried pipe and valves must receive a shop applied protective coating as described in the appropriate Section of the Specifications.

H. Contain, treat, and dispose of any dust, spray, drainage, or spillage resulting from coating operations. It is the Contractor's responsibility to determine if the materials to be disposed of are classified as Hazardous Waste. Disposed of waste, hazardous or otherwise, must be in accordance with applicable regulations. Contractor must be aware of and understand the regulations concerning disposal of waste generated by coating operations.

1.02 QUALITY ASSURANCE

A. Acceptable Manufacturers: Products which comply with the Contract Documents and are

manufactured by the following companies will be acceptable:

1. The Sherwin-Williams Company
2. Tnemec Company, Inc.
3. PPG Paints
4. Carboline

B. It is desired that the paint products be furnished by as few manufacturers as possible to meet the requirements of the Specifications. Coating products of the same type must be supplied by the same manufacturer. Do not mix products from different sources.

C. Applicator's Qualifications: Applicators must be qualified in this line of work and have a minimum of 5 years of experience in the application of the protective coatings of the types specified herein. Submit a list of recent projects and names of references for those projects.

D. Product Quality:

1. Use only the coatings specified in this Section. Use only those thinners and solvents recommended by the manufacturer, only in the amounts necessary to produce the manufacturer's recommended spreading rate, and in amounts not exceeding the maximum quantities stated in the manufacturer's literature.
2. The coating material must not show excessive settling in a freshly opened full can and must be easily re-dispersed with a paddle to a smooth, homogeneous state. It must show no curdling, livering, caking, or color separation and must be free of lumps or skim surfaces.

E. Inspection:

1. Inspect and provide substrate surfaces prepared in accordance with the Contract Documents and the printed directions and recommendations of paint manufacturer whose product is to be applied.
2. The Contractor shall give the Owner Representative a minimum of 14 days advance notice of the start of any work to allow scheduling for shop or field observation. Provide Owner Representative a minimum 3 days' notice for actual start of surface preparation and coating application work.
3. Provisions shall be made to allow Owner's representative full access to facilities and appropriate documentation regarding coating application.
4. Observation by the Owner's representative or the waiver of observation of any particular portion of the work shall not be construed to relieve the Contractor of his responsibility to perform the work in accordance with these Specifications.
5. Contractor is solely responsible for testing for this Section, at no further cost to the Owner. Owner may also make such tests if it is considered necessary. Cooperate with the Owner, providing equipment, scaffolds, and other equipment as requested by the Owner.

F. Testing Equipment: Furnish the testing apparatus necessary for testing coatings, including the following:

1. One set of U.S. Department of Commerce thickness calibration plates, certified by the National Bureau of Standards, to test dry film thickness.
2. Wet-film thickness gauges. Give one to Owner's representative. Each painter must keep one to test paint as it is applied.

3. One electronic dry-film thickness gauge capable or measuring 0-200 mils with calibration standards approved by the Bureau of Standards.
4. One Elcometer 319 Dewpoint Meter or approved equal.
5. One Tinker and Rasor Model M 1 Holiday Detector and recommended wetting agent and/or High Voltage Holiday Detector if required for coating thickness specified. One set of SSPC-VIS 1, 3 and 4 - Visual Standards as applicable.

G. Testing Reports: Submit an inspection report for each coating applied on the Project. The testing report must be completed on a form furnished by the Owner and must bear the signature of the Contractor and the Owner's representative.

H. The Contractor must schedule a construction conference prior to any field work being completed. The meeting will be on-site and will include the Owner, Contractor, painting superintendent, Engineer, Owner's representative and coating manufacturer's representative. At this meeting the coating plan and schedule will be reviewed in detail.

1.03 SUBMITTALS

A. The following Product Data for products, including manufacturer's data sheets, are due prior to ordering coating and surface preparation materials:

1. Coating manufacturer's color selection literature for coating materials and caulk.
2. Sample warranty document for products.
3. Provide certification from the manufacturer that all coatings will not contain more than 0.06 percent by weight of lead in the cured coating for each coat applied.
4. Coating manufacturer's Product Information and Safety Data Sheets (SDS) for each coating and caulk material. Product Information must include the following:
   a. The manufacturer's published instructions for use in specifying and applying all proposed coatings.
   b. Application instructions written and published by the coating manufacturer.
   c. All limitations, precautions and requirements that may adversely affect the coating, that may cause unsatisfactory results after the application or that may cause the coating not to serve the purpose for which it was intended, must be clearly and completely stated in the instructions. Limitations and requirements must include, but are not necessarily limited to the following:
      1). Surface preparation.
      2). Method(s) of application.
      3). Thickness of each coat (maximum and minimum DFT).
      4). Drying and curing time of each coat.
      5). Time (minimum and maximum) allowed between coats.
      6). Thinner and use of thinner.
      7). Proper mixing of coating before application.
      8). Weather limitations during and after application (temperature and humidity, time weighted).
      9). Physical properties of coating, including percent solids content by volume.
      10). Equipment settings (air cap, fluid tip, equipment pressure settings, etc.).

11). Pot life at various temperature and humidity conditions.

B. The following samples are required prior to ordering the materials:

1. Three samples of selected exterior finish colors for approval on 6-inch by 6-inch swatches. Label each swatch with the manufacturer's name, coating name/type, color name and number.

C. The following Product Data is required prior to coating work:

1. Coating Plan:

a. Anticipated coating process schedule by date, including dates when hold-point inspections are anticipated. Schedule must indicate detailed activities on a daily basis.

b. Detailed procedures and schedule for all pre-cleaning, surface preparation and application of coating, including touch-up and repair procedures for all coating systems.

c. Recoat schedule on the submitted coating materials.

d. Data sheets complete with a graduated scale or curve, produced by the coating manufacturer, with curing characteristics and recommendations regarding complete coating curing. The data sheets and scales or curves must include specific cure times over a wide range of temperatures and humidity.

e. Provide a written plan documenting how spent cleaning debris and/or paint over spray or droplets will be contained/confined to the Site during the surface preparation and coating application operations. Reasonable care must be exercised by the Contractor to prevent damage, nuisance, or hazardous conditions to adjacent or nearby property Owners. Include all materials and method to be used for protection of exterior surfaces, and allow for recovery and disposal of paint scraps and blast media.

2. Provide documentation on proposed containment system methods for blasting and coating operations.

3. Contractor must submit evidence of notification of the appropriate office of the Texas Commission on Environmental Quality (TCEQ) prior to abrasive blasting as required. Submit copies of any obtained permits.

4. Coating Manifest - Within 48 hours of coating delivery to the Site, Contractor must record the batch number stamped on each coating container and submit a typed list to the Owner's representative. Minimum information required is listed below.

a. Date of delivery to the Site.

b. Name and signature of superintendent recording the data.

c. List of batch number including corresponding coating identification, color, date of manufacture and volume of each container.

D. The following Certified Test Report(s) are required prior to coating work:

1. SDS sheets for all abrasive to be used on the Project.

2. Certification and laboratory test results indicating recycled metallic abrasive per SSPC-AB 2 or 4 and atomic absorption test results.

1.04 STANDARDS

A. The applicable provisions of the following standards apply as if written here in their entirety. Adhere to the latest standards and codes published by the following organizations.

B. In the event of a conflict between the published standards, codes, and this Section, the more stringent requirement govern as interpreted by the Engineer.

1. NSF International (NSF) / American National Standards Institute (ANSI):

NSF/ANSI Standard 61	Drinking Water Components

2. ASTM International (ASTM):

ASTM D523	Standard Test Method for Specular Gloss
ASTM D610	Standard Test Method for Evaluating Degree of Rusting on Painted Steel Surfaces
ASTM D2244	Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates
ASTM D3359	Standard Test Methods for Rating Adhesion by Tape Test
ASTM D4214	Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films
ASTM D4263	Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
ASTM D4285	Standard Test Method of Indicating Oil and Water in Compressed Air
ASTM D417	Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel
ASTM D541	Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Tester
ASTM D4787	Standard Practice for Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates
ASTM D5162	Standard Practice for Discontinuity (Holiday) Testing of Nonconductive Protective Coating on Metallic Substrates
ASTM D6386	Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting
ASTM D7234	Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Pull-Off Adhesion Testers
ASTM E337	Standard Practice Test Method for Measuring Humidity with a Psychrometer (the Measurement of Wet- and Dry-Bulb Temperatures)
ASTM F1869	Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

3. AWWA (American Water Works Association):

AWWA C210	Liquid-Epoxy Coating and Linings for Steel Water Pipelines
AWWA C222	Polyurethane Coatings and Linings for Steel Water Pipe and Fittings

4. Consumer Product Safety Act, Part 1303.

5. International Concrete Repair Institute (ICRI):

ICRI Technical Guideline No. 03732	Selecting and Specifying Concrete Surface Preparation for Coatings, Sealers and Polymer Overlays

6. NACE International (National Association of Corrosion Engineers):

NACE TPC2	Coating and Lining for Immersion Service: Chapter Safety, Chapter 2 Surface Preparation, Chapter 3 Curing, and Chapter 4 Inspection
NACE SP0178	Design Fabrication, and Surface Finish Practices for Tanks and Vessels to be Lined for Immersion Service
NACE SP0188	Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates
NACE SP0178	Surface Finishing of Welds Prior to Coating; Weld Replica Only to be used with NACE SP0178
NACE RP0287	Field Measurement of Surface Profile of Abrasive Blast Cleaned Steel Surfaces Using a Replica Tape

7. National Association of Pipe Fabricators (NAPF):

NAPF 500-03	Surface Preparation Standard for Ductile Iron Pipe and Fittings in Exposed Locations Receiving Special External Coatings and/or Special Internal Linings

8. OSHA (Occupational Safety & Health Administration):

29 CFR 1915.35	Painting
29 CFR 1926.62	Lead

9. The Society for Protective Coatings (SSPC):

SSPC-VIS 1	Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning
SSPC-VIS 3	Guide and Reference Photographs for Steel Surfaces Prepared by Power and Hand Tool Cleaning
SSPC Vol. 1	Good Painting Practices
SSPC-AB 1	Mineral and Slag Abrasives
SSPC-AB 2	Cleanliness of Recycled Ferrous Metallic Abrasives
SSPC-AB 3	Ferrous Metallic Abrasives
SSPC-AB 4	Recyclable Encapsulated Abrasive Media in a Compressible Matrix
SSPC-SP 1	Solvent Cleaning
SSPC-SP 2	Hand Tool Cleaning
SSPC-SP 3	Power Tool Cleaning
SSPC-SP 11	Bare Metal Power Tool Cleaning
SSPC-PA 1	Shop, Field and Maintenance Painting of Steel
SSPC-PA 2	Determining Compliance to Required DFT
SSPC-PA 10	Guide to Safety and Health Requirements for Industrial Painting Projects
SSPC-PA 17	Procedure for Determining Conformance to Steel Profile/Surface Roughness/Peak Count Requirements

SSPC Guide 6 (CON)	Containment of Debris
SSPC Guide 12	Illumination of Painting Projects
SSPC Guide 15	Retrieval and Analysis of Soluble Salts

10. SSPC/NACE International Joint Standards:

SSPC-SP 5/NACE 1	White Metal Blast Cleaning
SSPC-SP 6/NACE 3	Commercial Blast Cleaning
SSPC-SP 7/NACE 4	Brush - Off Blast Cleaning
SSPC-SP 10/NACE 2	Near - White Metal Blast Cleaning
SSPC-SP 13/NACE 6	Surface Preparation of Concrete

11. Texas Commission on Environmental Quality (TCEQ):

30 TAC Chapter 290, Subchapter D	Rules and Regulations for Public Water Systems

1.05 DELIVERY AND STORAGE

A. Deliver coating products to the Site in original unopened containers, with manufacturer's label and batch number attached. Do not apply products until the Owner's field representative has approved the product for use.

B. Use one location at each site for the storage of coating products. Protect the floor from spills and other damage. Protect the products from extreme heat or cold. Keep containers covered. Keep the storage rooms clean of trash and debris. Dispose of oily or used rags daily. Under no circumstances will they be allowed to accumulate. Take precautions to prevent fires. The storage of flammable liquids must comply with the City, State, or other fire codes.

C. Storage of coatings and other products must be in accordance with the manufacturer's requirements. Coatings that have been damage or not stored properly must not be applied and must be removed from the Site.

D. All products and coatings that are not approved for the Project must be removed from the Site and must not be stored at the Site.

E. All materials must be delivered to the Site in original sealed containers with the date of manufacture and batch number stamped thereon by the coating manufacturer. Materials are subject to random observations by the Owner's representative at the Site.

1.06 ENVIRONMENTAL CONDITIONS

A. Do not apply coatings under conditions that are unsuitable for the production of good results. Remove trash and debris from enclosed buildings and thoroughly clean prior to application of coatings. Do not begin application of coatings in areas where other trades are working, or where construction activities result in airborne dust or other debris. Do not apply coatings in conditions which do not conform to the recommendations of the coatings manufacturer.

B. Coatings must only be applied when conditions fall within the parameters listed in the manufacturer's printed data.

C. Contractor must provide dehumidification equipment sized to maintain dew point temperature 5 deg. F or more below surface temperature of metal surfaces to be cleaned and painted.

D. Do not apply any coatings when weather conditions are unfavorable. In the event that climatic conditions are not conducive for best results, postpone application of coatings until conditions conform to the manufacturer's recommendations and the provisions of this Section.

E. Do not apply coatings to a wet or damp surface in wet or damp weather conditions, or when there is dust in the air. Surfaces exposed to direct sunlight must be shaded by awnings or other protective devices while coatings are being applied, if recommended by coating manufacturer. When necessary, provide temporary heating devices of a type that produces no fumes which will discolor the paint system.

F. Heating and Dehumidification:

1. Dehumidification equipment must be used to control the environment during surface preparation, rehabilitation, coating application and coating curing at no additional cost to the Owner, if acceptable environmental conditions cannot be met.

   If the Contractor cannot meet the required environmental conditions to apply the interior coating system per this Section and the coating manufacturer's written recommendations, Contractor will cease operations until approved dehumidification equipment has been provided and acceptable environmental conditions are achieved.

   If coating system is applied without dehumidification or in conditions not acceptable by this Section and by the coating manufacturer's written requirements, Contractor must fully remove coating system applied and replace per the Owner's direction.

2. The Contractor must furnish all labor, materials, equipment, fabrication and quality control inspections, and all other incidentals required to control and maintain the environment of the reservoir within the parameters stated in this Section and must incorporate these and any other expenses into its bid.

3. The Owner reserves the rights, in the event the dehumidification equipment is not performing to the minimum requirements stated in this Section, to require the Contractor to modify and or add additional equipment to satisfy the conditions of this Section, at the sole cost to the Contractor.

4. It is the Contractor's responsibility to provide adequate dehumidification equipment to meet the requirements of this Section and coating manufacturer's requirements. The coating manufacturer's limits of surface temperature, tank inside air temperature and relative humidity requirements will govern, if more stringent than the requirements stated within this Section.

G. Forced Ventilation:

1. Provide continuous forced fresh air ventilation when working inside of containment systems or enclosed areas that are not openly vented from the beginning of surface preparation through final coating operations and coating curing.

2. Forced ventilation must be supplied per the recoat time required by the coating manufacturer and at least 48 hours after the final coat has been applied.

3. From the beginning of interior wet and/or dry coating application and until this coating is cured, the Contractor must monitor the air for the lower explosion limit (LEL) as published in the coating manufacturer's product SDS's.

4. Contractor is responsible for supplying, installing and maintaining the forced ventilation system.

H. Containment System:

1. Contractor must provide containment methods, either full or partial, which allows for the containment of the environmentally sensitive waste, dust and paint over spray that will be generated during the abrasive blasting and painting operation.
2. Minimum Containment for Field Surface Preparation:
   a. Provide a minimum SSPC Guide 6 (CON) Class 2A containment system when dry abrasive blasting.
   b. Provide a minimum SSPC Guide 6 (CON) Class 2W containment system when wet abrasive blasting. All water must be contained and properly disposed of.
   c. Provide a minimum SSPC Guide 6 (CON) Class 2P.E3 containment system when power tool cleaning.
3. The ground surrounding the project area must be protected from all debris, emissions, dust, and other materials generated in the cleaning operations with a minimum of two layers of polyethylene covered with plywood or the same material used for the perimeter containment system.
4. Containment is not required when blasting on the interior of a completely enclosed area (i.e. roof is in place) as long as no visible emissions are created.
5. The Contractor must ensure that no spent cleaning/blasting debris, dust, overspray, coating droplets, or emissions of any kind, escape to the atmosphere, or to adjacent buildings, private property, work sites, parking lots, etc.
6. The Owner reserves the right to stop Work or require containment, additional containment or different containment methods if the Contractor's operations create a nuisance beyond the PRV site property line in the sole opinion of the Owner, the Engineer, the Owner's representative, any regulatory agency, or neighbor. All costs of providing an adequate containment system must be included by the Contractor in the Base Bid.
7. The Contractor must be responsible for all materials that are used and for any apparatus used to contain dust emissions, debris, overspray, and coating droplets. The containment system attachments to existing or proposed structures must be designed not to impose excessive loading on the structure by a professional engineer licensed in the state the Project is located. Contractor must submit the P.E. designed and sealed details of the containment system on the tank.

   Any damage to the structure(s) as a direct or indirect result of the containment system must be repaired or sections replaced by the Contractor at no additional cost to the Owner. Neither the Owner nor the Owner's Engineer assumes any responsibility for the structural ability of the structure to support the containment system.
8. If tarps are used as part of the containment system, the tarps must be an impervious, solid, flame-resistant material, reinforced with a fiber mesh and must allow as much light as possible to pass through the material.

I. Visible Emissions:

1. Contractor must control visible emissions and releases while dust producing activities are underway.

2. Visible emissions more than SSPC Guide 6, Level 1 (1 percent of the workday or 5 minutes in an 8-hour shift) are unacceptable. Sustained emissions of more than 1 minute, regardless of the total time of emissions for the day is unacceptable. If unacceptable emissions are observed, Contractor must shut down immediately and correct the situation and clean up any debris generated from the release to the satisfaction of the Owner before continuing the Work.

1.07 WORKING CONDITIONS

A. Provide adequate lighting at any location that coatings are being applied or testing is performed. Illumination must be of sufficient intensity to achieve good results. Provide explosion-proof lighting when required.

B. Temporary ladders and scaffolds must conform to applicable safety requirements. Erect temporary scaffolds where needed to cover large areas. Provide ladders or scaffolding during testing procedures.

1.08 WARRANTY/GUARANTEE

A. Protective coating must be guaranteed for a period of 2 years as per the requirements of the General Conditions.

B. A warranty inspection must be conducted prior to the end of the warranty period. Any Defective Work discovered at this date must be corrected by the Contractor in accordance with the Contract Documents at no additional cost to the Owner.

2.00 PRODUCTS

2.01 GENERAL COATING REQUIREMENTS

A. All coatings must be free of heavy metals such as arsenic, barium, chromium, selenium, silver, lead, mercury and cadmium.

B. All coatings in contact with potable water must be certified by the NSF Standard 61.

C. Coatings submitted or used on this Project must not have a VOC (volatile organic content) in excess of 360 grams per liter or 3 lb. per gal.

D. Finish coatings must be from the same batch.

2.02 MATERIALS

A. Coating products are to be as follows:

Type A - Alkyd-Phenolic Universal Primer	
Manufacturer	**Approved Coating**
Tnemec	Series 1 Purple Prime
Sherwin-Williams	Kem Kromik Universal
Akzo Nobel / International Paint, LLC	Interlac 573
Devoe Coatings	Devprime 1403
Carboline	Carbocoat 150UP
PPG	Multiprime 4360

Type B - Epoxy-Polyamide Primer	
Manufacturer	**Approved Coating**
Tnemec	Series 66
Sherwin-Williams	Copoxy Primer
Akzo Nobel / International Paint, LLC	Intergard 251; Intergard 269 for valves and gates, submerged structural steel and misc. metals, and submerged piping
Devoe Coatings	Devran 201V Series
Carboline	890
PPG	Amercoat 385

Type C - Penetrating Epoxy Pre-Primer	
Manufacturer	**Approved Coating**
Tnemec	Approved Equal
Sherwin-Williams	Macropoxy 920 Pre-Prime
Akzo Nobel / International Paint, LLC	Interbond 600
Devoe Coatings	Approved Equal
Carboline	Rustbond Penetrating Sealer
PPG	Amerlock Sealer

Type D - Inorganic Zinc Primer (Minimum 80% Zinc by Weight)	
Manufacturer	**Approved Coating**
Carboline	Carbozinc 12 VOC
Sherwin-Williams	Zinc Clad II Plus
PPG	Dimetcote 9 VOC
Approved Manufacturer	Approved Equal

Type E - Organic Zinc Primer (Minimum 80% Zinc by Weight)	
Manufacturer	**Approved Coating**
Carboline	Carbozinc 859
Sherwin-Williams	Corothane I Galvapac
PPG	Amercoat 68HS
Akzo Nobel / International Paint, LLC	Interzinc 52
Approved Manufacturer	Approved Equal

Type F - Alkyd Enamel	
Manufacturer	**Approved Coating**
Tnemec	Series 23 Enduratone
Sherwin-Williams	DTM Alkyd Enamel
Akzo Nobel / International Paint, LLC	Interlac 665
Devoe Coatings	Devlac 1431
Carboline	Carbocoat 8225
PPG	Fast Dry 35

Type G - Epoxy-Polyamide Coatings	
Manufacturer	**Approved Coating**
Tnemec	Series 66
Sherwin-Williams	Macropoxy 646 Epoxy
Akzo Nobel / International Paint, LLC	Intergurd 475HS; Interseal 670HS for valves and gates, PVC pipe and conduit, submerged structural steel and misc. metals, and submerged piping
Devoe Coatings	Bar-Rust 235
Carboline	Carboguard 60
PPG	Amerlock 385

Type H - Epoxy-Polyamide Coatings for Potable Water (NSF 61 Certified)	
Manufacturer	**Approved Coating**
Tnemec	Series N140 Pota-Pox Plus
Sherwin-Williams	Tank Clad Epoxy
Akzo Nobel / International Paint, LLC	Interline 850 or Interseal 670HS (NSF colors)
Devoe Coatings	Bar-Rust 233H Series
Carboline	Carboguard 61
PPG	Amerlock 2/400

Type I - Aliphatic Polyurethane Enamel	
Manufacturer	**Approved Coating**
Tnemec	Series 1074 Endura-Shield II
Sherwin-Williams	Hi-Solids Polyurethane
Akzo Nobel / International Paint, LLC	Interthane 990 Series
Devoe Coatings	Devthane 379 Series

Type I - Aliphatic Polyurethane Enamel	
Manufacturer	**Approved Coating**
Carboline	Carbothane 133HB (Satin) or Carbothane 134HG (High Gloss)
PPG	Pitthane Ultra Series

Type J - Silicone Aluminum Coatings For High Temperature	
Manufacturer	**Approved Coating**
Tnemec	Series 39 Silicon Aluminum
Sherwin-Williams	Silver Brite Aluminum B59S8
Akzo Nobel / International Paint, LLC	Intertherm 50 Series
Devoe Coatings	Intertherm 50 Series
PPG	Hi-Temp 500
Carboline	Carbozinc 11; Finish: Thermaline 4700 Series (up to 1000 deg. F); Thermaline 4900 (up to 450 deg. F)

Type K- Epoxy Concrete Coating	
Manufacturer	**Approved Coating**
Tnemec	Series 64H-413 Hi-Build Tneme-Tar
Sherwin-Williams	Tar Guard Epoxy
Akzo Nobel / International Paint, LLC	Interzone 954
Devoe Coatings	Devtar 5A Series
PPG	Amercoat 78HB Coal Tar Epoxy
Carboline	Bitumastic 300M

Type L – Vinyl Ester or Epoxy Concrete Coating - High Friction Surface (HFS)	
Manufacturer	**Approved Coating**
Tnemec	Serie G436 Perma-Shield / Chembloc Series 252SC
Sherwin Williams	Dura-Plate 8200 / Cor-Cote VEN FF
Akzo Nobel / International Paint, LLC	Ceilcote 380 / 242GF Flakeline System
PPG	6850 CS
Carboline	Protecto-Coat 100XT

Type M - High Solids Epoxy Siloxane	
Manufacturer	**Approved Coating**
Carboline	Carboxane 2000

Type M - High Solids Epoxy Siloxane	
Manufacturer	**Approved Coating**
Sherwin-Williams	Polysiloxane XLE-80
PPG	PSX 700 Polysiloxane
Approved Manufacturer	Approved Equal

Type N - Epoxy Mastic	
Manufacturer	**Approved Coating**
Carboline	Carbomastic 15
Sherwin-Williams	Epoxy Mastic II
PPG	Amerlock 2/400 AL
Tnemec	Chembuild Series 135
AkzoNobel/International Paint, LLC	Interseal 670HS

Type O - Elastomeric Polyurethane Hybrid	
Manufacturer	**Approved Coating**
Carboline	Reactamine 760 Series
Sherwin-Williams	Sherflex S
PPG	Amerthane 490
Tnemec	Elasto-Shield Series 406
AkzoNobel/International Paint, LLC	Polibrid 705E Elastomeric

Type P - Glass Flake Reinforced Epoxy	
Manufacturer	**Approved Coating**
Carboline	Approved Equal
Sherwin-Williams	Sher-Glass FF
PPG	Amerlock 2/400 GF
Tnemec	Approved Equal
AkzoNobel/International Paint, LLC	Approved Equal

Type Q - 100% Solids Epoxy for Wastewater	
Manufacturer	**Approved Coating**
Carboline	Plasite 4550-S Novolac Epoxy
Sherwin-Williams	Dura-Plate 6000 Amine Epoxy

Type Q - 100% Solids Epoxy for Wastewater	
Manufacturer	**Approved Coating**
PPG	Novaguard 890 or Novaguard 810 Novolac Epoxy
Tnemec	Perma-Glaze Series G435 Modified Polyamine Epoxy
AkzoNobel/International Paint, LLC	Approved Equal

Type R – Water-Based Epoxy Filler/Sealer	
Manufacturer	**Approved Coating**
Carboline	Sanitile 500 VOC
Sherwin-Williams	Approved Equal
PPG	Approved Equal
Tnemec	Approved Equal
AkzoNobel/International Paint, LLC	Approved Equal

Type S – Cross-Linked Water-Based Epoxy	
Manufacturer	**Approved Coating**
Carboline	Sanitile 555 VOC
Sherwin-Williams	Approved Equal
PPG	Approved Equal
Tnemec	Approved Equal
AkzoNobel/International Paint, LLC	Approved Equal

B. Petrolatum (Wax) Tape:

1. Petrolatum (wax) tape must be installed per the manufacturer's written recommendations. Provide all primers and appurtenant materials as required for installation per the recommendations.
2. Approved Manufacturers:
    a. Trenton Corp. - Trenton Primer and #1 Wax-tape
    b. Denso North America, Inc. - Denso Paste and Densyl Tape
    c. Approved equal.

2.03 COLOR SELECTION

A. The color chart must include the complete available range of colors, including tints and shades.

B. Use a multi-color system coating for any surface receiving more than one coat. Each coat must be tinted differently from the preceding coat in a manner that will allow the various coats to be easily distinguished. Colors must generally be from light to dark shades, but the Contractor may have the option to select tint shades to insure coats will receive adequate coverage without bleeding or otherwise showing through the preceding coat.

C. Piping and equipment must be color coded in accordance with the requirements of the TCEQ.

3.00 EXECUTION

3.01 GENERAL

A. All coatings must be applied in strict conformance with the coating manufacturer's published specifications, this Section, or as approved by the Engineer.

B. Surfaces which will be inaccessible after installation must be coated prior to installation, or must be coated and approved in stages as the Work is installed.

C. The Engineer will approve surfaces for application of coatings at each stage. Any material that is coated prior to the Engineer's approval will be stripped back to bare metal and repainted.

D. At least 7 days or as required by the coating manufacturer, must be allowed for drying of finished surfaces before any machinery can be placed into service.

E. The number of coats called for in this Section are considered the minimum required. If more coats are required for complete coverage and uniform appearance they must be provided at no additional cost to the Owner.

3.02 STEEL SURFACE PREPARATION

A. The adequacy of the preparation of steel surfaces will be determined by comparing the surface with SSPC-VIS 1 and SSPC-VIS 3. Prepare surfaces in accordance with the following requirements:

1. SSPC-SP 1 — Solvent Cleaning.
2. SSPC-SP 2 — Hand Tool Cleaning.
3. SSPC-SP 3 — Power Tool Cleaning.
4. SSPC-SP 5 / NACE 1 — White Metal Blast Cleaning.
5. SSPC-SP 6 / NACE 3 — Commercial Blast Cleaning.
6. SSPC-SP 7 / NACE 4 — Brush-Off Blast Cleaning.
7. SSPC-SP 10 / NACE 2 — Near-White Blast Cleaning.
8. SSPC-SP 11 — Power Tool Cleaning to Bare Metal.

B. The resulting surface profile must be in accordance with the coating manufacturer's recommendations.

C. "Solvent Cleaning" must be performed prior to subsequent surface preparation, including abrasive blast cleaning.

D. All sharp edges and welds must be ground smooth to a rounded contour and all weld splatter must be removed prior to abrasive blasting. Edges of metal to be coated must be rounded to a

minimum of 1/16-inch radius of chamfered a minimum of 1/16 inch at an angle of 45 degrees.

E. Welds and adjacent areas:

1. Prepared such that there is:

a. No undercutting or reverse ridges on the weld bead.

b. No weld spatter on or adjacent to the weld or any other area to be painted.

c. No sharp peaks or ridges along the weld bead.

d. Grind embedded pieces of electrode or wire flush with the adjacent surface of the weld bead.

2. Weld profiles must conform to NACE RP0178, Profile 'D'.

3.03 DUCTILE IRON PIPE AND FITTINGS SURFACE PREPARATION

A. Prepare surfaces in accordance with the following requirements:

1. NAPF 500-03-01 — Solvent Cleaning.

2. NAPF 500-03-02 — Hand Tool Cleaning.

3. NAPF 500-03-03 — Power Tool Cleaning.

4. NAPF 500-03-04 — Abrasive Blast Cleaning for Ductile Iron Pipe.

5. NAPF 500-03-05 — Abrasive Blast Cleaning for Cast Ductile Iron Fittings.

B. "Solvent Cleaning" must be performed prior to subsequent surface preparation as specified in NAPF 500-03.

3.04 PETROLATUM (WAX) TAPE

A. Petrolatum (wax) tape must be installed per the manufacturer's written recommendations. Provide all primers and appurtenant materials as required for installation per the recommendations.

B. Tape must be installed on all buried couplings and at locations indicated on the Drawings and as specified.

3.05 CONCRETE SURFACE PREPARATION

A. The adequacy of the preparation of concrete surfaces will be determined by comparing the surface with ICRI Surface Finish Comparators. Prepare surfaces in accordance with the following requirements:

1. SSPC-SP 13 / NACE 6 — Surface Preparation of Concrete.

B. Allow a minimum of 28 days curing time to elapse before coatings are applied. Concrete surfaces which are scheduled to receive coatings must be in accordance with the coating manufacturer's moisture requirements.

C. Bug holes, air pockets, and other voids in the concrete will be filled or patched in chemical exposure areas, secondary containment, and where specifically required.

D. Concrete Surface Preparation Inspection:

1. Adhesion Testing:

a. Tensile testing of the surface preparation must be performed by the Contractor using a Type 4 or Type 5 pneumatic adhesion testing equipment in accordance with ASTM D7234 using 2-inch diameter dollies for concrete surface adhesion testing. Provide a minimum of three tests (dollies) per area and coating system. Engineer will select location of test dollies.

b. Concrete surface or applied coating must be scored for concrete adhesion testing.

c. Adhesive failure greater than 50 percent of the dolly surface area indicates inadequate surface preparation.

d. Cohesive failures which results in loss of sound concrete will be acceptable provided the loss is greater than 50 percent of the dolly surface area.

e. Low adhesion cohesive failures with a thin layer of concrete due to weak concrete or laitance over 50 percent of the dolly surface will be rejected.

2. Concrete Soundness:

Concrete soundness will be determined using the scratching or hammer impact methods as defined in SSPC-SP 13.

3. Moisture Content:

Moisture must be tested as specified in SSPC-SP 13 and in accordance with ASTM D4263 and ASTM F1869. Moisture content cannot exceed the moisture content recommended by the coating manufacturer.

3.06 SURFACE PREPARATION

A. Clean and degrease surfaces prior to abrasive blasting by solvent cleaning as specified using solvents, detergent/water, emulsions, and steam. Proposed method must be documented in the coating plan. Contractor must contain and properly dispose of all runoff and debris from cleaning.

B. If the following conditions exist or are prevalent, surface preparation and coating must be delayed or postponed until conditions are favorable. Each day's coating must be completed in time to permit the film sufficient drying time prior to damage by atmospheric conditions or changes. No surface preparation can begin or coating applied:

1. When the surface, air or material is below or above the manufacturer's printed instructions.

2. When surfaces are wet or damp.

3. During weather conditions of rain, snow, fog or mist.

4. When the air and steel temperature is less-than or equal to 5 deg. F above the dew point temperature.

5. If the relative humidity is above 85 percent.

6. When it is expected that the air and/or surface temperature will be below or above the coating manufacturer's recommended temperatures within 4 hours after applications of coating, minimum. Coating manufacturer may require additional time between application and temperature and weather changes.

C. Shop Surface Preparation:

1. Notify Owner at least 7 days prior to start of shop blast cleaning to allow for inspection of the Work during surface preparation and shop application of paints. Work is subject to the Owner's approval before shipment to the Site.

2. Items such as structural steel, metal doors and frames, metal louvers, and similar items as reviewed by the Engineer may be shop prepared and primed. Centrifugal wheel blast cleaning is an acceptable alternate to shop blast cleaning. Blast clean and prime in accordance with the Specifications.

3. Prepare surfaces by abrasive blasting as specified and apply shop prime coat. Shop primed steel plates must not have primer extended within 4 inches along all edges to be welded. All primer within 4 inches of an area to be welded must be removed prior to welding. Welding of painted surfaces will not be allowed.

D. All pre-assembled shop primed items must be prepared in accordance with these specifications and inspected by the Owner's representative before and after priming.

E. Abrasive Blasting:

1. Prior to extensive abrasive blasting operations, the Contractor must perform a test blast to verify that the surface cleanliness and profile meet the requirements of this Section and meet the coating manufacturer's requirements for the coating to be applied. If the test section does not meet the requirements, the Contract must make changes to the abrasive materials and methods to provide suitable blast.

2. Abrasive blast only the amount of surface area which can be primed the same day or before any rust starts to form, whichever occurs first. Areas which are not painted the same day must be re-blasted on the day the prime coat is applied.

3. Contractor must provide written notification of activities to the Air Section Manager at the applicable TCEQ Regional Office and any local authorities having jurisdiction over abrasive blasting activities. Refer to 30 TAC 111.135(b).

   For equipment or piping with lead concentrations of 1.0% (10,000 micrograms/gm) or greater in the coating, the Contractor shall notify the appropriate TACB regional office and any local authorities having jurisdiction over abrasive blasting activities of the blasting in writing at least 10, but not more than 30, working days prior to the date scheduled for the beginning of blasting operations.

4. Shrouding or recovery of all blast material will be mandatory during all exterior blasting.

5. Contractor must contain all waste and process discharge in accordance with the accepted methods for the process and materials that are in abatement.

6. Where abrasive blast cleaning will not remove or properly prepare metal surfaces, hand and/or power tool cleaning must be used to remove such conditions as weld splatter, laminations and radius-sharp edges. Hand tool or power tool must be used on areas less than 2 feet in diameter or smaller or on corners and edges.

7. All abrasive blast equipment must be equipped with, including but not limited to the following:

   a. Noise reducing devices.

   b. Hose coupling safety devices.

   c. Electrical grounding devices.

d. Moisture traps and filters.

e. Fresh air hoods for all blasters.

f. "Dead Man" switches on all blast hoses.

g. Air dryers.

F. Surface profile must be in accordance with manufacturer's printed requirements.

G. The adequacy of the preparation of surfaces must be determined by comparing the surface with SSPC-VIS 1, SSPC-VIS 3, NACE RP0178 and ICRI Surface Finish Comparators.

H. Adequate surface preparation must be verified throughout surface preparation per SSPC-PA 17. Minimum testing requirements:

1. Test the surface profile within the first 15 minutes and one additional time during each work shift or 12-hour period, whichever is shorter for each gun or blasting apparatus used or at any time the process producing the acceptable profile indicated above is changed, as interpreted by the Engineer.

2. Select a minimum of three 6-inch square locations and take two readings. The average to the two readings is a "profile measurement." The group of three locations is the "location average." The location average must be within the specified profile range.

3. Contractor must report the location averages (lowest location average and highest location average, and the profile measurement for each surface preparation apparatus.

4. If the substrate has been previously coated, an existing profile may exist. Contactor must adjust blast media size to ensure that the surface profile yield meets the profile required.

I. Wherever the words "solvent cleaning", "hand tool cleaning", "wire brushing", or "blast cleaning", or similar words of equal intent are used in the Specifications or in paint manufacturer's specifications, they are understood to refer to the applicable specifications indicated.

J. Where OSHA or EPA regulations preclude standard abrasive blast cleaning, wet or vacuum-blasting methods may be required. Coating manufacturer's recommendations for wet blast additives and first coat application will apply.

K. Clean surfaces of dust and residual particles from cleaning operations by dry (no oil or water vapor) air blast cleaning or other method prior to painting. Vacuum clean enclosed areas and other areas where dust settling is a problem and wiped with a tack cloth.

3.07 PREPARATION OF HOT-DIP GALVANIZED COATED IRON OR STEEL PRODUCTS

A. Remove all soluble and insoluble contaminants. Prepare hot-dip galvanized coated iron and steel products in accordance with ASTM D6386 and abrasive blast per ASTM D6386 to achieve an angular anchor profile as required by the coating manufacturer.

B. Contractor is responsible for coordinating with the coating manufacturer to verify compatibility of the specified coating system with the provided surface preparation.

3.08 PREPARATION OF EXISTING COATED OR SHOP PRIMED SURFACES

A. General:

1. Factory-applied primers to equipment must be those specified or verified by the Contractor to be compatible with the specified coating systems. Where possible, notify

manufacturers which shop prime coats will be required in order to be compatible with field-applied finish coats.

Where equipment is purchased which has the manufacturer's standard primer or a factory finish which is other than as specified in this Section, remove the factory-applied paint system or apply passivators or other special coatings as required to make the surface compatible with the finish coat specified.

2. Do not apply any coating to machinery, piping, or other surfaces before testing has been completed and systems approved. Any damage to coatings resulting from subsequent corrective procedures must be stripped back to bare metal and repainted with the appropriate paint system as directed by the Engineer.
3. Check for compatibility when applying coatings over existing coatings. Apply a test patch of the recommended coating system, covering at least 2 to 3 square feet or as directed by the Owner. Allow to cure 1 week before testing adhesion per ASTM D3359 in the presence of the Owner. If adhesion does not meet the manufacturer's published data, consult with the Engineer.
4. Shop primed or coated surfaces must be reviewed with the Engineer to determine if the extent of damage to the coating and suitability of finish coats to adhere to shop applied coats.
5. If a cured epoxy, polyurethane, or plural-component material is to be top coated provide brush-off blast as specified herein or as recommended by the coating manufacturer.
6. Surface preparation recommendations of coating manufacturer are subject to approval of the Engineer.

B. To be recoated or final coated:

1. Solvent clean.
2. Perform touch-up repairs of existing coating.
3. Asphaltic coated ductile iron pipe will require an application of a seal coat prior to the application of a cosmetic finish coat.

C. Touch-Up Repairs:

1. Clean loose, abraded, or damaged coatings to substrate by power tool to bare metal per SSPC-SP 11 and/or NAPF 500-03-03 "Power Tool Cleaning."
2. Feather surrounding intact coating.
3. Apply one spot coat of the specified primer to bare areas overlapping the prepared existing coating.
4. Apply one full finish coat of the specified primer or finish coat(s) overall.

D. Application of a Cosmetic Coat:

1. The exact nature of shop-applied coatings is not known in all cases.
2. Check compatibility by application to a small area prior to starting the coating.
3. If lifting or other problems occur, request disposition from the Engineer.

3.09 APPLICATION

A. Contractor and painting technicians are responsible for the application of the coating system and must have current applicator approvals from the coating manufacturer, as required.

B. After abrasive blast cleaning, dust and spent abrasive must be removed from the surfaces by vacuum process or with clean, dry, oil-free compressed air.

C. The prime coat must be applied as soon as possible after the blasting and surface cleaning is completed, inspected and approved by the Inspector. Blasted surfaces must be coated before rust forms on the surface. No prepared surface will be allowed to receive a coating if "rust bloom" or surface discoloration has occurred. All blasted surfaces must be coated to within 6 inches of the edge of a blasted area. No visible rust must be coated under any circumstances, including rust bloom or if discoloration has occurred, regardless of elapsed time between blasting and coating.

D. Provide mist coat if recommended by the coating manufacturer.

E. All weld seams, gaps, edges, bolts and difficult areas to coat must receive a stripe coat. Stripe coat must be a contrasting color. Stripe coat may be applied with intermediate or finish coating.

F. Contractor must apply each coat at the rate and in the manner specified by the coating manufacturer, except as may be modified herein. If material has thickened or must be diluted for application, coating must be built up to the same dry film thickness as specified for each coat of the complete system.

G. Maximum and minimum DFT must be per the supplied coating manufacturer's printed requirements and as required by this Section. DFT will be measured per SSPC-PA 2, Level 3 with an allowable measurement of spot DFT of:

1. 80 percent of minimum DFT specified.

2. 120 percent of maximum DFT specified.

H. Contractor and painting technicians are responsible for the application of coating system and must have current applicator certifications from the coating manufacturer. Submit certifications with coating submittal.

I. Coatings which have an expired shelf or pot life may not be used and must be removed from the Site.

J. Coating must be applied by skilled workmen and must be brushed out or sprayed evenly, without runs, crazing, sags, or other blemishes.

K. Sand between coats to remove over spray and dry fall.

L. Apply the first coat to the surface, including cutting in around edges, before the second coat is applied. The second coat and any successive coats must not to be applied before notifying the Owner's field representative and obtaining approval. Each coat must be tested before the successive coat is applied.

M. The coating curing period must be adjusted to compensate for less than adequate weather conditions, as recommended by the coating manufacturer, for complete curing of the entire coating system. The full curing time recommended by the manufacturer must be provided.

N. Coating must be continuous and must be accomplished in an orderly manner to facilitate proper inspection control.

O. Where a roller or brush is used to apply the coating, additional coats may be necessary to achieve the recommended dry film thickness and/or to achieve total coverage of the underlying surface. Coated surfaces must be totally free of all roller nap, roller marks, brush bristles and brush marks.

P. When using conventional coating spray equipment for coating operations, effective oil and water separators combined with after coolers or deliquescent dryers must be used in compressed air lines to remove detrimental oil and moisture from the air. Separators must be placed as far as practical from the compressor. Compressors may be tested periodically by the Owner's representative for oil and water contamination of compressed air. Testing must follow ASTM D4285. All compressor units found to produce unacceptable amounts of oil and or water, as determined by results of ASTM D4285 test data and interpretation of data by the Owner's representative must be replaced with a compressor that is acceptable.

Q. For porous surfaces, such as concrete or masonry, a prime coat may be thinned to provide maximum penetration and adhesion. The type and amount of thinning must be determined by the coating manufacturer and is dependent on surface density and type of coating.

3.10 WATER AND WASTEWATER PIPE COLORS

A. General coating colors in accordance with the TCEQ are as follows for general selection of pipe coatings. Contractor must provide samples for Engineer's approval prior to ordering as specified.

Pipe/Pumps/Valves System Description	Color
Backwash Waste/Drain	Dark Grey
Clarified Water	Green
Effluent after Clarification	Dark Green
Filter Effluent	Light Blue
Gray Water	Purple with Yellow Lettering
Heated Water	Blue with 6-inch Red Bands, spaced 30-inches apart
Potable Water/Treated Water	Light Blue
Power Conduits	In compliance with the NFPA 70 National Electrical Code
Raw Water	Tan
Reclaimed Water	Purple with Black Lettering
Sewage	Grey
Waste Water/Sewage	Brown

Other Lines	Color
Compressed Air	Light Green
Instrument Air	Light Green with Dark Green Bands

3.11 FIELD QUALITY CONTROL

A. Field Tests: Make wet film tests during painting operations to ensure proper thicknesses of coating are being applied. After each coat has been applied, test the paint film thickness with

a nondestructive, magnetic type thickness gauge. The total dry-film thickness for each coat must be per Paragraph 3.09.G. Apply additional coats until the specified thickness is reached or exceeded.

B. Holiday Testing

1. Holiday testing must be performed in accordance with ASTM D5162 for steel substrates and ASTM D4787 for concrete substrates.
2. Test the entire surface of coated steel and piping in moderate or severe environments, as determined by the Owner, with a holiday detector. For thickness between 10 and 20 mils (250 to 500 microns) a non-sudsing type wetting agent, as recommended by the holiday detector manufacturer, must be added to the water prior to wetting the detector sponge.
3. Holiday detect coatings in excess of 20 mils with high voltage holiday testers as recommended by the coating manufacturer.
4. Mark and repair failures in accordance with the manufacturer's printed instructions, then retest failure areas. No failures or other irregularities will be permitted in the final coats. Areas containing holidays must be repaired until tests indicate no holidays.

3.12 PROTECTION OF SURFACES NOT TO BE PAINTED

A. Remove, mask, or otherwise protect hardware, lighting fixtures, switch plates, aluminum surfaces, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not intended to be painted.

B. Provide drop cloths to prevent paint materials from falling on or marring adjacent surfaces.

C. Protect working parts of mechanical and electrical equipment from damage during surface preparation and painting process.

D. Mask openings in motors to prevent paint and other materials from entering the motors.

3.13 DAMAGED COATINGS, PINHOLES, AND HOLIDAYS

A. Feather edges and repaired in accordance with the recommendations of the paint manufacturer.

B. Repair fusion bonded coatings to be as recommended by the original applicator. Applicator must provide liquid repair kits for this purpose as recommended by the coating manufacturer.

C. Apply finish coats, including touchup and damage-repair coats in a manner that will present a uniform texture and color-matched appearance.

3.14 UNSATISFACTORY APPLICATION

A. If the item has an improper finish color, or insufficient film thickness, clean and topcoat surface with specified paint material to obtain the specified color and coverage. Obtain specific surface preparation information from the coating manufacturer.

B. Hand or power sand visible areas of chipped, peeled, or abraded paint and feather the edges. Follow with primer and finish coat in accordance with the Specifications. Depending on the extent of repair and its appearance, a finish sanding and topcoat may be required.

C. Evidence of runs, bridges, shiners, laps, or other imperfections are cause for rejection.

D. Repair defects in coating system per written recommendations of coating manufacturer.

E. Leave all staging up until the Owner has inspected the surface or coating. Replace staging removed prior to approval by Owner.

3.15 COATING INSPECTION

A. General:

1. All coats will be subject to inspection by the Engineer and the coating manufacturer's representative.
2. Visually inspect concrete, nonferrous metal, plastic, and wood surfaces to ensure proper and complete coverage has been attained.
3. Give particular attention to edges, angles, flanges, and other areas where insufficient film thicknesses are likely to be present and ensure proper millage in these areas.

B. Coating Thickness Testing:

1. Owner's representative may conduct coating thickness testing as necessary and without limitation.
2. Measure coating thickness specified in mils with an electronic type dry film thickness gauge.
3. Check each coat for the correct millage.
4. Tests for concrete coating thickness may be taken using a Tooke Gauge or gauge approved for testing coatings over concrete substrates. Contractor must repair coating after thickness testing, if required.

C. Coating Continuity (Holiday) Testing: Owner's representative will witness holiday testing performed by the Contractor.

3.16 CLEANING AND ADJUSTING

A. Promptly remove trash and debris resulting from painting operation from the Site. Remove drop cloths, masking tapes and other protective coverings. Remove paint spills, splatters, overlap of paint from adjacent material and other defects. Spot paint nicks and other defects.

B. Remove paint containers and waste products. Thoroughly clean paint storage rooms, removing spilled paint from walls and floors.

C. Damages due to over spray on buildings, vehicles, trees, or other surfaces not specified to be painted would be the responsibility of the Contractor.

3.17 SCHEDULE

A. Protective coatings must be applied in accordance with the following paint schedule. If additional or alternate primers, etc. are recommended by the coating manufacturer for any of the coatings specified, they must be provided at no additional cost to the Owner to provide a complete and compatible coating system, as approved by the Engineer.

PROTECTIVE COATINGS PAINT SCHEDULE

System	Application Description	Surface Prep	Product Type	No. of Coats	DFT/Coat (mils)
No. 1	**Above-Grade Interior/Exterior Steel and D.I. Piping Non-Immersion/Non-Corrosive Environment** All metal surfaces new and existing, such as exterior piping and valves, etc. **Application Notes:** 1. Intact Factory Applied Epoxy Coatings on Valves and Piping - Abrade surface to create a surface profile and spot prime with Epoxy Mastic. Coat with penetrating sealer and continue with stripe, intermediate and top coat as indicated.	**For New Piping and Valves:** SSPC-SP 1 SSPC-SP 6 NAPF 500-03-01 NAPF 500-03-04 NAPF 500-03-05	TYPE N - Epoxy Mastic TYPE C - Penetrating Epoxy Pre-Primer TYPE M - Stripe Coat Type M - HS Epoxy Siloxane	1 1 1	5.0 2.0 5.0 - 7.0
Total Minimum Dry Film Thickness					12 mils
No. 2	**Above-Grade Interior and Exterior PVC Pipe** Exterior surfaces PVC piping.	SSPC-SP 1 Light Sanding	TYPE B - Epoxy-Polyamide Primer TYPE I - Aliphatic Polyurethane Enamel	1 1	3.0 3.0
Total Minimum Dry Film Thickness					6.0 mils

END OF SECTION

SECTION 09 97 16

PIPELINE COATINGS AND LININGS

1.00 GENERAL

1.01 WORK RESULTS

A. This section covers the work necessary to apply external polyurethane coating and cement mortar lining on buried steel water pipe, field coating of joints, and field repair of coating damage, complete.

B. All exposed or above-grade piping shall be lined and coated with NSF 61 certified epoxy as specified in this Section and in Section 09 96 00.01 “High-Performance Coatings”, unless specifically specified otherwise.

C. All below-grade pressure reducing valve assembly piping shall be polyurethane coated and epoxy lined as specified in this Section and in Section 09 96 00.01 “High-Performance Coatings”, unless specifically specified otherwise

1.02 SUBMITTAL REQUIREMENTS

A. CONTRACTOR submittals shall be made in accordance with these Specifications.

B. Shop Drawings: Catalog cuts and other information for all products proposed. Provide copy of approved coating system submittals to the coating applicator.

C. Quality Control Submittals: Furnish the following:

1. Applicator's Experience with list of references substantiating compliance
2. Coating manufacturer's certification stating the applicator meets or exceeds their coating application requirements and recommendations.
3. Coating manufacturer shall provide a copy of the manufacturer’s coating application quality assurance manual.
4. If the manufacturer of field-applied coating differs from that of the shop applied primer, provide written confirmation from both manufacturers’ that the two coating materials are compatible.

D. Provide copies of Certified Test Reports for all coating and lining tests.

1.03 QUALITY ASSURANCE

A. Coating Applicator's Experience and Certification:

1. Coating Application Company and coating application supervisor (Certified Applicator) shall have a minimum of 5 years experience applying the specified coating system. Coating application personnel, whom have direct coating application responsibility, shall have a minimum of 2 years practical experience in application of the indicated coating system.
2. Coating applicator shall be certified by the coating manufacturer as an approved applicator.

3. Coating and/or lining manufacturer technical representative shall be present for a minimum of three days technical assistance and instruction at the start of coating and/or lining operations within the shop. During this visit, the technical representative shall observe surface preparation and coating application and conduct tests of the coating to insure conformance with application instructions, recommended methods, and conditions.

B. Coating and/or lining manufacturer's technical representative shall be onsite for three working days, minimum, at the start of each construction season to inspect coating application and procedures in the field. During this visit, the technical representative shall observe surface preparation and coating application and conduct tests of the coating to insure conformance with application instructions, recommended methods, and conditions.

C. Coating and/or lining manufacturer shall include 8 hours per month of field or shop coating technical support when requested by the Engineer.

D. Technical representative shall provide a written report to the Owner for each visit. Report shall include copies of test data collected, description of observations, and all recommended corrective actions. Report shall be submitted within 5 working days after the visit. When deemed necessary by the Owner, work will not be permitted to proceed until the recommended corrective actions have been implemented. After all corrective recommendations have been completed; the manufacturer representative shall return and certify that the application complies with the manufacturer's coating application recommendations.

E. Additional visits by the manufacturer's representative shall be made at sufficient intervals during surface preparation and coating or lining as may be required for product application quality assurance, and to determine compliance with manufacturer's instructions, and as may be necessary to resolve problems attributable to, or associated with, manufacturer's products furnished for this project.

1.04 ABBREVIATIONS

MDFT	Minimum Dry Film Thickness
mil	Thousandths of an Inch

1.05 DEFINITIONS

Manufacturer's Representative: Employee of coating manufacturer who is factory trained and knowledgeable in all technical aspects of their products and systems. Sales representatives are not acceptable as a technical representative unless written authorization from the coating manufacture is provided which states the sales representative has full authority to act on the behalf of the coating manufacturer.

1.06 REFERENCE STANDARDS

AWWA C205 Cement-Mortar Protective Lining and Coating for Steel Water Pipe-4-inch and Larger- Shop Applied.

AWWA C209 Cold Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines. AWWA

	C210 Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines.
AWWA C216	Heat-shrinkable Cross-linked Polyolefin Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines.
AWWA C217	Cold-Applied Petrolatum Tape and Petroleum Wax Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines.
AWWA C222	Polyurethane Coatings for Interior and Exterior of Steel Water Pipe and Fittings
NACE RP-0274	High Voltage Electrical Inspection of Pipeline Coatings Prior to Installation.
SSPC-SP-1	Solvent Cleaning Surface Preparation
SSPC-SP-2	Hand Tool Cleaning Surface Preparation
SSPC-SP-3	Power Tool Cleaning Surface Preparation
SSPC-SP-5	White metal Abrasive Blast Surface Preparation
SSPC-SP-6	Commercial Abrasive Blast Surface Preparation
SSPC-SP-10	Near White Metal Abrasive Blast Surface Preparation
SSPC-SP-11	Power Tool Cleaning to Bare Metal

1.07 SPECIAL WARRANTY REQUIREMENTS

The CONTRACTOR and coating applicator shall warrant to the OWNER and guarantee the work under this section against defective workmanship and materials for a period of two (2) years commencing on the date of final acceptance of the work.

1.08 OBSERVATION OF WORK

A. The CONTRACTOR shall give the OWNER Representative a minimum of 14 days advance notice of the start of any work to allow scheduling for shop or field observation. Provide OWNER Representative a minimum 3 days' notice for actual start of surface preparation and coating application work.

B. Provisions shall be made to allow OWNER’s representative full access to facilities and appropriate documentation regarding coating application.

C. Observation by the OWNER’s representative or the waiver of observation of any particular portion of the work shall not be construed to relieve the CONTRACTOR of his responsibility to perform the work in accordance with these Specifications.

D. Materials shall be subject to testing for conformance with these specifications as the OWNER's representative may determine, prior to or during incorporation into the work.

2.00 MATERIALS

2.01 GENERAL

A. Exterior and interior pipe and fitting surfaces shall be prepared and coated in accordance with referenced standards, written directions of the coating or lining manufacturer's, and these specifications, whichever is more stringent.

B. Coatings and linings will be stored, handled, and applied per manufacturer's written directions.

C. Pipeline coating or lining shall be the product of a single manufacturer. Product substitutions during the project will not be permitted.

2.02 EXTERIOR SHOP-APPLIED COATINGS

A. General

1. Steel pipe shall be coated in accordance with AWWA C222, except as modified herein.
2. Pipe that is atmospherically exposed shall be shop primed as specified herein and Section 09 96 00.01 "High-Performance Coatings."
3. Buried dielectrically coated pipe and fittings passing through a structure wall or floor shall be coated for a minimum of two-inches beyond the interior wall or floor surface.

B. Plural Component Polyurethane:

1. General: Plural component, polyurethane coating system (referred to as a polyurethane system) shall be applied in accordance with AWWA C222, and as modified herein.
2. Shop Surface Preparation:
    a. Steel pipe: SSPC-SP5, White Metal blast, 3.00 mil profile, minimum, or as required by the manufacturer, whichever is greater using standardized testing procedures including Press-O-Film and micrometer.
3. Shop Applied Coating Requirements:
    a. Self-priming, plural component, 100 percent solids, non-extended polyurethane, suitable for burial or immersion.
    b. One coat, 35 mils total dry film thickness, minimum, or as required to meet the holiday and coating defects limits specified this section.
    c. Shall be one of the following products, subject to review and acceptance of submitted product performance reports:
        1). Protec II, Futura Coatings, Montgomeryville, PA.
        2). Chemthane 2265, Chemline, Inc, St. Louis, MO.
        3). Polyclad 777, Carboline Global, St. Louis, MO.

4). Durashield 110 or Durashield 210, LifeLast, Pflugerville, TX.

5). No approved equal.

d. Acceptance of submitted product is contingent upon:

1). Submission of an independent testing report conducted within three years prior to bid opening documenting conformance to the coating performance criteria specified herein.

2). Verification that no significant change in product formulation has occurred through comparison of current product Part A and B formulation with infrared spectrometry analysis of test product for the laboratory test report.

4. Laboratory Coating Testing and Report:

a. General: Coating manufacturer shall submit to the Engineer for approval, test reports indicating conformance to the specified performance criteria using prepared samples as defined using coating materials conforming to the following general requirements:

1). Polyurethane coating material tested shall have been manufactured within 30 days of test sample preparation.

2). Coating material to have a minimum of three years prior pipeline coating application history.

3). Extended polyurethane coatings will not be acceptable.

4). Submission of incomplete reports, use of test procedures or methods other than those specified, or preparation of samples with a coating material other than those listed will result in rejection of the coating.

5). Reports shall be submitted for review and approval not less than 30 days prior to coating application along with current product data sheets and MSDS sheets for parts A and B.

6). New product formula tests shall be accompanied with Part A and B wet samples for infrared spectrometry analysis. Wet samples shall be from the lot and batch tested and shall be collected and sealed by the Engineer for laboratory analysis by the Engineer.

b. Test Sample Preparation:

1). Coating manufacturer to provide 10 days advanced notification of coating sample preparation for Owner observation.

2). Failure to fully conform to the preparation requirements will result in rejection of the submitted coating material.

3). Sample preparation completed by the coating manufacturer shall be fully documented and reported to the testing agency by the manufacturer.

4). All coating test samples shall be prepared in conformance with the following general requirements.

c. Sample Surface preparation

1). Method: Abrasive Blast, Green Diamond or Steel Grit, SSPC-SP5, White Metal

2). Profile: 3.25 mils (±0.25 mils), Angular profile, 90 Peak Count per inch minimum, measured and recorded using surface profilometer.

d. Coating Application:

1). Method: Spray film, in accordance with manufacturer's written shop application requirements.

2). Thickness: 35 mils, minimum

3). Cure: Air cure only, oven or other accelerated cures will not be acceptable.

4). Form: Sheet, steel panel, or steel pipe as required for test procedure.

e. Sample Quantity: Three minimum for each test performed or as required by the ASTM Test Standard, whichever is more stringent.

f. Coating Tests:

1). Testing shall be performed by a certified independent laboratory testing agency with a minimum five years experience in the performance of ASTM test procedures on coating systems.

2). All testing shall be at room temperature, unless specifically required otherwise by the ASTM test procedure.

g. Reporting

1). As required by the ASTM test method, and the following additional information:

a). Sample panel preparation date and identification

b). Surface preparation method and abrasive

c). Surface Preparation profile and peak count

d). Coating lot and date of manufacture

e). Application spray gun and equipment used

f). Application temperatures of coating materials and material temperature at the gun, ambient temperature, and panel surface temperature

2). Include all periodic test data and/or observations for all tested samples and show all multiple measurements in both table and graph.

3). Show all calculations as required by the ASTM test method.

4). Include digital photographic documentation of all visual assessments, test apparatus, and final panel condition using 4 mega pixels minimum resolution.

5). Submit reports in both PDF and color printed format with photographs in JEPG format on USB.

C. Exterior Coating for Exposed Steel Pipe

1. All atmospherically exposed piping shall be shop coated with the coating system as specified in Section 09 96 00.01 “High-Performance Coatings.”

2.03 INTERIOR SHOP-APPLIED LININGS

A. Cement Mortar Lining:

1. Clean and cement mortar line steel pipe and fittings in accordance with AWWA C205.
2. Cement: Conform to ASTM C150, Type II.
3. Shop applied cement mortar lining shall be uniform in thickness over the full length of the pipe joint.
4. Aggregate shall be silica sand or other aggregate that is not subject to leaching. Conform to ASTM C33.
5. Water for cement mortar: Clean and free from organic matter, strong alkalis, vegetable matter, and other impurities.

B. Liquid Applied Epoxy Lining:

1. Provide liquid epoxy primer and lining in all cement mortar lined metallic pipe at insulating joints for a minimum of two pipe diameters on each side of the insulated joint.
2. Epoxy coatings shall be NSF approved coatings suitable for potable water contact in accordance with ANSI/NSF Standards 60 and 61. Epoxy lining shall be Tnemec 140 Pota Pox or engineer approved equal. Lining system shall be NDF 61 approved. Total interior lining system shall be a minimum of 14 mils DFT.
3. Epoxy shall be applied over the cement mortar lining where specified for the pipeline lining material.
4. Prepare the cement mortar lining by abrasive blasting to remove all laitance and provide a surface profile.
5. Cement mortar shall be allowed to cure for a minimum of 15 days prior to surface preparation and coating application or 7 days with steam curing.
6. Mortar lining shall be dry when epoxy lining is applied.

2.04 SPECIALS, FITTINGS, AND CONNECTIONS

A. Coating and lining application for special sections, connections, and fittings for steel or ductile iron pipe shall conform to coating system and application requirements as specified in this section.

B. Specials, fittings, and connections shall be defined as any pipe section with turnouts for blowoffs, interconnects, any valve, or other appurtenances; tees; crosses; wyes; laterals; manholes; mitered angles or elbows; and pipes which require special fabrication that prevents mechanical production application of the specified coating system from end to end of pipe joint.

C. In addition to the items listed as specials, the following items shall also be considered as specials:

1. Pipe joints with pass through holes.

D. Hand applied tape coatings will not be permitted on any specials, fittings, connections, and elbow fittings.

E. Specials, fittings, and connections shall be externally coated with polyurethane coating system applied from end to end of pipe joint on all specials, fittings, and connections.

2.05 EXTERIOR FIELD JOINT COATING

A. Pipe joints shall be field coated after pipe assembly in accordance with AWWA C216, or C217, whichever is applicable and as specified herein.

B. Field joint coating shall be compatible with the shop-applied coating system and provided by the same manufacturer or a manufacturer approved by the pipe coating manufacturer.

C. Field joint coating materials shall be as follows or an approved equal.

1. Heat Shrink Sleeves:

a. Filler Material:

1). Provide filler material for all push-on, flange, and coupling type joints and at all changes in outside diameter are greater than 1/8-inch.

2). Filler material shall adhere to the pipe and heat shrink sleeve. Size and type shall be as recommended by the sleeve manufacturer for type of pipe and joint.

3). Filler mastic for joints subject to weld after backfill shall exceed 500 degrees F melt point temperature.

4). Filler material shall be applied in a manner and of sufficient thickness that no tenting or voids remain under the heat shrink sleeve.

b. Joint Coating:

1). Heat shrink, cross-linked polyolefin wrap or sleeve with a mastic sealant, 85-mils nominal thickness, suitable for pipeline operating temperature, as recommended by the manufacturer.

2). Provide standard recovery sleeve for welded or bell and spigot steel pipe joints. High recovery sleeves shall be provided for flange joints and coupling style joints.

3). Width of heat shrink sleeves shall be sufficient to overlap existing coating 2-inches minimum.

4). Consider sleeve shrinkage during installation and joint profile in determining sleeve width required. Overlapping of two or more heat shrink sleeves to achieve the necessary width on pipe joints will not be permitted without Owner approval.

5). Sleeve shall meet requirements for "Weld After Backfill" when allowed and approved by Engineer.

c. Holdback Primer: As specified this section

d. Manufacturer's: Berry-CPG Covalence WaterWrap

2. Wax Tape Coating:

a. Apply coating in accordance with AWWA C217, except as modified herein.

b. Wax tape coatings shall be field applied on all buried flexible joints, thrust restraint rods and brackets, and on joints, fittings, or irregular shapes or complex configurations that are not suited for the use of heat shrink coating system.

c. Do not use wax tape coating systems on vault piping, atmospherically exposed piping and appurtenances, or where subject to UV exposures.

d. Provide filler material to fill and smooth all irregular surfaces, such that no tenting or voids remain under the applied wax tape.

e. Use sand backfill to protect wax coating from damage.

f. Coating System:

1). Surface Preparation: SP11 Power Tool to Bare Metal.

2). Primer: petroleum or petrolatum wax

3). Filler Material: Filled petroleum or petrolatum wax

4). Inner Tape: Petroleum or petrolatum wax impregnated fabric, 6-inch width maximum, 40 mils thick

5). Outer Wrap: PVC or tape suitable for application to inner tape.

g. Wax tape coating system shall be as manufactured by:

1). Denso North American

2). Trenton

3). Or approved equal.

2.06 INTERIOR FIELD JOINT COATING

A. Mortar Lining:

1. After the backfill has been completed to final grade, the interior joint recess shall be filled with grout. The grout shall be tightly packed into the joint recess and troweled flush with the interior surface. Excess shall be removed.

2. At no point shall there be an indentation or projection of the mortar exceeding 1/16-inch.

3. With pipe smaller than 24-inches in diameter, before the spigot is inserted into the bell, the bell shall be daubed with grout. The joint shall be completed and excess mortar on the inside of the joint shall be swabbed out.

2.07 REPAIR OF COATINGS AND LININGS

A. General

1. Coating or lining repair materials shall be compatible with the shop-applied coating or lining system and shall be approved by the coating or lining manufacturer.

2. All major repairs on pipe coated with polyurethane coating system shall be repaired using heat shrink sleeves as specified for field joint coating in accordance with C216, except as modified herein.

3. Minor coating repairs for polyurethane coated or exposed pipe shall be as specified herein.

B. Coating Repair Materials

1. Heat Shrink Sleeves (major repair):

a. Filler Mastic: Provide mastic filler to fill tape void as required.

b. Full Wrap Coating: Cross-linked polyolefin wrap with a mastic sealant, 85-mil thickness nominal, suitable for pipeline operating temperature, sleeve material recovery as recommended by the manufacturer. Sleeve length shall provide a minimum of 3 inches overlap onto intact pipe coating.

c. Manufacturer's: Berry-CPG Covalence WaterWrap

2. Heat-Applied Patches (minor repair)

a. Heat applied adhesive, polyolefin backed, mastic coated tape, 12-inches maximum size.

b. Patch shall provide a minimum of 2 inches overlap onto intact pipe coating.

c. PERP patch as manufactured by Raychem (Polyken).

C. Polyurethane Coating

1. Polyurethane coating system repair shall be in accordance with the coating manufacturer's recommended procedures.

2. Coating material for minor repairs shall be single use kits or other mix ratio controlled packages of slow set polyurethane coating material similar to the existing coating.

3. Major repairs will be completed using the coating material specified for the coating or the lining. Coating shall be reapplied using plural component spray equipment by a manufacturer certified coating applicator.

D. Exposed Pipe Coating System

1. Touch-up repair all damage to the primer and/or intermediate coats with the specified coating system prior to final coating of the pipeline in accordance with Section 09 96 00.01 "High-Performance Coatings."

3.00 EXECUTION

3.01 ENVIRONMENTAL LIMITATIONS

A. General

1. Products shall comply with federal, state, and local requirements limiting the emission of volatile organic compounds and worker exposure.
2. Comply with applicable federal, state, and local, air pollution and environmental control regulations for surface preparation, blast cleaning, disposition of spent aggregate and debris, and coating application.
3. Do not perform abrasive blast cleaning whenever the relative humidity exceeds 85 percent, whenever surface temperature is less than 5 degrees above the dew point of the ambient air.
4. Do not apply coatings when:
    a. Surface and ambient temperatures exceed the maximum or minimum temperatures recommended by the coating manufacturer or these specifications,
    b. In dust or smoke-laden atmosphere, blowing dust or debris, damp or humid weather, or under conditions that could cause icing on the metal surface.
    c. For epoxy coatings or linings when it expected that surface temperatures would drop below 5 degrees above dew point within 4 hours after application of coating.
    d. Whenever relative humidity exceeds 85 percent for polyurethane coating application.
5. Where weather conditions or project requirements dictate, CONTRACTOR shall provide and operate heaters and/or dehumidification equipment to allow pipe surfaces to be abrasive blasted and coated as specified and in accordance with the manufacturers coating application recommendations.
6. Work activities can be restricted by the Owner until adequate temperature and humidity controls are in place and functioning within the environmental limits specified.
7. Coating applicator shall provide a monitoring system approved by the coating manufacturer that constantly records pipe and coating conditions during coating application. Recorded monitoring parameters shall include pipe temperature, line speed, surface preparation, holiday test and other parameters applicable to the type of coating.

B. Temperature Control

1. In cold weather or if moisture collects on the pipe, preheat pipe to a temperature between 45 and 90 degrees and 5 degrees above dew point, whichever is greater.
2. When temperatures are above or below the coating manufacturers recommended application temperatures, the CONTRACTOR will provide temperature controls as necessary to permit work to precede within the manufacturer’s temperature limitations.
3. Provide tenting, insulating blankets, baffles, or bulkheads as required to zone and control heating or cooling effectiveness.

4. Heating shall be with indirect fired heaters that do not increase humidity levels within the work area. Heaters shall be sized for the area to be heated.

C. Dehumidification

1. CONTRACTOR shall provide dehumidification equipment when necessary for shop or field environmental control during surface preparation and/or coating application. Dehumidification equipment shall be properly sized to maintain dew point temperature 5 degrees or more below surface temperature of metal surfaces to be cleaned and coated.
2. Cleaned metal surfaces shall be prevented from flash rusting throughout the project duration, condensation or icing shall be prevented throughout surface preparation and coating application.
3. Equipment size and power requirements shall be designed by personnel trained in the operation and setup of dehumidification equipment based on project requirements and anticipated weather conditions.
4. Dehumidification equipment shall operate 24 hours per day and continuously throughout surface preparation and coating application.
5. CONTRACTOR to provide personnel properly trained in the operation and maintenance of the dehumidification equipment or provided training by the dehumidification equipment supplier.
6. Daily maintenance requirements of the equipment shall be documented in writing and posted near the equipment for review by the Engineer.
7. Reblasting of flash rusted metal surfaces or removal of damaged coatings, because of equipment malfunction, shutdown, or other events that result in the loss of environmental control, will be at the sole expense of the CONTRACTOR.

3.02 SURFACE PREPARATION

A. General

1. Inspect and provide substrate surfaces prepared in accordance with these Specifications and the printed directions and recommendations of coating manufacturer whose product is to be applied.
2. Visible oil, grease, dirt, and contamination shall be removed in accordance with SSPC-SP1, solvent cleaning.
3. Surface imperfections such as metal slivers, burrs, weld splatter, gouges, or delaminations in the metal shall be removed by filing or grinding prior to abrasive surface preparation.
4. Protect prepared pipe from humidity, moisture, and rain. All flash rust, imperfections, or contamination on cleaned pipe surface shall be removed by reblasting.
5. Priming and coating of pipe shall be completed the same day as surface preparation.

B. Weld Surface Preparation

1. Requirements: Spray applied coating systems do not require weld grinding.

C. Steel Surface Preparation

1. Surface preparation of steel pipe shall be in accordance with SSPC surface preparation standards utilizing the degree of cleanliness specified in Section 2.02.B.2.a.
2. Grit and/or shot abrasive mixture and gradation shall be as required to achieve the degree of cleanliness and coating adhesion specified.
3. Pipe cleaned by abrasive blasting with recyclable steel grit and/or shot or other abrasive shall be cleaned of debris and spent abrasive in an air wash separator.
4. Polyurethane coating system shall have a sharp angular surface profile of the minimum depth specified.
5. Work shall be performed in a manner that does not permit the cleaned metal surface to rust back or flash rust.
6. Rust back or flash rust shall be fully removed with the steel surface cleanliness equal to the metal surface cleanliness prior to rust back or flash rusting. Determination of the equivalent surface cleanliness shall be at the Owner's sole discretion.

3.03 SHOP -APPLIED COATING SYSTEMS

A. Polyurethane Coating or Lining

1. Applicator Qualifications:
   a. Equipment will be certified by the coating manufacturer to meet the requirements for material mixing, temperature control, application rate, and ratio control for multi-part coatings.
   b. Equipment not meeting the written requirements of the coating manufacturer shall be rejected for coating application until repairs or replacement of the equipment is made to the satisfaction of the Owner.
   c. Personnel responsible for the application of the coating system shall have certification of attendance at the coating manufacturer's training class within the last three years. The certified applicator shall be present during all coating application work and shall have responsibility for controlling all aspects of the coating application.
2. Pipe surface temperature shall be between 50 and 100 degrees F or 5 degrees F above dew point, whichever is greater.
3. Coating application shall be performed in an environmentally controlled shop area that meets or exceeds the written environmental application requirements of the coating manufacturer. Application in outdoor conditions will not be acceptable without adequate environmental shelter, environmental controls, and/or dehumidification.
4. Coating adhesion and holidays testing shall be tested as specified in this section.
5. Coating manufacturer shall provide to the Engineer a copy of the manufacturer's coating application quality assurance manual prior to beginning coating application. Strict conformance to the requirements of the manual will be required. Deviation from the requirements of the manual will be grounds for the Engineer to reject the applied coating.
6. Unacceptable Coating Application

a. Coating applied under improper environmental conditions will be rejected.

b. Pipes that exceed the allowable quantity of coating defects, regardless of size or cause, shall be rejected.

c. Coating which fails the adhesion or holiday testing as specified this section shall be rejected.

d. Pipe coating that is subject to off ratio application, blistering, or is not applied in conformance with the coating manufacturer's written instructions or recommendations shall be rejected.

7. Rejected coating shall be removed from the full length of the pipe to bare metal and reapplied using proper application methods in accordance with the quality assurance manual and the requirements of these specifications.

8. Perform coating and lining repairs as specified in this section.

3.04 EXTERIOR COATING HOLDBACK

A. Coating holdbacks shall be straight and cut through the full thickness of the coating.

B. Cutbacks shall be completed in a manner that permits field coating of joints in accordance with the manufacturer's recommendations and as specified herein.

C. Holdbacks shall be as required for proper jointing of pipe, considering joint welding requirements, and be as follows:

Polyurethane coating	
Push-on joint, spigot	1 inch before centerline gasket
Push-on, bell	Flush with bell end
Welded, spigot	3 inches, minimum
Welded, Bell	4-inches, minimum

D. Holdback Corrosion Protection:

1. Holding primer for corrosion protection of cutbacks or holdbacks shall be compatible with the specified joint coating system and weld after backfill requirements, when applicable.

2. Approved holdback primers are:

a. Tnemec Omnithane – Suitable for all joints, except joints subject to weld after backfill

b. Tnemec 90E-92 Ethyl Silicate Inorganic Zinc Primer – suitable for all joints, including weld after backfill joints.

c. ICI Devoe Cathacoat 304V Ethyl Silicate Inorganic Zinc Primer – suitable for all joints including weld after backfill joints.

d. Polyken or Other Tape Primers – Not allowed

3. Primer shall not result in running or melting of the coating or cause toxic fumes when heated during weld after backfill operations.

4. Application and thickness of holding primer shall be in accordance with the coating manufacturer's recommendations, but shall not impair the clearances required for proper joint installation.
5. Primer application on spigot end of field welded pipe shall be held back 1 to 2 inches from the end of the spigot or as necessary to prevent toxic fumes during field welding.
6. Any corrosion within the holdback areas shall be abrasively blasted to near white metal in accordance with SP10 or power tool cleaned to bare metal in accordance with SP11 prior to applying joint coating.

3.05 PIPE LINING APPLICATION

A. Shop-applied Cement Mortar Lining:

1. Centrifugally line straight sections of pipe. Lining of special pieces or fittings shall be by mechanical, pneumatic, or hand placement. Provide cement mortar lining of uniform thickness. Finish to a smooth dense surface.
2. Steel plate specials larger than 16 inches in diameter shall have lining reinforced with 2-inch by 4-inch No. 13-gage welded steel wire mesh.
3. Centrifugally line straight sections of pipe. Lining of special pieces or fittings shall be by mechanical, pneumatic, or hand placement. Provide cement mortar lining of uniform thickness. Finish to a smooth dense surface.
4. Steel plate specials larger than 16 inches in diameter shall have lining reinforced with 2-inch by 4-inch No. 13-gage welded steel wire mesh.
5. Brace and support pipe during lining application to minimize pipe distortion or vibration. Bracing and supports shall not damage the pipe, coating, or lining.
6. Tightly close ends of pipe and fittings with plastic sheet caps. Plastic end caps shall be of sufficient thickness and strength to resist shipping, handling, and storage stresses.
7. Damage to the cement mortar lining, including disbondment, cracking, or blistering, caused by improper curing, shipping, handling, or installation shall be repaired in accordance with AWWA specifications and to the satisfaction of the Owner.
8. Other requirements of mortar lining materials and processes: As specified in AWWA C205.

B. Liquid Epoxy Lining:

1. Clean and coat the interior of cement mortar lined pipe at insulating joints or where specified with two coats of epoxy coating.
2. Epoxy coating applied at insulating joints shall be applied to both sides of the insulating joint for a minimum of two pipe diameters. If only one side of the joint can be coated the coating shall be applied for a minimum of four pipe diameters.

3. Mortar lining shall be allowed to cure 15 days or steam cured not less than 7 days prior to surface preparation of the mortar and epoxy coating application. Hand applied mortar lining shall be allowed to cure a minimum of 15 days or as required to meet the coating manufacturer's requirements for application on cement or concrete, whichever is greater.
4. Prepared mortar lining by abrasive blasting to remove all laitance and create a suitable anchor profile
5. Epoxy coating shall be applied in two coats minimum, at a total coating thickness of 16 mils dry film thickness. Coating applied over cement mortar lining shall be applied in a manner that will minimize gassing and pinholes in the completed lining.
6. Mortar lining shall be dry during epoxy lining application.

3.06 FIELD COATING JOINTS

A. General:

1. Remove all oil or grease contamination by solvent wiping the pipe and adjacent coating in accordance with SSPC-SP1, Solvent cleaning.
2. Clean pipe surface and adjacent coating of all mud, corrosion, and other foreign contaminates in accordance with SSPC-SP11, Power Tool Cleaning to Bare Metal or abrasive blast joints in accordance with SSPC-SP10, near white metal blast, that exhibit any surface corrosion or staining. When required, clean the full circumference of the pipe and a minimum of 6 inches onto the existing coating.
3. Remove all loose or damage pipe coating at joint and either repair the coating as specified herein or increase the length of the joint coating, where reasonable and practical.
4. Complete joint bonding of pipe joints before application of joint coating. Joint bonds shall be installed as specified in Section 26 42 14 "Impressed-Current Cathodic Protection System." Joint bonds shall be low profile bonds and all gaps and crevices around the bonds shall be filled with mastic sealant.
5. CONTRACTOR to electrically test completed joint coating for holidays with high voltage spark tester.

B. Weld After Backfill Joint Requirements:

1. Post-welded or 'Weld after Backfill' joints are defined as welded pipe joints that have been coated and backfilled prior to completing interior welds.
2. Post welded joints shall be coated and protected as follows:
    a. Joint coating shall be Canusa AquaShield heat shrink joint sleeves only. Tape wrapped joints will not be acceptable.
    b. Provide 6-inch wide Canusa AquaShield protective layer centered over the interior weld location as recommended by the joint sleeve manufacturer. Heat resistant tape will not be acceptable.
    c. Hold back primer shall be suitable for post weld conditions as specified this section and shall not exhibit any binder breakdown in the heat effect zone that causes loss of joint coating adhesion to the holdback primer.

d. Filler mastic materials shall be high temperature materials with 500 degree F minimum melting point .

e. Joints shall be fully buried prior to welding, with not less than 36-inch cover of soil or flowable fill material on all sides. Sand or flowable fill backfill is preferred for weld after backfill joints.

3. Welding of the joints shall be in conformance with SAWS Standard Specification 816: Steel Pipe Installation and as modified herein:

a. All welding shall be with stick electrodes and two or more weld passes as required to meet the specified AWS qualified welding procedures and maximum coating temperature limitations. 'Weld after Backfill' procedures on wall thicknesses of ¼ inch or less must be approved by the Construction Manager based on field testing demonstrating the welding procedures can comply with the requirements of this specification.

b. Welding speed, amperage, and voltage shall be as required to maintain a maximum heat input of 23,000 joules or a maximum surface temperature at the coating/steel interface of 800 degrees F, whichever is least.

c. Maximum weld temperature and duration shall not result in full carbonization of the joint coating adhesive. Full carbonization is defined as the loss of volatile organic compounds that result in complete loss of tackiness, adhesion to the steel, and corrosion protection properties.

d. Finished joint coating shall not have any visual creases or folds in the joint coating backing material that extends through both the inner protective layer and outer joint sleeve.

4. If CONTRACTOR elects to post-weld any joints, CONTRACTOR shall demonstrate that the joint welding procedures will not significantly damage the coating by fully excavating the first two joints for evaluation of the joint coating condition. Owner will randomly select up to five additional post-welded joints for excavation by CONTRACTOR for evaluation of joint coating condition. Joint coating will be destructively evaluated by the Owner. CONTRACTOR will removed and replace joint heat shrink sleeve upon completion of the evaluation.

5. In the event that any excavated post welded joint exhibits any heat related damage as defined herein, CONTRACTOR shall modify and test a new post welding procedure prior to completing any additional post-welded joints. CONTRACTOR shall demonstrate that the revised joint welding procedure will not significantly damage the coating by repeating the weld after backfill evaluation requirements defined in this Section, including excavation of the five additional randomly selected joints for destructive evaluation.

C. Heat Shrink Sleeve Joint Coating:

1. Store, handle, and apply field heat shrink sleeve coatings in accordance with AWWA C216 and these specifications.

2. Store sleeves in shipping box until use is required. Keep dry and sheltered from exposure to direct sunlight. Store off the ground or concrete floors and maintain at a temperature between 60 and 100 degrees as recommended by the sleeve manufacturer.

3. Metal surface shall be free of all dirt, dust, and surface corrosion prior to sleeve application. Surface preparation shall be in accordance with the joint coating manufacturer's recommendations.

4. Where corrosion in the holdback area is visible, surfaces shall be prepared in accordance with SSPC-SP10, near white metal blast, or SSPC-SP11, power tool cleaning to bare metal.

5. Preheat pipe uniformly as recommended by the sleeve manufacturer. Monitor pipe temperature using a surface temperature gauge, infrared thermometer, or color changing crayons. Protect preheated pipe from rain, snow, frost, or moisture with tenting or shields and do not permit the joint to cool.

6. Fill all cracks, crevices, gaps, and step-downs greater than ¼ inch with filler mastic in accordance with the manufacturer's recommendations for the full circumference of the pipe.

7. Apply heat shrink sleeve when it is at a minimum temperature of 60 degrees and while maintaining the pipe temperature above the preheat temperature specified. Apply sleeve in accordance with the manufacturer's instructions and center the sleeve over the joint to provide a minimum 2-inch overlap onto the existing pipe coating.

8. Completed joint sleeve shall be fully bonded to the pipe and existing coating surface without voids. Mastic beading shall be visible along the full circumference of the sleeve. There shall be no excessive wrinkling or burns on the sleeves. Sleeves that do not meet these requirements shall be removed and the joint recoated as directed by the Owner. Minor repairs may be repaired using heat applied patch material specified for minor coating repairs.

9. Allow the sleeve to cool before backfilling. In hot climates, provide shading from direct sunlight. Water quenching will be allowed only when permitted by the sleeve manufacturer.

10. Heat shrink joint coatings which have become wrinkled or disbonded because of prolonged exposure to UV light or thermal cycling shall be removed and replaced.

11. Double coating of defective or damaged heat shrink coatings will not be permitted. Any double coated heat shrink sleeves shall be immediately rejected and CONTRACTOR shall remove and recoat the joint.

3.07 REPAIR OF COATING AND LININGS

A. General:

1. All areas where holidays are detected or coating is visually damaged, such as blisters, tears, rips, bubbles, wrinkles, cuts, or other defects shall be repaired. Areas where no holidays are detected, but are visually damaged shall also be repaired.

2. Maximum defects allowable shall be as specified herein for the coating system.

B. Polyurethane Coating or Lining Repairs

1. General

a. Complete coating or lining repairs in accordance with the coating manufacturers written instructions and these specifications, whichever is stricter.

b. Defect Size:

1). Minor repairs - repairs that are less than 6-inches in the greatest dimension.

2). Major repairs - repairs that exceed 6-inches in the greatest dimension.

c. Pipes exceeding the maximum number or size of coating defects shall be stripped of coating, reblasted, and recoated.

d. Pipe arriving in the field with defects or repairs exceeding the maximum number or size of coating defects will be returned to the shop for recoating at the CONTRACTOR's expense.

2. Minor Repairs:

a. Coating or lining repairs on any joint of pipe shall not exceed 1.5 per 100 square feet of surface area.

b. Two or more minor repairs within 6-inches diameter circle will be considered a single repair.

c. Repairs for adhesion testing will not be included in the total number of repairs.

d. Minor repairs

1). Surface Preparation: Clean and feather the defect by power tool sanding with 80 grit or coarser sandpaper to roughen the existing coat and feather the edges of the defect for a minimum of 2-inches around the defect.

2). Shop repair Materials:

a). Slow setting parent material polyurethane coating material in syringes or other single use packaging that controls mix ratio.

b). Coating Manufacturer's polyurethane coating repair products subject to Engineer approval.

3). Field Repair Materials:

a). Melt stick coating repair (not acceptable for repairs greater than 1-inch diameter); ScotchCoat P206, or approved equal.

b). Heat applied coating materials; PERP Patch, Tyco Adhesives, or approved equal.

c). Coating Manufacturer's polyurethane coating repair products subject to Engineer approval.

4). Apply a single coat of the specified patch coating material at the specified coating thickness.

5). Repairs adhesion shall be 50 percent of the specified coating adhesion.

3. Major Repairs:

a. Major repairs shall not exceed two per pipe joint and the combined area shall not be greater than 50 percent of the pipe.

b. Major repairs:

1). Surface Preparation:

a). The metal surface and surrounding coating shall be abrasively blasted in accordance with SSPC-SP10, near white metal, or to equal in cleanliness and profile as the original surface preparation.

b). Existing coating shall be feathered and roughened to the equivalent of 40 grit sandpaper.

2). Shop Repair Materials:

Same material as the pipeline coating or lining and shall be applied by using plural component spray equipment.

3). Field Repair Materials:

a). Same material as the pipeline coating or lining and shall be applied by using plural component spray equipment.

b). Heat shrink sleeves as specified for pipeline joints.

c. One coat of the specified original coating material shall be applied over the repaired surface at the specified thickness.

d. Repair adhesion shall be equal to the specified coating adhesion.

3.08 INSPECTION AND TESTING

A. General

1. Applicator shall inspect and test the coating system in accordance with referenced standards and these specifications, whichever is more stringent.

2. The frequency of the testing shall be determined by the applicator, but shall not be less than the requirements of this specification.

3. OWNER or OWNER's Representative will conduct random independent inspections and tests for the final acceptance or rejection of pipe coating or lining at any time prior to installing and backfilling pipe.

B. Adhesion Testing

1. General

a. Adhesion testing shall be conducted at the shop prior to shipment. Pipe shipped without adhesion testing will be field-tested. Pipe rejected in the field will be returned to the shop for repair at the sole expense of the CONTRACTOR.

b. A minimum of two pipes will be tested for adhesion from each lot of pipe coated up to 3,000 square feet of pipe. An additional adhesion test

will be conducted on every increment up to 2,000 square feet of pipe coated in excess of the first 3,000 square feet of pipe. (i.e. if one workday of production is 6,000 square feet of pipe, four adhesion tests will be conducted on the pipe lot.)

c. A pipe lot is defined as the quantity of pipe that is coated by a single crew within a work shift, but not to exceed 12-hours.

d. The pipe coating applicator shall repair all coating damage from shop adhesion testing. CONTRACTOR shall be responsible for coating repairs for all field adhesion testing.

e. Adhesion tests will be performed not less than 24 hours after coating application. Tests conducted prior to 24-hours will be acceptable only if the test meets or exceeds the adhesion criteria specified and the test was requested by the pipe fabricator.

f. Pipe will be randomly selected for adhesion testing.

g. OWNER or the OWNER's Representative has the right to conduct additional adhesion testing as deemed necessary to assure the pipe meets or exceeds the requirements of this specification at any time and location prior to pipe installation.

2. Rejection of Coating

a. If any pipe within a lot fails to meet the test criteria specified for the coating type, that pipe shall be rejected along with all other pipes within the lot. Each pipe within the rejected pipe lot will then be individually tested and rejected on a pipe-by-pipe basis in conformance with the test procedures and criteria specific for the coating type.

b. All rejected pipe shall have all coating removed from the full length pipe and the pipe abrasive blasted and recoated.

3. Polyurethane Adhesion Testing

a. Acceptance Criteria

1). Polyurethane coating or lining shall have an adhesion to steel of 1,500 pounds per square inch, minimum. Acceptance will be based on one pull minimum, with no pulls less than the minimum criteria where multiple pulls are conducted on the same joint of pipe.

2). The median value for all coating or lining adhesion pulls performed within a lot of pipe shall not be less than 1,750 psi.

3). Each pipe failing the minimum adhesion criteria shall be rejected. AWWA C222 rejection of pipe based on multiple adhesion pulls is specifically excluded from this specification.

4). Pipe lots failing the median value for all adhesion pulls shall be rejected and each pipe within the lot tested for adhesion. Each pipe that fails the minimum adhesion criteria shall be rejected.

5). Failure shall be by adhesive and cohesive failure only. Adhesive failure is defined as separation of the coating from the steel substrate. Cohesive failure is defined as failure within the coating, resulting in coating remaining both on the steel substrate and dolly.

b. Test Procedures

1). Polyurethane coating adhesion to steel substrates shall be tested using self-aligning pneumatic pull off equipment, such as the Delfesko Positest, and test procedures in accordance with ASTM D4541 and AWWA C222, except as modified in this section.

2). All adhesion test pull records shall be maintained in an electronic spreadsheet that includes pipe identification, pipe coating date, adhesion test date, surface tested (interior or exterior), surface temperature, coating thickness, tensile force applied, rate of pressure change per second, mode of failure, and percentage of substrate failure relative of dolly surface.

3). Dollies for adhesion testing shall be 20 millimeters in diameter, and glued to the coating surface and allowed to cure for a minimum of 12 hours before testing.

4). Polyurethane coatings shall be scored around the dolly prior to conducting the adhesion test. Scoring shall be completed manually, normal to the pipe surface, or in a manner that does not stress or over heat the coating.

5). Adhesion testing shall be performed at temperatures between 55 and 100 degrees F. Tests may be performed at temperatures up to 115 degrees F if no significant affect in the test results are statistically detectable.

6). Partial substrate and glue failures will be retested if the substrate failure is less than 50 percent relative of the dolly surface area and the applied tension was less than the specified adhesion. Pipes that have partial substrate failures greater than 50 percent and less than the specified adhesion will be rejected as a substrate adhesion failure.

7). Glue failures in excess of the minimum required tensile adhesion would be accepted as meeting the specified adhesion requirements.

8). Adhesion tests will be conducted on polyurethane pipe coating and lining independently and will be accepted or rejected independently of the other.

c. Adhesion Test Repairs

1). Repair patches on the polyurethane coating shall be randomly selected for adhesion testing in a manner as described herein and at the discretion of the coating inspector conducting the adhesion tests. Adhesion of repairs shall be as specified for the type of

repair. A minimum of one test per day shall be provided. If the test fails, additional tests may be required by the Engineer.

C. Holiday Testing

1. Holiday tests on polyurethane coatings or linings will be conducted on the completed coating or lining after cure or 24-hours, whichever is less, using a high voltage spark test in accordance with NACE Standard RP-0274 and these specifications. In addition, the pipe shall be holiday tested by the CONTRACTOR just before the pipe is laid in the trench.

2. Coating thickness used for holiday testing shall be the minimum specified coating thickness.

D. Dry Film Thickness Testing

1. Coatings shall be tested for dry film thickness using a properly calibrated magnetic pull off or eddy current equipment.

2. Coating thickness measurements shall be conducted as necessary and without limitation. Testing conformance to the requirements of SSPC PA-2 is specifically excluded from this specification.

3.09 HANDLING, TRANSPORTATION, AND STORAGE

A. Pipe shall be handled in such a manner as to protect the pipe and coating from damage.

B. Coated pipe shall not be shipped or installed until coating has developed full adhesion and cure.

C. During coating application, storage, loading, transportation, unloading, laying and installation, every precaution shall be taken to protect and prevent damage to pipe, lining, and coating. Forklift equipment shall have all bearing surfaces padded with suitable padding material. Lift pipe with web slings a minimum of 12-inch wide and of a type that will not damage the coating. Metal chains, cable, tongs, forklifts or other equipment likely to damage the coating will not be permitted. Dragging or skidding of pipe on grade or in the trench will not be permitted.

D. Provide transportation vehicles with padded bolsters between each layer of pipe and heavy padding under load ties. Bolsters shall be curved to fit the outside of the pipe and 12 inches wide, minimum. All pipe contact locations shall be heavily padded with carpet and strips of the outer tape wrap material (adhesive side against the carpet) during shipment to the project site and from the storage yard to the point of installation.

E. Pipe shall not be stored on rocks, gravel, or other hard materials that might damage the coating. Provide padded 12-inch wide skids and chucks, sand bags, select loamy or sand berms, or suspended from cutback ends, where possible, to minimize coating damage. Pipe shall not be laid on asphalt without suitable padding at all contact points.

F. Pipe shall be inspected by the CONTRACTOR at the project site for damage. Any damage to the pipe, lining, or coating shall be repaired as directed if, in the opinion of the ENGINEER, a satisfactory repair can be made; otherwise, the damaged section shall be replaced at the sole expense to the CONTRACTOR.

G. No metal tools or heavy objects shall be permitted to come into contact unnecessarily with the finished coating. Workmen shall not be permitted to walk on the coating except when absolutely necessary and approved by the Owner. When permitted, shoes with rubber or

composition soles and heels or other suitable footwear that will not damage coating shall be used.

H. Long-term Exposure: Pipe shall either be provided with UV inhibitor for lengthy of above grade exposure or covered to prevent UV degradation of outer wrap. Amount of UV stabilizers required will depend on the project location, laying schedule, anticipated length of exposure, and type of outer wrap. Manufacturer shall be consulted for recommended UV inhibitors requirements or pipe shall be stored under a protective cover. Protective covering can be colored plastic sheeting, canvas, or other UV blocking material. Clear plastic sheets are not acceptable. Areas of coating that display UV degradation shall be removed and repaired at sole cost of the CONTRACTOR.

I. End Caps: Pipe ends of mortar lined pipe and fittings shall be tightly closed with a plastic wrap to aid in curing and to minimize drying out of and contamination of the lining. Plastic end cap shall consist of a minimum of one 10-mil sheet of polyethylene or other suitable material. End caps shall be substantial enough to resist shipment, handling, and storage loads and firmly attached in place. The plastic end cap shall remain intact and in place until pipe installation. Damaged or missing plastic end caps shall be repaired or replaced.

J. Bracing:

1. The steel pipe manufacturer shall furnish and install adequate bracing or strutting to keep the pipe from becoming deformed or damage from occurring to the coating or linings. Strut-type bracing shall be installed as soon as possible after application of lining. Struts shall remain in place during handling, storage, transportation, and installation of pipe and fittings until after the pipe zone material is compacted.

2. The struts shall be installed with pads and wedges in such a manner that the pipe lining will not be damaged and the struts will not be dislodged during shipping and handling of the pipe. If struts are welded, they shall be installed and removed in such a manner to prevent damage to the steel cylinder, lining, or coatings. All damage shall be repaired to the satisfaction of the Engineer.

4.00 MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. Polyurethane coating will not be measured for payment.

4.02 PAYMENT

A. No direct payment shall be made for incidental costs associated with polyurethane coating. All costs in connection with this work shall be included in the applicable contract price for the item to which the work pertains.

END OF SECTION

SECTION 10 14 00

SIGNAGE

1.0 GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, tools, equipment, and incidentals as shown, specified, and required to furnish and install signage.
   2. Extent of signage is shown and specified.
   3. Types of products required include the following:
      a. Room information and directional signs.
      b. Health, safety, warning, floor loading and fire extinguisher location signs.
      c. Pipe markers, tags, and equipment nameplates.
      d. Right-to-know labels, signs and tags.
      e. Exterior building identification signs.
      f. Stainless steel fasteners, supports, very-high-bond high-performance mounting tape, primers and other accessories.

B. Coordination:
   1. Coordinate fasteners with mounting surfaces. Review other Sections to ensure compatibility of signage mounting accessories with various surfaces on which signage will be installed.
   2. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before signage Work.

C. Related Sections:
   1. Section 09 91 00, Painting.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. AA DSA-45, Designation System for Aluminum Finishes.
   2. ASME A13.1 Scheme for the Identification of Piping Systems.
   3. ANSI/ICC A117.1, Accessible and Usable Buildings and Facilities.
   4. ANSI Z535.1, Marking Physical Hazards Safety Color Code.
   5. ANSI Z535.2, Environmental and Facility Safety Signs.
   6. ANSI Z535.3, Criteria for Safety Symbols.
   7. ASTM B26/B26M, Specification for Aluminum-Alloy Sand Castings.
   8. ASTM B584, Specification for Copper Alloy Sand Castings for General Applications.

9. ASTM E527, Practice for Numbering Metals and Alloys in the Unified Numbering System (UNS).
10. CDA, Properties of Cast Copper Alloys.
11. NFPA 704, System for the Identification of the Hazards of Materials for Emergency Response.
12. UL 924, Safety of Emergency Lighting and Power Equipment.

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Signage Manufacturers:
      a. Engage firms specializing in producing types of products specified, in compliance with the Contract Documents, with documented record of successful in-service performance, and that possess sufficient production capacity to avoid delaying the Work.
      b. Submit to ENGINEER name and experience record of manufacturers.

B. Component Supply and Compatibility:
   1. Obtain each separate type of signage from a single Supplier and from a single manufacturer.

C. Regulatory Requirements: Comply with applicable requirements of the following:
   1. OSHA, 29 CFR Part 1910.1200, Hazard Communication Standard.
   2. OSHA, 29 CFR Part 1910, Subpart Z, Toxic and Hazardous Substances.
   3. OSHA, 29 CFR Part 1910.144, Safety Color Code for Marking Physical Hazards.
   4. OSHA, 29 CFR Part 1910. 145, Specification for Accident Prevention Signs and Tags.
   5. United States Access Board, Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines.
   6. Americans with Disabilities Act (ADA), Public Law 101-36, 28 CFR Part 36, Appendix A, Accessibility Guidelines for Buildings and Facilities (ADAAG), relative to characters and symbols contrast only.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Schedule of all signage required for the Work, indicating signage type location, and other information to demonstrate compliance with the Contract Documents.
      b. Fabrication and erection information for each type of signage
      c. Valve schedule for small-diameter valves, in accordance with this Section.
      d. Complete selection of each specified manufacturer's standard and custom graphic layouts and pictograms, colors, and alphabetic/text styles.

e. Full-size graphic layout drawings for plaques and other items where final graphic appearance is necessary prior to signage fabrication, incorporating all required graphic features specified or shown.

f. Mounting and Installation Data:

1) Drawings of and information on anchorages and accessory items.

2) Submit location template drawings for items supported or anchored to permanent construction.

3) Coordinate mounting position, method, and proposed mounting accessories and fasteners with actual Project conditions. Indicate required mounting accessories on plan drawings showing locations of required exit signs based on measurements taken at the Site. Show final location and identify type of mounting surface for each exit sign. Coordinate location of exit signs for non-interference with other Work and as required by authorities having jurisdiction.

2. Product Data:

a. Copies of manufacturer's technical data, including catalog information and specifications, for each product specified.

3. Samples:

a. Each color and finish of exposed materials and accessories required for signage.

b. Sample Signage:

1) Full-size Sample of each type of permanent informational and directional sign incorporating all features specified.

2) Full-sized Sample of each snap-on pipe marker proposed for use with mounting accessories.

3) Full-sized Sample equipment nameplate, valve tag, pipe tag, and accessories. Stamp valve tag with information shown on valve schedules. When not indicated in the Contract Documents, information on the type of coding system will be furnished to CONTRACTOR by ENGINEER.

4) Full-sized Sample right-to-know signs, labels and tags.

c. ENGINEER's review of Samples will be for color and texture only. Compliance with other requirements is CONTRACTOR's responsibility.

B. Informational Submittals: Submit the following:

1. Manufacturer's Instructions:

a. Templates for anchorages to be installed in concrete or masonry.

b. Manufacturer's instructions and recommendations for support and foundations of signs installed outdoors.

C. Maintenance Material Submittals: Submit the following:

1. Extra Stock Materials:

a. Furnish extra stock materials from the same manufactured lot as the materials installed.

b. Submit documentation of actual quantities of signage installed for the Project and calculations indicating the required quantity of extra stock materials.

c. Furnish the following spare parts and accessories:
   1) For every 20 of each type (snap-on only) of pipe markers installed:
   2) For every 20 valve tags and pipe tags installed:
      a) One stainless steel cable and splice.

2.0 PRODUCTS

2.1 SYSTEM PERFORMANCE

A. General:
   1. Details shown or indicated for signage, such as alpha-numeric and text type representation, letter spacing, designs of borders, and other graphic features, are generic and intended only to establish text, general positions, and symbols.
   2. Colors shall be brilliant, distinctive shades, matching the safety colors specified in ANSI Z535.1 and OSHA 1910.144.
   3. Accident prevention signs and tags shall comply with OSHA 1910.145.
   4. Health, safety, and warning signs shall comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, OSHA 1910.144, and 1910.145, unless otherwise shown or indicated. Colors shall be as indicated in Table 1 of ANSI Z535.1. In addition to text, safety symbol pictograms shall be incorporated into each sign.

2.2 PANEL SIGNS – INFORMATION AND DIRECTIONAL

A. Products and Manufacturers: Provide one of the following:
   1. Graphic Blast MP and FG ADA System and Custom Design ADA Series, by Best Sign Systems, Inc. (via distributor Mission City Specialty Co., San Antonio, TX)
   2. Blast Etched Fiberglass and Blast Etched Melamine Signs, by **Visigraph** Corporation.
   3. Or Engineer-approved equal.

B. Panel Signs – Room Identification, Information, Entry, and Directional:
   1. Product Description: Provide unframed signs, surface-etched, 1/32-inch raised tactile lettering and pictograms, sandblasted on an opaque sheet.
   2. Materials:
      a. Interior Signs: Three-ply, self-extinguishing melamine plastic.
      b. Exterior Signs: One-piece fiberglass.
   3. Size and Thickness: 0.125-inch thick; eight inches by eight inches with 1/2- inch radiused corners.
   4. Graphics and Text: White, Standard Helvetica Medium characters and matching arrow type-face; upper and lower case letters, one-inch high capitals and, in addition, Grade 2 Braille alphabet for room designation, directional, entry, and information signs.

2.3 PANEL SIGNS – HEALTH, SAFETY, WARNING, FLOOR LOADING, AND FIRE EXTINGUISHER LOCATION

A. Product Description: Provide rigid fiberglass reinforced plastic signs with fade- resistant embedded graphics.

B. Products and Manufacturers: Provide one of the following:
   1. Graphic Blast Word and Picture Series, by Best Sign Systems, Inc.
   2. Blast Etched Fiberglass Signs, by Visigraph Corporation.
   3. Or Engineer-approved equal.

C. General:
   1. Size and Thickness: 0.125-inch thick; 10 inches by 14 inches, unless otherwise shown or indicated.
   2. Graphics and Text: Standard Helvetica Medium characters and matching arrow type-face; upper and lower case, one-inch high capitals..
   3. Exposure: As recommended by sign manufacturer for both indoor and outdoor use and with an upper service temperature limit of 190degrees F. Average durability for outdoor use shall be 15 years.

D. Safety Instruction Signs: Standard color of sign background shall be white; panel shall be green with white letters and numbers. Letters and numbers used against white background shall be black.

E. Caution Signs: Standard color of sign background shall be yellow; panel shall be black with yellow letters and numbers.

F. Danger Signs: Standard color of sign background shall be white; panel shall be black with red insert with white letters and numbers. Letters and numbers used against white background shall be black.

G. Warning Signs: Standard color of sign background shall be orange; panel shall be black with orange insert with black letters and numbers. Letters and numbers used against orange background shall be black.

H. No Smoking Signs: Standard color of sign background shall be white. Letters and numbers used against white background shall be red.

I. Biohazard Signs: Standard color of sign background shall be white; panel shall be black with white letters. Sign shall include red international biohazard pictogram on white background.

J. Floor Loading Signs: Standard color of sign background shall be white; panel shall be blue with white letters and numbers. Letters and numbers used against white background shall be black.

K. Fire Extinguisher Location Signs (surface-mounted units only): Standard color of sign background shall be red with white letters and numbers. Each sign shall

include international fire extinguisher pictogram and directional arrow indicating location of fire extinguisher.

L. Auxiliary Products:
1. Mounting Brackets: Provide sign manufacturer's standard mounting brackets for installing projected or double-sided signs.

2.4 PIPE MARKERS

A. Description:
1. Provide snap-on pipe markers for each pipeline provided under the Contract, and for other piping indicated to receive pipe markers.

B. Products and Manufacturers: Provide one of the following:
1. Custom High Performance Pipe Markers (B-689), and SnapOn Pipe Markers (B-915), by Brady Worldwide, Inc., Signmark Division.
2. Or Engineer-approved equal.

C. Pipe Markers:
1. Lettering of Titles/Legend and Color Field Size:
a. Letter size and color field length shall be as indicated in Table 10 14 00-A of this Section:

TABLE 10 14 00-A, PIPE MARKERS:
SIZE OF TEXT AND COLOR FIELD

Outside Diameter of Pipeline or Covering* (inches)	Size of Text (Legend Characters)	Minimum Length of Color Field**
3/4 to 1.25	1/2-inch	8 inches
1.5 to 1-7/8	3/4-inch	8 inches
2 to 5-7/8	1.25-inch	12 inches
6 to 9-7/8	2.5-inch	24 inches
10 and Larger	3.5-inch	32 inches
*Outside diameter includes pipe diameter plus insulation and jacketing. **Length of sign and color field shall be as required to accommodate required legend, and shall not be less than minimum length indicated unless required otherwise by space constraints.		

b. Text and symbols shall be Standard Helvetica Medium, all upper case. Pipe markers shall include text with separate arrow signs indicating direction of flow of pipeline contents. Pipe markers with arrows shall be located as specified in Part 3 of this Section.
c. Pipe markers indicating pipeline contents shall identify pipeline contents by complete name, as indicated in Table 10 14 00-B of this Section. Obtain from ENGINEER interpretation of required pipe marker text for pipelines provided under the Project that are not listed in Table 10 14 00-B of this Section.

2. Pipe Marker Materials:
   a. General: The following are applicable to all types of pipe markers furnished under this Section:
      1) Provide pipe markers with ultraviolet light-resistant, sealed, subsurface color graphics, recommended by sign manufacturer, suitable for both indoor and outdoor use.
      2) Pipe markers shall be resistant to abrasion, chemical reagents, and physical agitation such as washdowns and wind.
      3) Provide manufacturer's full selection of standard and custom sizes and graphics.
      4) Where manufacturer has established minimum order quantities for custom units provide minimum order quantities at no additional cost to OWNER.
   b. Materials: Provide the following at CONTRACTOR's option, suitable for outside diameter of the associated pipe and pipe covering:
      1) Snap-on Pipe Markers: Snap-on pipe markers shall be the only pipe markers used. They shall be cylindrically coiled, printed plastic sheets. Pipe marker total thickness for pipe and pipe covering from 3/4-inch to 2-3/8-inch outside diameter shall be not less than 0.020- inch. Pipe marker total thickness for pipe and pipe covering from 2.5-inch through six-inch ourside diameter shall be not less than 0.030-inch. Suitable for service temperature ranging from -40 degrees F to 180 degrees F.
3. Legend for Pipe Markers: Pipe markers shall have the text or abbreviations in the color combinations indicated in Table 10 14 00-B of this Section to identify the pipeline service hazard. Pipe marker colors shall comply with ASME A13.1, unless otherewise indicated.

TABLE 10 14 00-B,
SCHEDULE OF PIPE MARKERS*

Pipeline Legend	Lettering/Text Color	Background Color
Potable Water	White	Light Blue
Overflow	Black	Dark Gray
Vent	Black	Tan
Sump Drain	White	Dark Gray
Roof Drain	White	Dark Gray
HVAC Condensate	White	Dark Gray
Fluoride	Black	Orange

2.5 EQUIPMENT NAMEPLATES

A. Description:
   1. Provide equipment nameplate for each equipment item furnished under the Contract, and for other equipment items indicated to receive nameplates. Equipment nameplates specified in this Article are in addition to equipment manufacturer's standard nameplate with manufacturer name, model number, serial number, and similar information.

2. Install equipment nameplates as indicated in Part 3 of this Section. Mechanically fasten equipment nameplates to the associated equipment item.

B. Products and Manufacturers: Provide one of the following:
   1. Engraved Plastic Tags (B-1), by Brady Worldwide, Inc.
   2. Custom Engraved Plastic Nameplates, by Seton Identification Products, a Tricor Direct Company
   3. Or Engineer-approved equal.

C. Equipment Nameplates:
   1. Material: Type 304 or Type 316 stainless steel, 26-gage, with rounded corners. Suitable for temperatures ranging from -40 to 89 degrees C.
   2. Provide each equipment nameplate with not less than two holes, each approximately 3/16-inch diameter, for mechanically fastening nameplate to the associated equipment. Provide appropriate stainless steel fasteners.
   3. Nameplate Size:
      a. Size shall be as required for required text, and shall be not less than one-inch by four inches.
   4. Text Engraved on Nameplates:
      a. Text Size: Equipment nameplate titles shall have text as large as possible to fit on nameplate; text shall be not less than 1/2-inch high. All text on a given nameplate shall be one size.
      b. Text and symbols shall be Standard Helvetica Medium, all upper-case.
      c. Left-justify multiple lines of text
      d. Where more than one item of the same type of equipment is furnished, consecutively number each associated equipment nameplates as shown or indicated; for example “Pump No. 1”, “Pump No. 2”, “Pump No. 3”, and so on.
   5. Legend for Nameplates:
      a. Nameplates for equipment, including operating stands for valves and gates, shall be in accordance with the required text and colors indicated in Table 10 14 00-C.
      b. Obtain interpretation from ENGINEER for equipment not included in Table 10 14 00-C.

TABLE 10 14 00-C, SCHEDULE OF EQUIPMENT NAMEPLATES*			
Legend		**Color***	
First Line	**Second Line**	**Lettering/Text**	**Background**
Air Handling Unit	**		
Air Conditioning Unit	**		
Exhaust Fan	**		
Hydrofluosilicic Acid Bulk Storage Tank	**		
Hydrofluosilicic Acid Day Tank	**		
Hydrofluosilicic Acid Metering Pump	**		
Well Pump	**		
Well Motor	**		
High Service Pump	**		
High Service Motor	**		

* Color will be selected by ENGINEER.

** The legend on the indicated nameplates shall also include the appropriate number designation for such equipment, including valve stands and gate operators as shown on the Process and Instrumentation Drawings or as indicated by ENGINEER.

2.6 VALVE AND PIPELINE TAGS

A. Products and Manufacturers: Provide one of the following:
   1. Custom Engraved Stainless Steel Valve Tags, by Brady Worldwide, Inc.
   2. Custom Stainless Steel Valve Tags, by Seton Identification Products, a Tricor Direct Company
   3. Or Engineer-approved equal.

B. Metal Tags:
   1. For each valve and for pipelines smaller than 3/4-inch outside diameter, provide permanently-legible, round metal tags, each two-inch diameter, Type 304 or Type 316 stainless steel, with engraved lettering filled with black enamel. Provide tags with 3/16-inch diameter hole located that does not interfere with legend.
   2. Legend for Valve Tags:
      a. Based on information provided on the Drawings, submit to ENGINEER not less than 14 days before system startup, a valve schedule indicating all required valves.
      b. For each valve, the valve schedule shall indicate: location, valve type, valve number, words to identify valve's function, type of operator, and normal operating position.
      c. Information presented in the valve schedules shall be coded on tags in a system provided by or acceptable to OWNER. Each valve shall be

coded and identified by ENGINEER utilizing a combination of up to twelve letters and numbers.

3. Legend for Small Pipeline Tags: Comply with requirements for pipe markers relative to legend. Where legend is not indicated, obtain interpretation from ENGINEER.
4. Miscellaneous Valve and Small Pipeline Tag Accessories:
   a. Stainless Steel Wire: Nylon-coated; 0.048-inch outside diameter.
   b. Clamps: Brass.
   c. Lead Seals: Monel; four ply, 0.014-inch by 10 inches long; for attaching tags.
   d. Hand Sealing Press: As recommended by tag manufacturer for crimping lead seals.

2.7 PANEL SIGNS – RIGHT-TO-KNOW LABELS, SIGNS, AND TAGS

A. Products and Manufacturers: Provide one of the following:
   1. Custom B-302 Pressure Sensitive Polyester Right-To-Know Labels, B-120 Fiberglass Chemical Tank Signs, Front No. 1/Back No. 1 B-851 Right-To- Know Accident Prevention Tags and Right-To-Know Pictograms, by Brady Worldwide, Inc.
   2. Right-to-Know & HazCom Signs, Labels, and Tags, by Seton Identification Products, a Tricor Direct Company.
   3. Or Engineer-approved equal.

B. General:
   1. Right-to-know signs, labels, and tags shall use NFPA 704 “diamond” hazard identification systems and shall comply with OSHA 1910.1200 and OSHA Subpart Z.

C. Tank Signs:
   1. Provide quantity of signs shown or indicated, identifying the chemical stored in the tank, chemical's hazards, required protective equipment in text and pictograms, first-aid for eyes, skin, ingestion and inhalation, information on confined space entry and NFPA 704-required hazard rating system information.
   2. Right-to-know fiberglass signs for storage tanks shall have pressure- sensitive adhesive backs and be provided with subsurface numbers, symbols, text, and legends. Labels shall indicate chemical name and chemical abstracts service number, fire and health hazard potential, reactivity, personal protection and target organ legends in compliance with NFPA 704 format and OSHA 1910.1200.

D. Labels: Provide right-to-know polyester labels for each hazardous chemical container. Provide labels seven inches by ten inches with information pre-printed by manufacturer. Provide labels with two-mil polyester overlaminate and with a complete line of all standard and custom pictograms.

E. Tags: Provide 15-mil right-to-know vinyl tags with self-adhering clear polyester overlaminate. Tags shall be laminated plastic and provided with nylon tie fasteners. Provide tags three inches by 5.75 inches with two chamfered corners with reinforced 3/16-inch diameter grommeted hole.

2.8 WARNING SIGN

A. Provide warning sign on entrance gate to facility.
   1. Sign shall be mounted to fence with stainless steel fasteners.
   2. Sign shall be constructed of reflective aluminum.
   3. Sign shall be minimum 63 mils thick.
   4. Sign shall conform to Texas Manual on Uniformed Traffic Control Devices
   5. Provide sign with following graphic.

2.9 INDIVIDUAL DIMENSIONAL CUT-OUT CHARACTERS

A. Provide individual cut-out metal letters and numbers with smooth, flat faces, sharp corners, true lines, and accurate profiles.
B. Products and Manufacturers: Provide one of the following:
   1. Cut-Out Individual Clear Anodized Aluminum Letters and Numbers, by Gemini, Inc.
   2. Cut-Out Individual Clear Anodized Aluminum Letters and Numbers, by Visigraph Corporation.
   3. Or Engineer-approved equal.
   4. Refer to drawings for signage and location

2.10 AUXILIARY MATERIALS

A. Very-High-Bond High-Performance Bonding Tape:
   1. Provide all surface-mounted signage with very-high-bond foam tape backing except where specified as requiring mechanical fasteners.
   2. Products and Manufacturers: Provide one of the following:
      a. Scotch Brand (Very-High-Bond) 4942 VHB Double Coated Acrylic Foam Tape and No. 94 Acrylic Primer, by 3M Industrial Tape and Specialties Division.
      b. Or equal.
   3. Provide a very-high-bonding pressure sensitive joining system consisting of double-coated conformable acrylic foam tape and release liners.
   4. Thickness: 0.045-inch.
   5. Tape Width: 1.5 inches.
   6. Color: Dark gray.
   7. Bonding Adhesive: Acrylic; very-high-bond, solvent and shear resistance.
   8. Primer: High-performance tape manufacturers recommended acrylic primer.

B. Fasteners: Provide fasteners of non-magnetic stainless steel of size and type required and recommended by the associated individual signage manufacturer.

C. Anchors and Inserts: Provide nonferrous metal or hot-dipped galvanized anchors and inserts. Provide toothed stainless steel or lead expansion bolts for drilled-in- place anchors.

D. Mounting Brackets:
   1. Provide manufacturer's standard mounting brackets for each of the following sign types: hanging, projected, double-sided.
   2. Provide inserts, and mechanical and adhesive anchoring devices as specified in this Article for installation of signage.

2.11 FABRICATION

A. Shop Assembly:
   1. Fabricate and preassemble items in the shop to the greatest extent possible.
   2. Disassemble units only to extent necessary for shipping and handling limitations.
   3. Clearly mark units for reassembly and coordinated installation.

2.12 SOURCE QUALITY CONTROL

A. Fabrication Tolerances:
   1. Produce smooth, even, level sign panel surfaces, constructed to remain flat under installed conditions within tolerance of plus or minus 1/16-inch measured diagonally across each sign.

3.0 EXECUTION

3.1 INSPECTION

A. Examine substrates and conditions under which signage will be installed and notify ENGINEER in writing of conditions detrimental to the proper and timely completion of theWork. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. General:
   1. Location:
      a. Install signage and appurtenances at the locations shown or indicated. When locations are not shown or indicated, install signage at locations directed by ENGINEER.
      b. Provide exit signs at locations shown or indicated. Surface-mount signs above each point of egress, unless otherwise shown or indicated.
      c. Lightly mark and locate position of each sign. Obtain ENGINEER's acceptance of marked locations before mounting.
   2. Installation – General:
      a. Install signs level, plumb, and at proper height.
      b. Signage shall be securely mounted with concealed, very-high-bond acrylic foam tape, specified adhesives, or mechanical fasteners where specified. Attach signs to surfaces in accordance with sign manufacturer's instructions, unless otherwise shown or indicated.
      c. Provide very-high-bond acrylic foam tape on back of signage using a full perimeter of specified tape. Leave no gaps in tape perimeter at back of signage; peel off second release liner and press onto surfaces.
   3. Repair or replace damaged units.

B. Panel Signs – Room Identification, Directional, and Information Signs:
   1. Where permanent identification is provided for rooms and spaces, install signs on the wall adjacent to the latch side of the door.
   2. Where there is no wall space on the latch side of the door, including at double leaf doors, install signs on the nearest adjacent wall.
   3. Mounting height shall be in accordance with ADA-ABA Accessibility Guidelines in areas accessible to disabled people. For other areas install signs with five feethes from the finished floor to centerline of sign. Mount such signage so that a person may approach within three inches of the sign without encountering protruding objects or, when reading sign, be forced to stand within the swing of a door.

C. Pipe Markers, Equipment Nameplates, and Pipe and Valve Tags:
   1. Location of Pipe Markers and Pipe Tags:
      a. Provide pipe markers with text (pipeline contents or service) and adjacent arrow indicating the direction of flow of pipeline contents on each piping system provided under the Project and other piping systems shown or indicated as to receive pipe markers.
      b. Locations: Provide pipe markers at each of the following locations:

1) At intervals of not more than 30 linear feet apart
2) Directly adjacent to each side of each penetration by the pipeline of the following: wall, floor, ceiling, roof.
3) Adjacent to each change in flow direction.
4) On each branch where pipes connect together including but not limited to tees, wyes, and crosses.
5) Adjacent to each side of each valve (including but not limited to check valves, isolation valves, control valves, and other valves), strainer cleanouts, and each equipment item along the pipeline.
6) Comply with ASME A13.1.

c. Provide flow-direction arrows at intervals not greater than 15 linear feet. Where flow may be bi-directional, provide arrows adjacent to each other to indicate both directions.

d. Pipe marker locations will be determined by ENGINEER, but in general place pipe markers where personnel view of label is unobstructed. When pipeline is overhead, install label on the two lower quarters of the pipe or pipe covering. Pipe markers shall be clearly visible from personnel operating positions, especially operating positions adjacent to valves and equipment.

e. Provide pipe tags, where specified, at locations as specified for pipe markers.

2. Location of Valve Tags and Valve Nameplates:
   a. Valve nampeplates and valve signs for large valves shall be located on or adjacent to the valve.
   b. For smaller valves, attach tags to valve bonnet or valve flange bolts.
   c. For valves to receive equipment nameplates, as specified in this Section, install nameplate as requied for other equipment nameplates.
   d. Do not attach tags, nameplates, or signs to valve handwheels or other valve actuators.
3. Equipment Nameplates:
   a. Locate nameplates on equipment bases and on structures at readily- visible elevation in such positions relative to the equipment and structures as to prevent damage to nameplate.
   b. Position nameplace for ease of reading by operations and maintenance personnel.

D. Panel Signs – Right-To-Know Signs, Labels, and Tags:
1. Locate tags at intervals of not more than 20 feet center-to-center along chemical pipelines and fill pipelines and on each side of locations where pipelines emerge from penetrations with other materials.
2. Install tank signs on each tank shown or indicated to receive signage at quarter-points on tank circumference, five feet above finished floor.

E. Individual Dimensional Characters:
1. Install characters using standard fastening methods to comply with manufacturer's written instructions for character form, type of mounting, wall construction, and condition of exposure indicated. Provide heavy paper template to establish character spacing and to locate holes for fasteners.
2. Projected Mounting: Install characters at projection distance from wall surface indicated.

3.3 PROTECTION AND CLEANING

A. After installation, clean soiled signage surfaces in accordance with manufacturer's written instructions.

B. Protect signage from damage until completion of the Work.

END OF SECTION

PART 1 – GENERAL

11295.1 DESCRIPTION

The work covered under this item shall consist of furnishing all labor, supervision, tools, materials, equipment and incidentals required to completely install and put into operation a pressure reducing valve, as specified herein and shown on the plans. The pressure reducing valve shall be a hydraulically operated, diaphragm actuated control valve that reduces higher upstream pressure to lower constant downstream pressure regardless of fluctuating demand or varying upstream pressure.

11295.2 REFERENCES

1. American Society for Testing and Materials (ASTM).

2. ASTM A48 – Standard Specification for Gray Iron Castings.

3. ASTM A126 – Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

4. ASTM A436 – Standard Specification for Austenitic Gray Iron Casting.

5. ASTM A536 – Standard Specification for Ductile Iron Castings.

6. American National Standards Institute (ANSI)

7. ANSI B16.42 – Ductile Iron Pipe Flanges and Flanged Fittings

8. NSF 61 – Drinking Water System Components

11295.3 QUALITY ASSURANCE

1. The valve shall be the product of a manufacturer regularly engaged in the manufacture of hydraulic valves having similar service and size. The valves covered by the specifications are intended to be standard equipment that have proven ability.

2. Valves manufactured by other than those specified herein will <u>not</u> be considered for substitution. Any non-approved materials or equipment installed shall be removed by Contractor at no additional expense to Owner.

3. All equipment specified under this section shall be furnished by the valve manufacturer. The manufacturer shall be responsible for the adequacy and

compatibility of all unit components including but not limited to the valve, actuator, and valve control system. Any component of each complete unit not provided by the valve manufacture shall be designed, fabricated, tested, and installed by factory-authorized representatives experienced in the design and manufacture of the equipment. This requirement, however, shall not be construed as relieving the Contractor of the overall responsibility for this portion of the work.

4. The valve shall be certified as a complete drinking water valve according to NSF 61.

11295.4 SUBMITTALS

1. The following information/documents shall be submitted to Engineer and Owner. Submittals must be approved by Engineer and Owner prior to ordering of materials or equipment:

   A. Technical bulletins and brochures.

   B. Certifications of compliance with these specifications.

   C. Electronic copies of certified drawings showing the principal dimensions, general construction, and material specification for each valve size and/or model.

2. Complete Operation and Maintenance Manual(s) shall be submitted to Engineer and Owner prior to final project walk through inspection.

11295.5 REGULATORY AND SAFETY REQUIREMENTS

1. Contractor shall comply with all applicable federal, state, and local regulations.

2. Contractor shall comply with all applicable OSHA safety requirements.

3. Work shall be completed in accordance with the Bexar County Storm Water Pollution Prevention Plan for the site, as applicable.

PART 2 – PRODUCTS

11295.6 OPERATING INSTRUCTION/TRAINING

1. A factory representative of all major component manufactures, who has complete knowledge of proper operation and maintenance, shall be provided

for one day to instruct representatives of the Owner on proper operation and maintenance of those components. If there are difficulties in operation of the equipment during instruction sessions, additional sessions shall be provided at no cost to the Owner.

2. Prior to scheduling Owner training, Operation and Maintenance manual shall be submitted for review.

3. Operation and maintenance manual shall be explained to Owner's representatives during the training.

11295.7 SHIPPING AND STORAGE

1. All parts shall be properly protected so that no damage or deterioration will occur from time of shipment until installation is completed and the units and equipment are ready for operation.

2. Contractor shall properly store and protect all equipment and parts against any damage prior to installation. If damaged, Contractor shall be responsible for replacement of equipment and parts at Contractor's own expense.

3. The finished surfaces of all exposed flanges shall be protected by wooden flanges, strongly built and securely bolted thereto.

4. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion.

11295.8 WARRANTY

1. 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 and the unit(s) restored to service at no expense to the Owner. Warranty shall be for a period of two years and begin on the Date of Final Acceptance.

11295.9 PRODUCTS

1. Pressure Reducing Valves

   a) Manufacturer: Valves furnished under this specification shall be Model 90-01 as manufactured by Cla-Val.

   b) Main Valve

      1) The valve shall be hydraulically operated and single diaphragm-

actuated. The valve shall consist of three major components: the body, with seat installed; the cover, with bearings installed; and the diaphragm assembly. The diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve, separating operating pressure from line pressure. Packing glands and/or stuffing boxes are not permitted and there shall be no pistons operating the main valve or pilot controls.

2) The valve shall contain a resilient, synthetic rubber disc with a rectangular cross-section contained on three and one-half sides by a disc retainer and forming a tight seal against a single removable seat insert. No O-ring type discs (circular, square, or quad type) shall be permitted as the seating surface. The disc guide shall be of the contoured type to permit smooth transition of flow and shall hold the disc firmly in place. The cylindrical disc retainer shall be of a sturdy one-piece design capable of withstanding opening and closing shocks. It must have straight edge sides and a radius at the top edge to prevent excessive diaphragm wear as the diaphragm flexes across this surface. No hourglass shaped disc retainers shall be permitted and no V-type or slotted type disc guides shall be used.

3) The diaphragm assembly containing a non-magnetic 303 stainless steel stem; of sufficient diameter to withstand high hydraulic pressures shall be fully guided at both ends by a bearing in the valve cover and an integral bearing in the valve seat. The seat shall be a solid, one-piece design and shall have a minimum of a five-degree taper on the seating surface for a positive, drip-tight shut off. No center guides shall be permitted. The stem shall be drilled and tapped in the cover end to receive and affix accessories that aide in the valves' performance.

4) The flexible, non-wicking, FDA approved diaphragm shall consist of nylon fabric bonded with synthetic rubber compatible with the operating fluid. The center hole for the main valve stem must be sealed by the vulcanized process or a rubber grommet sealing the center stem hole from the operating pressure. The diaphragm must withstand a Mullins Burst Test of a minimum of 600 psi per layer of nylon fabric and shall be cycle tested 100,000 times to insure longevity. The diaphragm shall not be used as the seating surface. The diaphragm shall be fully supported in the valve body and cover by machined surfaces which support no less than one-half of the total surface area of the diaphragm in either the fully opened or fully closed position.

5) The main valve seat and the stem bearing in the valve cover shall be removable. The cover bearing and seat in 6" and smaller size valves shall be threaded into the cover and body. The valve seat in 8" and larger size valves shall be retained by flat head machine screws for ease of maintenance. The lower bearing of the valve stem shall be contained concentrically within the seal and shall be exposed to the flow on all sides to avoid deposits. To ensure proper alignment of the valve stem, the valve body and cover shall be machined with a full circumference locating lip. No "pinned" covers to the valve body shall be permitted. Cover bearing, disc retainer, and seat shall be made of the same material. All necessary repairs and/or modifications other than replacement of the main valve body shall be possible without removing the valve from the pipeline. Packing glands and/or stuffing boxes shall not be permitted.

6) The valve manufacturer shall warrant the valve to be free of defects in material and workmanship for a period of three years from date of shipment, provided the valve is installed and used in accordance with all applicable instructions. Electrical components shall have a one-year warranty. The valve manufacturer shall be able to supply a complete line of equipment from 1 ¼" through 48" sizes and a complete selection of complementary equipment. The valve manufacturer shall also provide a computerized cavitation chart which shows flow rate, differential pressure, percentage of valve opening, Cv factor, system velocity, and if there will be potential for cavitation damage.

c) Material Specifications

1) Valve size:
   - Main Line (High Flow): 8" Full Port
   - Bypass Line (Low Flow): 4" Full Port

2) Main Valve Body and Actuator: Ductile Iron (ASTM A-536)

3) Main Valve Trim: 316 Stainless Steel

4) Tubing and Fittings: 316 Stainless Steel

5) Actuator Internal Assembly: 316 Stainless Steel

6) Internal Trim (Closure and Seat): 316 Stainless Steel

7) Control Accessories: 316 Stainless Steel

8) Bolts and Nuts: 316 Stainless Steel

9) End Flange: ANSI B16.42, Class 150

10) Min. Working Pressure Rating: 200 PSI

11) Temperature Range: -40 to +180 Degrees F

12) Rubber Material: Buna “N”

13) Coating: Epoxy coated by baked on resin fusion method process, 10 mils thick, internal & external, 3 mil fluorothane coating

d) Valve Options

1) Valve Position Indicator

- Limit switch assembly with weatherproof enclosure that will provide position indication to SCADA (open, closed, and transition)

2) Closing and Opening Speed Control

3) Valve and fittings shall be configured for exterior installation and freeze protected with heat trace cable and removable insulated jackets for access to repair (equivalent to Thermaxx products). Fittings to include removable jackets for PRVs, isolation valves, drain ports, instrumentation, meter, and air release valve.

4) A 4” pressure gauge shall be included on both the suction and discharge side of the valve.

e) Material Specification for Pilot Control

1) Body & Cover: Stainless Steel

2) Pressure Rating: 250 psi

3) Trim: 303 Stainless Steel

4) Rubber Material: Buna N

5) Tubing and Fittings: Stainless Steel

6) Operating Fluids: Potable Water

7) Voltage: 120/60 Volt AC

8) Adjustment Range: 20-200 PSI (sustaining), 30-300 PSI (reducing)

9) Enclosure Tyle: NEMA IV Watertight

2. Pressure Relief Valves

a) Manufacturer: Pressure Relief Valves shall be Model 50G-01B, KC as manufactured by Cla-Val. No other manufacturers will be accepted.

b) Main Valve

1) The valve shall be hydraulically operated, single diaphragm-actuated, globe or angle pattern. The valve shall consist of three major components: the body, with seat installed; the cover, with bearings installed; and the diaphragm assembly. The diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve, separating operating pressure from line pressure. Packing glands and/or stuffing boxes are not permitted and there shall be no pistons operating the main valve or pilot controls.

2) The valve shall contain a resilient, synthetic rubber disc with a rectangular cross-section contained on three and one-half sides by a disc retainer and forming a tight seal against a single removable insert. No O-ring type discs (circular, square, or quad type) shall be permitted as the seating surface. The disc guide shall be of the contoured type to permit smooth transition of flow and shall hold the disc firmly in place. The cylindrical disc retainer shall be of a sturdy one-piece design capable of withstanding opening and closing shocks. It must have straight edge sides and a radius at the top edge to prevent excessive diaphragm wear as the diaphragm flexes across this surface. No hourglass shaped disc retainers shall be permitted and no V-type or slotted type disc guides shall be used.

3) The diaphragm assembly containing a non-magnetic 303 stainless steel stem; of sufficient diameter to withstand high hydraulic pressures shall be fully guided at both ends by a bearing in the valve cover and an integral bearing in the valve seat. The seat shall be a solid, one-piece design and shall have a minimum of a five-degree taper on the seating

surface for a positive, drip-tight shut off. No center guides shall be permitted. The stem shall be drilled and tapped in the cover end to receive and affix accessories that aide in the valves performance.

4) The flexible, non-wicking, FDA approved diaphragm shall consist of nylon reinforced Buna-N rubber compatible with the operating fluid. The center hole for the main valve stem must be sealed by the vulcanized process or a rubber grommet sealing the center stem hole from the operating pressure. The diaphragm shall not be used as the seating surface. The diaphragm shall be fully supported in the valve body and cover by machined surfaces which support no less than one-half of the total surface area of the diaphragm in either the fully opened or fully closed position.

5) The main valve seat and the stem bearing in the valve cover shall be removable. The cover bearing and seat in 6” and smaller size valves shall be threaded into the cover and body. The valve seat in 8” and larger size valves shall be retained by flat head machine screws for ease of maintenance. The lower bearing of the valve stem shall be contained concentrically within the seat and shall be exposed to the flow on all sides to avoid deposits. To insure proper alignment of the valve stem, the valve body and cover shall be machined with a full circumference locating lip. No “pinned” covers to the valve body shall be permitted. Cover bearing, disc retainer, and seat shall be made of the same material. All necessary repairs and/or modifications other than replacement of the main valve body shall be possible without removing the valve from the pipeline. Packing glands and/or stuffing boxes shall not be permitted.

6) The valve manufacturer shall be able to supply a complete line of equipment from 1 ¼” through 48” sizes and a complete selection of complementary equipment. The valve manufacturer shall also provide a computerized cavitation chart which shows flow rate, differential pressure, percentage of valve opening, Cv factor, system velocity, and if there will be potential for cavitation damage.

c) Material Specifications

1) Valve Size: 3” Full Port

2) Main Valve Body and Cover: Ductile Iron/ASTM A-536

3) Main Valve Trim: 304 or 216L Stainless Steel

4) Stem: 303 Stainless Steel

5) End Detail: ANSI B16.42 150 LB. FLG.

6) Pressure Rating: 250 PSI

7) Temperature Range: -40 to +180 Degrees F

8) Rubber Material: Buna N

9) Coating: Epoxy coated by baked on resin fusion method process 10 mils thick internal & external, with 3 mil fluorothane coating

d) Valve Options

1) Valve and fittings shall be configured for exterior installation and freeze protected with heat trace cable and weatherproof insulation.

e) Pilot Control System: The normally closed pressure relief pilot control shall be a direct-acting, adjustable, spring-loaded, normally open, diaphragm valve designed to maintain constant upstream pressure with close limits. An increase in line pressure and close gradually to prevent surges. A needle valve controls the opening and closing speed of the main valve.

f) Material Specification for Pilot Control

1) Body & Cover: Stainless Steel

2) Pressure Rating: 150 psi

3) Trim: 303 Stainless Steel

4) Rubber Material: Buna N

5) Tubing and Fittings: Stainless Steel

6) Operating Fluids: Potable Water

7) Voltage: 120/60 Volt AC

8) Adjustment Range: 20-200 psi

9) Enclosure Type: NEMA Type 4 Watertight

PART 3 – EXECUTION

11295.10 INSTALLATION

1. The pressure reducing valve shall be installed in accordance with the instructions of the manufacturer and as shown on the drawings.

2. Pressure set points for the pressure reducing valve (PRV) – **to be verified with the Owner prior to installation**:

    - 8” Valve PRV set point = 74 psi

    - 4” Valve PRV set point = 74 psi

3. Installation and adjustment shall be checked and approved by a manufacturer’s direct factory representative. After acceptance, the representative shall address a letter to the Owner outlining all installation and start up procedures. The letter shall include a statement that the valves are installed per the manufacturer’s recommendations. The manufacturer or his qualified representative shall conduct training session for the Owner’s personnel in the operation and maintenance of the valves.

4. The valve manufacturer shall provide a direct factory representative to calibrate the valve and verify operation during start up.

PART 4 – PAYMENT

11295.11 ADDITIONAL SPARE PARTS

1. Provide the following spare parts for the main line and bypass valves in the quantities specified:

    a) One 8” diaphragm and seat repair kit

    b) One 4” diaphragm and seat repair kit

    c) One CRD pressure reducing pilot system valve

END OF SECTION

SECTION 40 05 53

IDENTIFICATION FOR PROCESS PIPING and EQUIPMENT

1.00 GENERAL

1.01 WORK INCLUDED

A. Provide identifying devices for the following:

1. Piping.
2. Equipment.
3. Electrical Equipment.
4. Valves.
5. HVAC equipment.
6. Fire sprinkler and piping.
7. Control devices.

B. Types of identification devices specified in this section include the following:

1. Painted Identification Materials
2. Equipment Labels
3. Plastic Pipe Markers
4. Plastic Tape
5. Underground-Type Plastic Line Marker
6. Valve Tags
7. Valve Schedule Frames
8. Engraved plastic-Laminate Signs

QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of identification devices of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

1.02 SUBMITTALS

A. Submittals shall include:

1. Product data sheets for identifying devices.
2. Schedules: Submit valve schedule for each piping system electronically. Tabulate the valve number, piping system, system abbreviation (as shown on the tag), location of valves (room or spec), and variations for identification (if any). Mark valves which are intended for emergency shut-off and similar special uses, by special “flags”, in margin of schedule.

1.03 STANDARDS

A. The applicable provisions of the following standards shall apply as if written here in their entirety:

1. American National Standards Institute (ANSI) Standards:

ANSI A13.1	Pipe Marking Specifications

1.04 DELIVERY AND STORAGE

A. Store products inside storage sheds until installed.

1.05 GUARANTEES

A. Guarantee Identifying devices installed in wet locations or areas subject to moisture to be weather resistant for a period of 3 years after installation as per the requirements in the General Conditions.

2.00 PRODUCTS

2.01 MATERIALS

A. Acceptable Manufacturers

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering mechanical identification materials which may be incorporated in the work include but are not limited to, the following:

a. Allen Systems, Inc.

b. Brady (W.H.) Co; Signmark Div.

c. Industrial Safety Supply Co., Inc.

d. Seton Name Plate Corp.

B. Plastic Pipe Markers

1. Snap-On Type: Provide Manufacturer's standard pre-printed, semi-rigid snap-on, color-coded pipe markers, complying with ANSI A13.1.

2. Insulation: Furnish 1-inch thick molded fiberglass insulation with jacket for each plastic pipe marker to be installed on un-insulated pipes subjected to fluid temperatures of 125 °F or greater. Cut length to extend 2-inches beyond each end of plastic pipe marker.

a. Small Pipes: For external diameters less than 6 inches (including insulation if any), provide full- band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:

1). Snap-on application of pre-tensioned semi-rigid plastic pipe marker.

2). Adhesive lap joint in pipe marker overlap

3). Laminated or bonded application of pipe marker to pipe (or insulation).

4). Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than ¾-inch wide; full circle at both eds of pipe marker, tape lapped 1-1/2 inch.

b. Large Pipes: For external diameters of 6 inches and larger (including insulation if any), provide either full-band or strip-type pipe markers, but not narrower than three times letter height (and of required length), fastened by one of the following methods:

1). Laminated or bonded application of pipe marker to pipe (or insulation).

2). Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 1-1/2-inch wide; full circle at both ends of pipe marker, tape lapped 3 inches.

3). Trapped-to-pipe (or insulation) application of semi-rigid type, with Manufacturer's standard stainless steel bands.

c. Lettering: Manufacturer's standard pre-printed nomenclature which best describes piping system in each instance, as selected by the Engineer in case of variance with name as shown or specified.

1). Arrows: Print each pipe marker with arrows indicating direction of flow either with integrally with piping system service lettering (to accommodate both directions), or as separate unit of plastic.

C. Underground-Type Plastic Line Markers

1. General: Manufacturer's standard permanent, bright-colored, continuous-printed plastic tape, intended for direct-burial service; not less than 6 inch wide x 4 mils thick. Provide tape with printing which most accurately indicates type of service of buried pipe.

2. Provide multi-ply tape consisting of solid aluminum foil core between two layers of plastic tape.

D. Painted Identification Materials

1. Stencils: Standard fiberboard stencils, prepared for required applications with letter sizes generally complying with recommendations of ANSI A13.1 for piping and similar applications, but not less than 1-1/4-inch high letters for ductwork and not less than 3/4" high letters for access door signs and similar operational instructions.

2. Stencil Paint: Standard exterior type stenciling enamel; black, except as otherwise indicated; either brushing grade or pressurized spray-can form and grade.

3. Identification Paint: Standard identification enamel of colors indicated or, if not otherwise indicated for piping systems, complying with ANSI A13.1 and/or the Owner selection for colors.

E. Equipment Labels

1. Metal Labels for Equipment:

a. Material and Thickness: Stainless steel, 0.025-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.

b. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

c. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

d. Fasteners: Stainless-steel rivets or self-tapping screw

e. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

F. Nameplates for Equipment in Chlorine Areas:

1. Laminated three-layer plastic with engraved black letters on light, contrasting background color. Reference Section 46 31 00 Chlorine Gas Feed Equipment for more requirements.

G. Valve Tags

1. Brass Valve Tags: Provide 19-gauge polished brass valve tags, with a stamp-engraved piping system abbreviation in ¼-inch high letters and sequenced valve numbers ½-inch high, and with 5/32-inch hole for fastener.

a. Provide 1-1/2-inch diameter tags, except as otherwise indicated.

b. Provide size and shape as specified or scheduled for each piping system.

c. Fill tag engraving with black enamel.

2. Plastic Laminate Valve Tags: Provide Manufacturer's standard 3/32-inch thick engraved plastic laminate valve tags, with piping system abbreviation in 1/4-inch high letters and sequenced valve numbers ½-inch high, and with 5/3-inch hole for fastener.

a. Provide 1-1/2-inch square black tags with white lettering, except as otherwise indicated.

b. Provide size, shape and color combination as specified or scheduled for each piping system.

3. Valve Tag Fasteners: Provide Manufacturer's standard solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose.

4. Access Panel Markers: Provide Manufacturer's standard 1/16-inch thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve. Include 1/8-inch center hole to allow attachment.

H. Equipment Nameplate: Seton Style 2060 “Seton-ply” engraved plastic plaque, approximately 3/4 by 2-1/2 inches in size. Plaque shall be 1/16 inch thick having beveled edges and drilled with two mounting holes when attached by screws. Mounting screws shall be stainless steel. Lettering shall be approximately 3/16 inch high. Text to include equipment mark and equipment description (Example: EXHAUST FAN EF-5). Identification label on nameplate shall correspond to a typewritten legend included in the O & M Manual which includes the following:

1. Equipment identifier.

2. Location inside building (or on project site).

3. Manufacturer’s model number.

4. Brief description of function.

5. Reference to shop drawings, parts lists, or other data included in the O & M Manual.

I. Fire Sprinkler System Signs: Signs for fire protection system shall conform to NFPA-13 and shall be equal to Seton Style SFB, furnished in porcelain with “white on red” color.

3.00 EXECUTION

GENERAL

A. Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finish including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

3.01 PREPARATION

A. Install piping complete with insulation and valves in place prior to installing identification devices. Mount electrical components, including electrical control devices. Piping shall be dry and free of oil, grease, or other contaminants. Insulation shall be completely dry.

3.02 INSTALLATION

A. Install pipe labels on piping exposed to view, in any location inside buildings or structures, or in underground vaults, pump stations, basements, or other exposed locations.

B. Install a minimum of one label in each area or room and additional labels at spacings not to exceed 5 feet. Position labels so that lettering is visible from the front of piping at floor level. Provide labels of a size that is legible from floor level. Install labels in rows with uniform spacings where several pipes run parallel to each other.

C. Name the fluid flowing inside the pipe on color coded labels with text per the schedule below. Labels shall also include an arrow indicating the direction of flow.

3.03 PIPING SYSTEM IDENTIFICATION

A. General: Install pipe markers of one of the following types on each system indicated to receive identification, and include arrows to show normal direction of flow:

1. Stenciled markers, including color-coded background band or rectangle, and contrasting lettering of black or white. Extend color band or rectangle 2 inches beyond ends of lettering.

    a. Stenciled markers, with lettering color complying with ANSI A13.1.

    b. Plastic pipe markers, with application system as indicated under "Materials" in this section. Install on pipe insulation segment where required for hot non-insulated pipes.

    c. Stenciled markers, black or white for best contrast, wherever continuous color-coded painting of piping is provided.

    d. Locate pipe markers and color bands as follows wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) and exterior non-concealed locations.

        1). Near each valve and control device.

        2). Near each branch, excluding short take-offs for fixtures and terminal units; mark each pipe at branch, where there could be question of flow pattern.

        3). Near locations where pipes pass through walls or floors/ceilings, or enter non-accessible enclosures.

        4). At access doors, manholes and similar access points which permit view of concealed piping.

        5). Near major equipment items and other points of origination and termination.

6). Spaced intermediately at maximum spacing of 50 feet along each piping run, except reduce spacing to 25 ft in congested areas of piping and equipment.

7). On piping above removable acoustical ceilings, except omit intermediately spaced markers.

3.04 UNDERGROUND PIPING IDENTIFICATION

A. General: During back-filling/top-soiling of each exterior underground piping system, install continuous underground-type plastic line marker, located directly over buried line at 6 to 8 inches below finished grade. Where multiple small lines are buried in common trench and do not exceed overall width of 16 inches, install single line marker. For tile fields and similar installations, mark only edge pipe lines of field.

3.05 VALVE IDENTIFICATION

A. Install a valve tag on all valves. Attach the tag to hand wheel of valve stem so that it does not interfere with operation of valve tag brass link chains or copper meter seals furnished by the Tag Manufacturer.

B. Number valves to correspond to a typewritten list included in the Operational and Maintenance Manual and include the following information:

1. Valve Number.
2. Description of piping fluid or purpose.
3. Normal position of valve (Open or Closed).
4. Manufacturer's catalog number.
5. Brief description of valve specification.
6. Brief description of valve's function in the system.

C. Valve identification shall be based on the following example:

Valve Number	Function	Location	Normal Position	Mfg's Cat No.	Valve Type	Description
P-1	Domestic Water	Rm. 103	Open	Crane Fig. 315C	Gate rising stem	Shut off to heater

3.06 EQUIPMENT IDENTIFICATION

A. Provide an equipment identifier on each separate piece of equipment, including process equipment, HVAC equipment, plumbing equipment (other than plumbing fixtures), and electrical equipment. Provide a nameplate for each separate piece of electrical equipment, including but not limited to panelboards, switchgear, starters, disconnects, control devices and control panels. Provide name tags for each separate switch, starter, contactor, or other compartment on electrical switchgear.

B. Engrave lettering on nameplates corresponding to the identification marks. Install nameplates prominently on equipment not occurring in occupied spaces. Install nameplates on the inside covers of lighting panelboards. Install nameplates on all other equipment centered and at top of equipment. Nameplates shall not be installed in a location that interferes with the equipment's ability to operate.

C. Attach nameplates to exterior equipment with two 3/8-inch stainless steel screws. Interior plaque may be attached by screws, or by the adhesion method when approved by the Engineer.

3.06 ELECTRICAL OUTLET

A. Provide a nameplate for electrical outlet listed below. The nameplate shall be white letters on red background, and shall specify the outlet's voltage and ampere rating. The nameplate on special outlets shall have an appropriate warning. Lettering shall be 1/8 inch high. Overall plate size shall be approximately 3/4 by 2-1/2 inches.

B. Provide nameplates on the following:

1. 208/240 outlet: voltage and ampere rating.

2. Special outlet: voltage, ampere rating and intended function (Example: Welder Outlet 240 V – 40 A).

3.07 POTABLE AND NON-POTABLE WATER

A. Provide name tags at every water hydrant or outlet. Fabricate name tags of 3/4-by-1-1/2-by-1/8-inch aluminum with a medium, duranodic finish and plexiglas face panel. The face panel shall have 1-inch high, white, helvetica medium lettering on blue background stating "Potable Water", or white lettering on green background stating "Non-Potable Water". Place signs on walls above the hydrant locations and attach to backplates. Yard hydrants shall have concrete piers which are 6 inches in diameter by 36 inches with signs attached to the face of the concrete directly in front of the hydrants. Extend the piers 4 inches minimum above finish grade. Signs shall be manufactured by Vomer Products, Inc., equal to Vocator Exterior sign series E9/12.

3.08 SPARE PARTS

A. Furnish minimum of 5 percent extra stock of each mechanical identification material required, including additional numbered valve tags (not less than three) for each piping system, additional piping system identification markers, and additional plastic laminate engraving blanks of assorted sizes.

B. Where stenciled markers are provided, clean and retain stencils after completion of stenciling and include used stencils in extra stock, along with required stock of stenciling paints and applicators.

3.09 SCHEDULES

A. Prepare a typed schedule showing piping label requirements, valve tag identification, and equipment tags. Include each valve or piping type and the appropriate identification on the schedule. Submit the schedule to the Engineer for approval.

B. Mark valve tags and pipe labels to conform with the following legend, or with requirements of standards noted. Include the full name, as appearing under the column heading "Description", and the abbreviation under the column heading "Abbrev. Legend."

Description	Valve Prefix	Abbrev. Legend	Label Color (Letter on Background)
Plumbing			
Sewer, Sanitary	W	SW	Black on Green
Sewer, Storm	SS	SS	Black on Green
Waste, Drain	W	DP	Black on Green
Waste, Acid	W	AW	Black on Yellow
Water, Domestic, Cold	P	CW	Black on Green
Water, Domestic, Hot	P	HW	Black on Yellow
Water, Domestic, Ret.	P	HWR	Black on Yellow
Water, Distilled	P	DW	Black on Green
Water, Non-potable	N	NPW	Black on Green
Fire Protection			
Fire Protection, Mains	F	FM	White on Red
Fire Protection, Sprinkler	F	FS	White on Red
Gas Piping			
Natural Gas	G	NG	Black on Yellow
Fuel Gas	G	NG	Black on Yellow
Acetylene	G	AC	Black on Yellow
Argon	G	AG	White on Blue
Hydrogen	G	HG	Black on Yellow
Nitrogen	G	NI	Black on Green
Nitrous Oxide	G	NO	White on Blue
Methane	G	MT	Black on Yellow
Oxygen	G	OX	Black on Yellow
Compressed Air	G	CA	White on Blue
Instrument Air	G	IA	White on Blue
Vapor	G	VG	Black on Yellow
Vacuum	G	VP	White on Blue
HVAC			
Refrigerant, Suction	H	RS	Black on Green
Refrigerant, Liquid	H	RL	Black on Green
Chilled Water	H	CW	Black on Green
Chilled Water Ret.	H	CWR	Black on Green
Hot Water	H	HW	Black on Yellow

Description	Valve Prefix	Abbrev. Legend	Label Color (Letter on Background)
Hot Water, Ret.	H	HWR	Black on Yellow
Condensate	H	CD	Black on Green
Process Piping			
Brine	PP	LI	White on Green
Chlorine	PP	CH	Black on Yellow
Hydrofluorosilicic Acid	PP	AM	Black on Orange
Electrical			
Panelboards	LP-1		White on Black
Starters for Exhaust Fan	S/EF-1		White on Black
Control Panels for Exhaust Fan	CP/EF-1		White on Black
Disconnects for Exhaust Fan	DS/EF-1		White on Black
Junction Boxes	JB/101		White on Black
Controllers for Exhaust Fan	CI/EF-1		White on Black

C. Piping Color Schedule:

Description	Pipe Color
Potable Water	Light Blue
Compressed Air	Light Green
Instrument Air	Light Green with Dark Green Bands
Chlorine (gas, liquid, or vent)	Yellow
Chlorine (solution)	Yellow with Red Bands
Fluoride	White with Yellow Bands
Backwash Supply	Light Blue
Drain	Dark Grey
Raw Water	Tan

END OF SECTION

TECHNICAL SPECIFICATIONS
FOR
440 QUARRY DEVELOPMENT PRV

PREPARED BY

CLEARY ZIMMERMANN ENGINEERS, LLC

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TBPE FIRM NO. F-9357

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ENGINEER OF RECORD
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TBPE LICENSE No.
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CLEARY ZIMMERMANN ENGINEERS, INC.
TEXAS REGISTERED ENGINEERING FIRM NO. F-9357

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SECTION 16015

GENERAL ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SCOPE

A. The General Conditions and Requirements, Special Provisions, are hereby made a part of this Section.

B. The Electrical Drawings and Specifications under this section shall be made a part of the contract documents. The Drawings and specifications of this contract, as well as supplements issued thereto, information to bidders and pertinent documents issued by the Owner's representative are a part of these drawings and specifications and shall be complied with in every respect. All of the above documents will be on file at the office of the Owner's representative and shall be examined by all bidders. Failure to examine all documents shall not relieve the responsibility or be used as a basis for additional compensation due to omission of details of other sections from the electrical documents.

C. Furnish all work, labor, tools, superintendence, material, equipment, and operations necessary to provide for a complete and workable electrical system as defined by the contract documents.

D. Be responsible for visiting the site and checking the existing conditions. Ascertain the conditions to be met for installing the work and adjust bid accordingly.

E. It is intent of the contract document that upon completion of the electrical work, the entire system shall be in a finished, workable condition.

F. All work that may be called for in the specifications but not shown on the drawings; or, all work that may be shown on the drawings but not called for in the specifications, shall be performed by the Contractor as if described in both. Should work be required which is not set forth in either document, but which work is nevertheless required for fulfilling of the intent thereof; then, the contractor shall perform all work as fully as if it were specifically set forth in the current documents.

G. The definition of terms used throughout the contract documents shall be as specified by the following agencies:

1. Underwriters Laboratories
2. National Electrical Manufacturers Association
3. American National Standard Institute
4. Insulated Power Cable Engineers Association
5. National Electrical code
6. National Fire Protection Association

1.2 PERMITS, CODES AND UTILITIES

A. Secure all permits, licenses, and inspections as required by all authorities having jurisdiction. Give all notices and comply with all laws, ordinances, rules, regulations and contract requirements bearing on the work.

B. The minimum requirements of the electrical system installation shall conform to the latest edition of the National Electrical Code as well as state and local codes.

C. Codes and ordinances having jurisdiction and specified codes shall serve as minimum requirements; but, if the Contract Documents indicate requirements which are in excess of those minimum requirements then the requirements of the Contract Documents shall be followed. Should there be any conflicts between the Contract Documents and codes, or any ordinances, report these with bid.

D. Determine the exact requirements for the utility service connections and metering facilities as set forth by the utilities that will serve the project, and pay for and perform all work as required by those utilities.

1.3 STANDARDS

A. All materials and equipment shall conform to the requirements of the Contract Documents. They shall be new, free from defects, and they shall conform to the following standards where these organizations have set standards:

1. Underwriters Laboratories, Inc. (UL)
2. National Electrical Manufacturer's Association. (NEMA)
3. American National Standards Association. (ANSI)
4. Insulated Cable Engineers Association. (ICEA)
5. Institute of Electrical and Electronic Engineers (IEEE)

B. All material and equipment, of the same class, shall be supplied by the same manufacturer unless specified to the contrary.

C. All products shall bear UL labels where standards have been set for listing.

1.4 SUBMITTALS

A. Shop drawings shall be taken mean detailed drawings with dimensions, schedules, weights, capacities, installation details and pertinent information that will be needed to describe material or equipment in detail.

B. Submittal procedures are described in other specification sections

1.5 ACCEPTANCE AND SUBSTITUTIONS

A. All manufacturers named are a basis as a standard of quality and substitutions of any equal product will be considered for acceptance. The judgment of equality of product substitution shall be made by the Engineer.

B. Furnish all required supporting data. The submittal of substitutions for review shall not be cause for time extensions.

C. Where substitutions are offered, the substituted product shall meet and exceed the product performance as set forth in the specified manufacturer's current catalog literature, as well as meeting the details of the Contract Documents.

D. The details on the drawings and the requirements of the specifications are based on the first listed item of material or equipment; if any other than the first listed materials or equipment is furnished, then assume responsibility for the correct function, operation, and accommodation of the substituted item. In the event of misfits or changes in work required, either in this Section or other Sections of the Contract, or in both; bear all costs in connection with all changes arising out of the use of other than the first listed item specified.

1.6 OPERATIONS AND MAINTENANCE MANUALS

A. Six (6) weeks prior to the completion of the project, compile an operations and maintenance manual on each item of equipment. These manuals shall include detailed instructions and maintenance, as well spare parts lists.

B. Submit electronic copies through SAWS CPMS for review.

PART 2 - PRODUCTS

2.1 MATERIALS AND WORKMANSHIP

A. All materials, unless otherwise specified, shall be current United States manufacture, new, free from all defects, and of the best quality.

B. Materials and equipment shall be installed in accordance with the manufacturers' recommendations and the best standard practice for the type of work involved. All work shall be executed by electricians skilled in their respective trades, and the installations shall present a neat, precise appearance.

C. The responsibility for the furnishing and intended installation of the proper electrical equipment and/or material as intended rests entirely upon the Contract. The Contractor shall request advice and supervisory assistance from the representative of specific manufacturers during the installation.

2.2 MATERIAL AND EQUIPMENT REQUIREMENTS

A. Manufacturer's Instructions: The manufacturer's published instructions shall be followed for preparing, assembling, installing, erecting, and cleaning manufacturer materials or equipment, unless otherwise indicated. The Contractor shall promptly notify the Owner's Representative in writing of any conflict between the requirements of the Contract Documents and the manufacturer's direction and shall obtain the clarification of the Owner's Representative before proceeding with the work. Should the Contractor perform any such work that does not comply with the manufacturer's directions or such clarification by the Owner's Representative, he shall bear all costs arising in connection with the correction of the deficiencies.

B. Storage at Site: The Contractor shall not receive material or equipment at the jobsite until there is suitable space provided to properly protect equipment from rust, drip, humidity, and dust damage from surrounding work. All new or relocated equipment shall be stored inside or protected from the environment. Equipment that is not properly stored shall be replaced by the contractor at no cost to the owner.

C. Capacities shall be not less than those indicated and shall be such that no component or system becomes inoperative or is damaged because of startup or other overload conditions.

D. Conformance to Agency Requirements: Where materials or equipment are specified to be approved, listed, tested, or labeled by the Underwriters Laboratories, Inc., or constructed and/or tested in accordance with the standards as listed in the NEC, the Contractor shall submit proof that the items furnished under this section of the specifications conform to such requirements. The label of the Underwriters Laboratories, Inc. applied to the item will be acceptable as sufficient evidence that the items conform to such requirements.

E. Nameplates: Each major component of equipment shall have the manufacturer's name, address, and model-identification number embossed on a plate securely attached to the item of equipment. All data on nameplates shall be legible at the time of Final Inspection. All equipment starters and disconnects shall be tagged with the equipment designated mark and circuit.

F. Prevention of Rust: Standard factory finish will be acceptable on equipment specified by model number, otherwise surfaces of ferrous metal shall be given a rust-inhibiting coating. The treatment shall withstand 200 hours in salt-spray fog test, in accordance with Method 6061 of Federal Standard No. 141. Immediately after completion of the test, the specimen shall show no signs of wrinkling or cracking and no signs of rust creepage beyond 1/8 inch on either side of the scratch mark. Where rust inhibitor coating is specified hereinafter, any treatment that will pass the above test is acceptable unless a specific coating is specified, except that coal tar or asphalt-type coatings will not be acceptable unless so stated for a specific item. Where steel is specified to be hot-dip galvanized, mill-galvanized sheet steel may be used provided all raw edges are painted with a zinc-pigmented paint conforming to Military Specification MIL-P-26915.

G. Protection of Connections: Switches, breaker handles, keys setscrews, handles and other parts not listed for normal occupied operation (light switches, etc.) shall be located accessible to but out of paths to prevent their accidental shutoff.

H. Verifications of Dimensions: The Contractor shall be responsible for the coordination and proper relation of his work to the Equipment and to the work of all trades. The Contractor shall visit the premises and thoroughly familiarize himself with all details of the work and working conditions, to verify all dimensions in the field, and to advise the Owner's Representative of any discrepancy before performing any work. Adjustments to the work required in order to facilitate a coordinated installation shall be made at no additional cost to the Owner, or Engineer.

I. Standard Products: Materials and equipment to be provided shall be the standard catalog products of manufacturers regularly engaged in the manufacture of products conforming to these specifications, and shall essentially duplicate materials and equipment that have been in satisfactory use at least two years.

PART 3 - EXCAVATION

3.1 EXCAVATION AND BACKFILLING

A. Do all excavating and backfilling necessary for the installation of the work. This shall include shoring and pumping in ditches to keep them dry until the work in question has been installed. All shoring required to protect the excavation and safeguard employees shall be properly performed.

B. All excavations shall be made to the proper depth, with allowances made for floors, forms, beams, piping, finished grades, etc. Ground under conduits shall be well compacted before conduits are installed.

C. All backfilling shall be made with selected soil; free of rock and debris and shall be pneumatically tamped in six (6") inch layers to secure a field density ratio of 90%.

D. All excavated material not suitable and not used in the backfill shall be removed offsite at the Contractors expense.

E. Field check and verify the locations of all underground utilities prior to any excavating. Avoid disturbing these as far as possible. In the event existing utilities are broken into or damaged, they shall be repaired so as to make their operation equal to that before the trenching was started.

F. Where the excavation requires the opening of existing walks, drives, or other existing pavement, these facilities shall be cut as required to install new lines and to make connections to existing lines. The sizes of the cut shall be held to a minimum consistent with the work to be installed. After installation of new work is completed and the excavation has been backfilled in accordance with above, repair existing walks, drives or other existing pavement to match existing installation.

3.2 CUTTING AND PATCHING

A. Cutting and patching required under this section shall be done in a neat workmanlike manner. Cutting lines shall be uniform and smooth.

B. Use concrete saws for large cuts in concrete and core drills for small round cuts in concrete.

C. Where openings are cut through masonry walls, provide lintel or other structural supports to protect the remaining masonry. Adequate support shall be provided during the cutting operation to prevent damage to masonry.

D. Where large openings are cut through metal surfaces, attach metal angles around the opening.

E. Patch concrete openings that are to be filled with non-shrinking cementing compound. Finish concrete patching shall be troweled smooth and shall be uniform with surrounding surfaces.

3.3 WATERPROOFING

A. Provide waterproof flashing for each penetration of exterior walls and roofs.

B. Flashing for conduit penetrations through built-up roofs shall be made with pitch pans filled with pitch. Conduit penetrations through poured concrete roofs shall be made with sleeves and annulus caulked.

C. Penetrations through walls at below ground elevations shall be waterproofed by conduit sealing fittings or other methods as indicated.

D. Interiors of raceways that are likely to have water ingress such as runs from hand holes into below-grade installations shall have water stops installed to prevent water from entering into installations.

3.4 CONDUIT SUPPORT

A. Conduit Support: All conduits throughout the building, both horizontal and vertical, shall be adequately supported from the construction to line of grade, with proper provision for expansion, contraction, vibration elimination, and anchorage. Vertical conduits shall be supported from floor lines with riser clamps sized to fit the lines and to adequately support their weight. At the bases of lines, where required for proper support, provide anchor base fittings or other approved supports.

3.5 HANGERS

A. General: Each hanger shall be properly sized to fit the supported pipe or to fit the outside of the insulation on lines where specified.

B. Attachment:

1. The load on each hanger and/or insert shall not exceed the safe allowable load for any component of the support system, including the concrete which holds the inserts. Reinforcement at inserts shall be provided as required to develop the strength required.
2. Where pipes are supported under steel beams, approved-type beam clamps shall be used.
3. Where conduit is supported under wood joists, hanger rods shall be attached to joists with side beam brackets or angle clips.

C. Spacing: All hangers shall be so located as to properly support horizontal lines without appreciable sagging of these lines. All PVC shall be supported at intervals recommended by the manufacturer, or as otherwise specified or indicated.

D. Trapezes: Where multiple lines are run horizontally at the same elevation and grade, they may be supported on trapezes of Kindorf, Elcen, or approved equal, channel-suspended on rods or pipes. Trapeze members including suspension rods shall each be properly sized for the number, size, and loaded weight of the lines they are to support.

E. Ceiling-Mounted Devices: All lighting and devices or assemblies mounted in lay-in-type ceilings and which are supported by the ceiling grid, directly or indirectly, and which weigh in excess of 2 lbs., shall be provided with at least two 12-gauge minimum wire supports connected securely between the device or assembly and the structure, to serve as a safety support in the event of the collapse of or a disturbance in the support of the ceiling system that might cause the device or assembly to fall through the ceiling. This includes, but is not limited to, light fixtures, J-boxes, and heavy speakers. Provide additional support as required where the weight of the device or assembly will exceed the safe limits of the wire supports.

F. Miscellaneous: Provide any other special foundations, hangers, and supports indicated on the drawings, specified elsewhere herein, or required by conditions at the site. Hangers and supporting structures for suspended equipment shall be provided as required to support the load from the building structure in a manner acceptable to the Owner's Representative.

3.6 EQUIPMENT PROTECTION

A. Provide suitable protection for all equipment, work and property against damage during construction.

B. Assume full responsibility for material and equipment stored at the site.

C. Conduit openings shall be closed with caps or plugs during installation. All outlet boxes and cabinets shall be kept free of concrete, plaster, dirt, and debris.

D. Equipment shall be and tightly sealed against entrance of dust, dirt, and moisture.

3.7 CLEAN-UP

A. Remove all temporary labels, dirt, paint, grease and stains from all exposed equipment. Upon completion of work, clean equipment and the entire installation so as to present a first class job suitable for occupancy. No loose parts or scraps or equipment shall be left on the premises.

B. Equipment paint scars shall be repaired with paint kits supplied by the equipment manufacturer, or with an approved paint.

C. Clean interiors of each item of electrical equipment. At completion of work all equipment interiors shall be free from dust, dirt, and debris.

3.8 TESTS AND INSPECTIONS

A. All equipment shall put through a trial run-in test to ascertain the performance complies with the intent of the specifications. All-in tests shall be made in the presence of the Owner's Representative. All cables shall have an insulation test performed.

B. Cables installed with an unacceptable insulation reading shall be removed and new cable installed and retested at no additional cost to the owner. The Contractor shall make all tests deemed necessary by the inspection departments of the authority having jurisdiction, Board of Underwriters, etc. He shall provide all equipment, materials, and labor for making such tests. Fuel, test equipment materials for system operational tests shall be paid for by the contractor.

C. Other: Additional tests specified hereinafter under the various specifications sections shall be made.

D. Notification: The Owner's Representative shall be notified at his office 36 hours prior to each test and other specifications requirements requiring action on the part of the Owner, Engineer, and/or Owner's Representative.

E. Test Logs: All tests which the Contractor conducts shall have pertinent data logged by the Contractor at the time of testing. Data shall include date, time, personnel, description and extent

of system tested, test conditions, test results, specified results, and any other pertinent data. Data shall be delivered to the Owner's representative as specified under "Requirements for Final Acceptance".

3.9 CONDITIONS OF EQUIPMENT AT FINAL ACCEPTANCE

A. At the time of acceptance, the Contractor shall have inspected all installed systems to assure the following has been completed:

1. Fixtures are operating, and lenses and reflectors are free of dust, debris, and fingerprints.
2. Panelboards have all conductors neatly formed, bundled, and made-up tight. Cans shall be vacuum cleaned and surfaces cleaned of stray paint, dust, grease, and fingerprints. All circuit directories to be neatly typed and in place.
3. Wall plates and exposed switch and receptacle parts to be clean, free of paint, plaster, etc.
4. Safety and disconnect switches and motor control centers, Control Panels, etc. to be vacuum cleaned of debris and dust, and all surfaces free of stray paint, grease, and fingerprints.
5. Switchgear, transformers, and system devices shall be cleaned internally and externally and have all surfaces restored to original surface conditions.
6. Touch-up all scratched surfaces using paint matching the existing equipment paint. Where paint cannot be matched, the entire surface shall be repainted in a color and manner approved by the Engineer.

END OF SECTION

SECTION 16050

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Raceways.
2. Wire and connectors.
3. Supporting devices for electrical components.
4. Concrete equipment bases.
5. Electrical demolition.
6. Cutting and patching for electrical construction.
7. Touchup painting.

1.3 SUBMITTALS

A. Supporting Devices

1.4 QUALITY ASSURANCE

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

B. Comply with NFPA 70, National Electrical Code Handbook, 2020.

1.5 COORDINATION

A. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in structure during progress of construction to facilitate the electrical installations that follow.

1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.

B. Coordinate electrical service connections to components furnished by utility companies.

1. Coordinate installation and connection of exterior underground and overhead utilities and services, including provision for electricity-metering components.
2. Comply with requirements of authorities having jurisdiction and of utility company providing electrical power and other services.

C. Where electrical identification devices are applied to field-finished surfaces, coordinate installation of identification devices with completion of finished surface.

PART 2 - PRODUCTS

2.1 RACEWAYS

A. See Section 16130 “Raceways and Boxes.”

2.2 CONDUCTORS

A. See Section 16120 “Conductors and Cables.”

2.3 SUPPORTING DEVICES

A. Mounting hardware, nuts, bolts, lock washers, and washers, shall be grade 316 stainless steel.

B. Unless otherwise indicated, slotted channel framing and supporting devices shall be manufactured of ASTM 6063, T-6 grade aluminum; 1-5/8"wide x 3-1/4" deep (double opening type). Clamp nuts for use with slotted channels shall be grade 316 stainless steel.

C. Conduit straps for use with slotted channels shall be aluminum with stainless steel hardware.

D. After-set concrete inserts shall consist of stainless steel expansion bolts, 1/4: minimum diameter, 500 lbs. minimum pull-out resistance. Furnish Phillips, Wej-it, or equal.

E. Hanger rod shall be 3/8": minimum diameter galvanized steel all-thread.

F. Conduit "U" bolts shall be 316 stainless steel with stainless hex-head bolts.

G. Plastic saddles for supporting buried conduits shall be interlocking type that provides separation between conduits vertically and laterally and between bottom of conduits and trench floor.

H. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for nonarmored electrical cables in riser conduits. Plugs have number and size of conductor gripping holes as required to suit individual risers. Body constructed of malleable-iron casting with hot-dip galvanized finish.

2.4 EQUIPMENT FOR UTILITY COMPANY’S ELECTRICITY METERING

A. Current-Transforming Cabinets: Comply with requirements of electrical power utility company.

B. Meter Sockets: Comply with requirements of electrical power utility company.

C. Provide power utility company communication conduit to meter.

2.5 CONCRETE BASES

A. Concrete: 3000-psi, 28-day compressive strength. Provide minimum 4 inches beyond equipment.

B. Bollards: Provide bollards around transformer. Protect equipment on road or driveway sides.

2.6 TOUCHUP PAINT

A. For Equipment: Equipment manufacturer's paint selected to match installed equipment finish.

B. Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

PART 3 - EXECUTION

3.1 ELECTRICAL EQUIPMENT INSTALLATION

A. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.

B. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.

3.2 ELECTRICAL SUPPORTING DEVICE APPLICATION

A. Damp Locations and Outdoors: Stainless steel or aluminum materials or nonmetallic, U-channel system components.

B. Dry Locations: Stainless Steel or aluminum materials.

C. Support Clamps for PVC Raceways: Click-type clamp system.

D. Selection of Supports: Comply with manufacturer's written instructions.

E. Strength of Supports: Adequate to carry present and future loads, times a safety factor of at least four; minimum of 200-lb design load.

3.3 SUPPORT INSTALLATION

A. Install support devices to securely and permanently fasten and support electrical components.

B. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assemblies and for securing hanger rods and conduits.

C. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.

D. Size supports for multiple raceway installations so capacity can be increased by a 25 percent minimum in the future.

E. Support individual horizontal raceways with separate, stainless steel pipe hangers or clamps.

F. Install 1/4-inch-diameter or larger threaded stainless steel hanger rods, unless otherwise indicated.

G. Arrange supports in vertical runs so the weight of raceways and enclosed conductors is carried entirely by raceway supports, with no weight load on raceway terminals.

H. Simultaneously install vertical conductor supports with conductors.

I. Separately support cast boxes that are threaded to raceways and used for fixture support. Support sheet-metal boxes directly from the building structure or by bar hangers. If bar hangers are used, attach bar to raceways on opposite sides of the box and support the raceway with an approved fastener not more than 24 inches from the box.

J. Install metal channel racks for mounting cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices unless components are mounted directly to structural elements of adequate strength.

K. Install sleeves for cable and raceway penetrations of concrete slabs and walls unless core-drilled holes are used. Install sleeves for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.

L. Securely fasten electrical items and their supports to the building structure, unless otherwise indicated. Perform fastening according to the following unless other fastening methods are indicated:

1. Wood: Fasten with wood screws or screw-type nails.
2. Masonry: Toggle bolts on hollow masonry units and expansion bolts on solid masonry units.
3. New Concrete: Concrete inserts with machine screws and bolts.
4. Existing Concrete: Expansion bolts.
5. Steel: Welded threaded studs or spring-tension clamps on steel.
   a. Field Welding: Comply with AWS D1.1.
6. Welding to steel structure may be used only for threaded studs, not for conduits, pipe straps, or other items.
7. Light Steel: Sheet-metal screws.
8. Fasteners: Select so the load applied to each fastener does not exceed 25 percent of its proof-test load.

3.4 FIRESTOPPING

A. Apply firestopping to cable and raceway penetrations of fire-rated floor and wall assemblies to achieve fire-resistance rating of the assembly.

3.5 CONCRETE BASES

A. Construct concrete bases of dimensions indicated, but not less than 6 inches larger, in both directions, than supported unit and bollards. Follow supported equipment manufacturer's anchorage recommendations and setting templates for anchor-bolt and tie locations, unless otherwise indicated. Use 3000-psi, 28-day compressive-strength concrete and reinforcement.

3.6 CUTTING AND PATCHING

A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.

B. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new fireproofing where existing firestopping has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

3.7 FIELD QUALITY CONTROL

A. Inspect installed components for damage and faulty work, including the following:

1. Raceways.
2. Building wire and connectors.
3. Supporting devices for electrical components.
4. Electrical identification.
5. Electricity-metering components.
6. Concrete bases.
7. Electrical demolition.
8. Cutting and patching for electrical construction.
9. Touchup painting.

3.8 CLEANING AND PROTECTION

A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.

B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 16060

GROUNDING AND BONDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. This Section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections or on the drawings.

1.3 QUALITY ASSURANCE

A. Testing Agency Qualifications: Testing agency as defined by OSHA in 29 CFR 1910.7 or a member company of the InterNational Electrical Testing Association and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association to supervise on-site testing specified in Part 3.

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

1. Comply with UL 467.

C. Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Grounding Conductors, Cables, Connectors, and Rods:
   a. Apache Grounding/Erico Inc.
   b. Boggs, Inc.
   c. Chance/Hubbell.
   d. Copperweld Corp.
   e. Dossert Corp.
   f. Erico Inc.; Electrical Products Group.
   g. Framatome Connectors/Burndy Electrical.

h. Galvan Industries, Inc.
i. Harger Lightning Protection, Inc.
j. Hastings Fiber Glass Products, Inc.
k. Heary Brothers Lightning Protection Co.
l. Ideal Industries, Inc.
m. ILSCO.
n. Kearney/Cooper Power Systems.
o. Korns: C. C. Korns Co.; Division of Robroy Industries.
p. Lightning Master Corp.
q. Lyncole XIT Grounding.
r. O-Z/Gedney Co.; a business of the EGS Electrical Group.
s. Raco, Inc.; Division of Hubbell.
t. Robbins Lightning, Inc.
u. Salisbury: W. H. Salisbury & Co.
v. Superior Grounding Systems, Inc.
w. Thomas & Betts, Electrical.

2.2 GROUNDING CONDUCTORS

A. For insulated conductors, comply with Division 16 Section "Conductors and Cables."

B. Material: Copper.

C. Equipment Grounding Conductors: Insulated with green-colored insulation.

D. Isolated Ground Conductors: Insulated with green-colored insulation with yellow stripe. On feeders with isolated ground, use colored tape, alternating bands of green and yellow tape to provide a minimum of three bands of green and two bands of yellow.

E. Grounding Electrode Conductors: Stranded cable.

F. Underground Conductors: Bare, stranded, unless otherwise indicated.

G. Bare Copper Conductors: Comply with the following:

1. Solid Conductors: ASTM B 3.
2. Assembly of Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.

H. Copper Bonding Conductors: As follows:

1. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG copper conductor, 1/4 inch in diameter.
2. Bonding Conductor: No. 4 or No. 6 AWG, stranded copper conductor.
3. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
4. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

I. Ground Conductor and Conductor Protector for Wood Poles: As follows:

1. No. 4 AWG minimum, soft-drawn copper conductor.
2. Conductor Protector: Half-round PVC or wood molding. If wood, use pressure-treated fir, or cypress or cedar.

J. Grounding Bus: Bare, annealed copper bars of rectangular cross section, with insulators.

2.3 CONNECTOR PRODUCTS

A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.

B. Bolted Connectors: Bolted-pressure-type connectors, or compression type.

C. Welded Connectors: Exothermic-welded type, in kit form, and selected per manufacturer's written instructions.

2.4 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel.

B. Ground Rods: Sectional type; copper-clad steel.

1. Size: 3/4 by 120 inches.

C. Test Wells: Provide handholes for test wells.

PART 3 - EXECUTION

3.1 APPLICATION

A. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.

B. In raceways, use insulated equipment grounding conductors.

C. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections, except those at test wells.

D. Equipment Grounding Conductor Terminations: Use bolted pressure clamps.

E. Ground Rod Clamps at Test Wells: Use bolted pressure clamps with at least two bolts.

F. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Use insulated spacer; space 1 inch from wall and support from wall 6 inches above finished floor, unless otherwise indicated.

2. At doors, route the bus up to the top of the door frame, across the top of the doorway, and down to the specified height above the floor.

G. Underground Grounding Conductors: Use bare stranded-copper conductor, No. 4/0 AWG minimum. Bury at least 24 inches below grade or bury 12 inches above duct bank when installed as part of the duct bank.

3.2 EQUIPMENT GROUNDING CONDUCTORS

A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.

B. Install equipment grounding conductors in all feeders and circuits.

C. Busway Supply Circuits: Install insulated equipment grounding conductor from the grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.

D. Computer Outlet Circuits: Install insulated equipment grounding conductor in branch-circuit runs from computer-area power panels or power-distribution units.

E. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate grounding conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.

F. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate equipment grounding conductor. Isolate equipment grounding conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.

G. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.

H. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate equipment grounding conductor to each electric water heater, heat-tracing, and antifrost heating cable. Bond conductor to heater units, piping, connected equipment, and components.

I. Metal Poles Supporting Outdoor Lighting Fixtures: Provide a grounding electrode in addition to installing a separate equipment grounding conductor with supply branch-circuit conductors

J. Common Ground Bonding with Lightning Protection System: Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.

3.3 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.

3.4 CONNECTIONS

A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
2. Make connections with clean, bare metal at points of contact.
3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

B. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

C. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.

D. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.

E. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

F. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.

G. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

END OF SECTION

SECTION 16075

ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. This Section includes electrical identification materials and devices required to comply with ANSI C2, NFPA 70, OSHA standards, and authorities having jurisdiction.

1.3 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

B. Schedule of Nomenclature: An index of electrical equipment and system components used in identification signs and labels

1.4 QUALITY ASSURANCE

A. Comply with ANSI C2.

B. Comply with NFPA 70.

C. Comply with ANSI A13.1 and NFPA 70 for color-coding.

PART 2 - PRODUCTS

2.1 LABELS

A. Colored banding tape shall be 5 mil stretchable vinyl with permanent solid color. Color shall be as herein after specified. Tape shall be Plymouth “Slipknot 45”, 3M Scotch #35, or equal.

B. Numbered wire marking labels shall be colored vinyl markers, T&B, Brady, or equal. With clear heat shrinking tubing placed over the marking labels.

C. Cable identification labels shall be water resistant polyester with blank write-on space, T&B, Brady or equal. For use in handholds, manholes and boxes.

D. Underground-Conduit Warning Tape: Permanent, bright-colored, continuous-printed, vinyl tape.

1. Not less than 6 inches wide by 4 mils thick

2. Compounded for permanent direct-burial service.
3. Embedded continuous metallic strip or core.
4. Printed legend indicating type of underground line.

2.2 NAMEPLATES AND SIGNS

A. Safety Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145.

B. Engraved Plastic Nameplates and Signs: Engraving stock, melamine plastic laminate, minimum 1/16 inch thick for signs up to 20 sq. in. and 1/8 inch thick for larger sizes.

1. Engraved legend with black letters on white face.
2. Punched or drilled for mechanical fasteners.

C. Baked-Enamel Signs for Interior Use: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for the application. 1/4-inch grommets in corners for mounting.

D. Exterior, Metal-Backed, Butyrate Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for the application. 1/4-inch grommets in corners for mounting.

E. Fasteners for Nameplates and Signs: Self-tapping, stainless-steel screws or No. 10/32, stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Phase label black pigmented power wires with color banding tape. Color of tape applies shall be that specified below:

CONDUCTOR	120/240V SYSTEMS	480V SYSTEMS
Phase A	Black	Purple
Phase B	Red	Brown
Phase C	Blue	Yellow
Neutral	White	Gray
Equipment Ground	Green	Green

B. Numbered labels shall be installed to identify circuit numbers from panel boards. Install labels on each wire in each panel board, junction, pullbox, and device.

C. Label each wiring run with write-on waterproof labels inside each motor control center and in service switchboard. Install write-on label ties around wire group at conduit entrance and write-on label the wire size, and service.

D. Install numbered marking on each control wiring termination at each terminal strip and at each device. Do this in motor control center, terminal cabinets, safety switches, remote controllers, pilot operators, and instrumentation equipment. Number selected shall correspond to number on terminal strip.

E. Phase bank each power wire and cable with colored banding tape. Do this at each termination

F. Apply numbered wire marking labels to control wires; power wiring in Panelboards, pull and junction boxes, and at outlets to identify circuit numbers. Each control wire shall be labeled at each connection.

G. Apply write-on identification labels to wiring sets in each hand-hole to identify function. Use waterproof labels.

H. Apply write-on identification labels to empty conduits to identify each with information as to terminus of other end and also trade size of conduit.

I. Install micarta nameplates with engraving to identify function and/or load served for the following:

1. Starters
2. Overcurrent Devices
3. Safety Switches
4. Instruments
5. Control Panels
6. Motor Control Centers
7. Panel Boards
8. Switchgear and Switchboards

Micarta nameplates shall be attached with stainless steel screws, use two(2) per each nameplate.

Submit for review a schedule for engraving along with size for each proposed micarta nameplate. Do not fabricate nameplate until review has been completed.

J. Type circuit directory information on circuit directory cards on all panelboards.

END OF SECTION

SECTION 16120

CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. This Section includes building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.

1.3 SUBMITTALS

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

B. Qualification Data: For testing agency.

C. Field Quality-Control Test Reports: Megohn Meter Test Report

1.4 QUALITY ASSURANCE

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

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 WIRE AND CABLE

A. All conductors shall be soft-drawn, stranded annealed copper that meets ANSI 44, ASTM B3-74/38-72.

B. Insulation for all power and controls single conductors not used in cable trays shall be type XHHW-2 and complying with NEMA WC 5 or 7, UL-83 and UL-1063.

C. Conductors shall be color coded for voltage and phase as per NEC and any local amendments.

D. Large conductors shall have taped color coding.

E. Jacket shall be polyamide outer nylon covering per UL-83 and UL-1063.

F. Multiconductor shielded cables shall be polyethylene insulated tinned copper conductors within an aluminium-polyester shield tinned copper drain wire and a chrome PVC jacket. Shield shall provide 100% coverage. Cables shall be UL style 2092 and shall be Beldon Beldfoil #8760 or equal, with number of conductors shown.

G. Multiconductor signal cables shall consist of twisted pairs of insulated copper conductors, size and number of pairs as indicated, with a petroleum-polyethylene compound which fills all cable interstices, a non-hydroscopic core tape, .005" copper shield and a polyethylene jacket. Cable shall be manufactured to REA Specification PE-39 for REA Designation BJCF cables and shall be Okonite type KTC-F or equal.

H. Multiconductor cords shall consist of rubber insulated high-strained copper conductors contained within a neoprene jacket. Furnish type SJO/300V class for 120/240V class applications.

I. Multiconductor cables for installation in cable trays shall consist of stranded tinned copper conductors, 30 mil FR-EPR flame-retardant ethylene-propylene-rubber insulation, color coded, two-conductors flat, three or more conductors twisted with CPE jacket overall. Furnish Belden tray cable, or equal.

J. Variable Frequency Drive (VFD) power cables shall consist of stranded, tinned-copper power conductors contained within a cross-linked polyolefin, 2kV insulation meeting the requirements for Type P of IEEE 1580 and Type X110 of UL 1309/CSA 245. Each conductor shall have printed phase I.D. Cable shall include 3 ground conductors consisting of stranded, tinned-copper insulated with insulation equivalent to the power conductor insulation. The shield shall be constructed of tinned-copper braid with an aluminum/polyester tape providing 100% coverage. The jacket shall meet UL 1309/CSA 245 as well as IEEE1580.

2.2 CONNECTORS

A. Power connectors shall be insulated tap connectors. Furnish NSI Polaris connectors with no equals.

B. Insulated spring-wire connectors, "wire-nuts", for small building wire taps and splices shall be plated spring steel with thermoplastic jacket. Connector shall be rated at 150 degrees Celsius continuous. Furnished 3M "Hyflex", T&B "PT" or equal.

C. Insulated set-screw connectors shall consist of copper body with flame-retardant plastic insulated shield. Furnished Ideal, T&B, or equal.

D. Connectors for control conductor connections to screw terminals shall be crimp-type with vinyl insulated barrell and tin-plated copper ring-tongue style connector. Furnish T&B, "Sta-kon", 3M "Scothlok". Or equal.

2.3 INSULATING PRODUCTS

A. Tape products shall be furnished as herein after specified and shall be Plymouth, Okonite, F.E.,

3M, or equal.

B. General purpose electrical tape shall be 7 mil thick stretchable vinyl plastic, pressure adhesive type,"slipknot Grey", 3M Scotch 33+, or equal.

C. Insulating void-filling tape and high voltage bedding tape shall be stretchable thylene propylene rubber with high-tack and fast fusing surfaces. Tape shall be rated for 90 degrees Celsius continuous, 130 degrees Celsius overload, and shall be moisture proof void filling tape shall be "plysafe", 3M Schotch 23, or equal.

D. High temperature protective tape shall be rated 180 degrees Celsius continuous indoor/outdoor, stretchable, self-bonding silicone rubber. High temperature tape shall be "plysil #3445", 3M Scotch 70, or equal.

PART 3- EXECUTION

3.1 WIRING

A. Conductors shall be sized as shown and where no size is indicated, the conductor size shall be size #12 AWG.

B. All control wiring, 120/240V wiring and insulated equipment grounding conductors shall be type XHHW-2 insulated stranded copper conductors.

C. All control and power cables shall be run continuous without splices except where approved by the engineer.

D. Except as otherwise specified, taps and splices with #10 AWG and smaller shall be made with insulated spring wire connectors. Such connectors in damp or wet locations shall be further insulated with an envelope of stretched piece of EPR tape around each wire to fill the interstices between the wires. Then, apply one-half lapped layer of electrical tape over all.

E. Motor connections made with #10 AWG and smaller wire shall be made up with set-screwed copper lugs with threaded-on insulating jacket. After make-up of each connector, install two (2) layers half-lapped, high temperature tape over connector barrel and down over wires into connector on (1") inch.

F. Motor connections made with #8 AWG and larger wire shall be made up with cast copper alloy splice connector. Apply over each connector and down 1.5 inches over each wire entry, wrapping in high temperature tape. Apply at least three (3) layers, half-lapper each layer of such tape with maximum built-up over the connector. Then apply final wrapping of at least three (3) layers, half-lapped each layer of electrical tape.

G. Taps, splices, and connection in #8 AWG and larger wires shall be made with copper alloy bolted pressure connectors. Each such connector shall be insulated by means of applying insulation putty over sharp edges so as to present a smooth bonding surface. Next, apply at least four (4) layers, half-lapped each layer of EPR tape. Then, make final wrapping of at least three (3) layers, half-lapped each layer of electrical tape.

H. Control wiring connections to stud type and screw type terminals shall be made with ring-tongue type crimp connectors. Label each terminal jacket with wire marking label at each connection.

I. Each wire connection shall be made up tightly so that resistance of connection is as low as equivalent length of associated conductor resistance.

J. Phase label black pigmented power wires with color banding tape. Color of tape applies shall be that specified below.

CONDUCTOR	120/240V SYSTEMS	480V SYSTEMS
Phase A	Black	Purple
Phase B	Red	Brown
Phase C	Blue	Yellow
Neutral	White	Gray
Equipment Ground	Green	Green

DC Positive	Blue
DC Negative	White w/ blue tracer

K. Numbered labels shall be installed to identify circuit numbers from panel boards. Install labels on each wire in each panelboard, junction, and pullbox, and device connection.

L. Label each wiring run with write-on waterproof labels inside each motor control center and in service switchboard. Install write-on label ties around wire group at conduit entrance and write-on label the wire size, and service.

M. Install numbered marking on each control wiring termination at each terminal strip and at each device. Do this in motor control center, terminal cabinets, safety switches, remote controllers, pilot operators, and instrumentation equipment. Number selected shall correspond to number on terminal strip.

N. All wiring inside enclosures will be neatly trained and laced with nylon tie-wraps.

O. All wiring shall be installed in raceways unless otherwise noted; however, no wire shall be drawn into a conduit until all work of a nature which may cause injury is completed. Do not exceed wire and cable manufacturer's recommended pulling tensions. A cable pulling compound shall be used as a lubricant and its composition shall not affect the conductor or its insulation.

END OF SECTION

SECTION 16130

RACEWAYS AND BOXES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

1.3 SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: Show fabrication and installation details of components for raceways, fittings, boxes, enclosures, and cabinets.

1.4 QUALITY ASSURANCE

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

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 RACEWAYS

A. Above ground conduit shall be Aluminum Rigid Conduit and shall comply with Article 346 of NEC and U.L. standard UL-6.

B. Below grade conduit shall be non-metallic rigid PVC Schedule 40, rated 90 degrees Celsius and conform to NEMA TC-2 and UL-651 Standards, transitions to above ground to be made with PVC-coated rigid aluminum conduit.

C. Connections to motors shall be made using liquid tight flexible conduit and shall consist of aluminum flexible interlocking core with thermoplastic cover.

D. Below grade to above grade conduit elbows shall be PVC-coated aluminum rigid conduit.

2.2 CONDUIT FITTINGS

A. NEMA 1 lock nuts for rigid metallic conduit shall be stainless steel.

B. Outdoor field applied hubs for sheet metal enclosures shall be stainless steel ring, nylon throat, threaded NPT insert and shall be MYERS "SCRU-TITE", or equal.

C. Conduit hubs for non-metallic enclosures shall be fiberglass polyester reinforced with galvanized steel core, complete with lockout and grounding bushing and shall be Square D Type NH, or equal.

D. Rigid metallic conduit chase nipples, slip fittings, unions, reducers shall be alumimum.

E. Rigid metallic conduit grounding bushings shall be aluminum or stainless steel with threaded hub, nylon insulated throat, and ground lug.

F. Liquid tight flexible conduit fittings shall be aluminum body with internal locking ring.

2.3 CONDUIT BODIES, BOXES, AND ENCLOSURES

A. Conduit bodies such as "C", "LB", "T" and the like pulling fittings shall be sand-cast copper free aluminum. Covers shall be gasketed cast metal with stainless steel cover screws and clamp style attachment. Furnish Crouse-Hinds Form 7, or equal.

B. Conduit bodies such as "GUA", "GUAT", "GUAL", and the like pulling/splicing fittings shall be copper free aluminum with cast metal covers. All such conduit bodies shall be Crouse-Hinds GU/EA series, Appleton "GR" series, equal.

C. Cast metal outlet boxes, pullboxes, and junction boxes whose volume is smaller than 100 cubic inches, and cast metal device boxes, shall be sand-cast copper free aluminum. All boxes shall have threaded hubs. Furnish Crouse-Hinds "FD" style Condulets, Appleton "FD" style Unilets, or equal.

D. Covers for cast metal boxes shall be gasketed cast metal covers with stainless steel screws.

E. Enclosures shall be NEMA types as indicated. NEMA 4X types shall be 316 stainless steel with gasketed door and 316 stainless steel hardware.

F. Conduit hubs for NEMA 4X enclosed safety switches shall be aluminum body type with fiberglass reinforced polyester covering and with grounding bushing inside.

G. Conduit hubs for NEMA 3 and NEMA 4 and NEMA 4X enclosures shall be water-tight threaded hubs with grounding bushing inside.

H. Each enclosure shall be equipped with ground lug.

2.4 MISCELLANEOUS MATERIAL

A. Double bushing for insulating wiring through sheet metal panels shall consist of mating male and female threaded phenolic bushings. Phenolic insulation shall be high-impact "ABB", Gedney type "ABB", or equal.

B. Cable grips shall be grip-type wire mesh with machined metal support. Furnish Kellems, Appleton, or equal products.

C. Conduit pull-cords for use in empty raceways shall be glass-fiber reinforced tape with foot-marked along its length. Furnish Thomas, Greenlee, or equal products.

D. Conduit thread coating compound shall be conductive, non-galling, and corrosion-inhibiting. Furnish Crouse-Hinds type "STL", Appleton type "ST", or equal.

E. Wire pulling compound shall be non-injurious to insulation and to conduit and shall be lubricating, non-crumbling, and non-combustible. Furnish Gedney "Wire-Quick", Ideal "Yellow", or equal.

F. Plastic compound for field-coating of ferrous material products shall be PVC in liquid form that sets-up semi-hard upon curing. Furnishing Rob Roy "rob Kote", Sedco "Patch Coat", or equal.

G. Splicing kit shall be provided with insulating and sealing compound to provide a moisture-tight splice. Provide Scotchcast Series 82 or equal splicing kit.

H. Conduit straps for use with slotted channels shall be aluminum with stainless steel hardware.

I. After-set concrete inserts shall consist of stainless steel expansion bolts, 1/4: minimum diameter, 500 lbs. minimum pull-out resistance. Furnish Phillips, Wej-it, or equal.

J. Conduit "U" bolts shall be stainless steel with stainless steel hex-head bolts.

K. Plastic saddles for supporting buried conduits shall be interlocking type that provides separation between conduits vertically and laterally and between bottom of conduits and trench floor.

PART 3 - EXECUTION

3.1 RACEWAYS

A. Install the conduit system to provide the facility with the utmost degree of reliability and maintenance free operation. The conduit system shall have the appearance of having been installed by competent workmen. Kinked conduit, conduit inadequately supported or carelessly installed, do not give such reliability and maintenance free operation and will not be accepted.

B. Raceways shall be installed for all wiring runs except as otherwise indicated.

C. Conduit sizes, where not indicated, shall be N.E.C. code-sized to accommodate the number and diameter of wires to be pulled into the conduit. Unless otherwise indicated, 3/4" trade-size shall be minimum size conduit.

D. Unless otherwise noted, conduit runs shall be installed exposed. Such runs shall be made parallel to the lines of the structure. Where aluminum conduit or supporting devices come in contact with concrete, the conduit and or supporting devices shall be coated with zinc chromate or other suitable coating to prevent galvanic action.

E. Conduit runs installed below-grade in earth shall be PVC. Use manufacturer's approved cement for joining couplings and adapters. Runs shall be installed so that tops of conduits are at least twenty-four (24") inches below finished grade. Support runs on plastic spacers and encase conduits with reinforced 3000 PSI concrete dyed red. Concrete shall be a minimum of 3" beyond conduits on all sides. Cover top of concrete with red colored concrete dye backfill to finished grade with selected soil that is free from clods, debris, rocks and the like. Pneumatically tamp backfill in six (6") inches to eight (8") inches below finished grade, install continuous run of "BURIED CABLE" marking taped with tracer wire. Below grade changes in direction greater than or equal to 20° shall be accomplished with PVC-coated aluminum elbows.

G. Rigid aluminum conduit runs shall have their couplings and connections made with screwed fittings and shall be made up wrench-tight. Check all threaded conduit joints prior to wire pull.

H. All conduit runs shall be watertight over their lengths of run except where drain fittings are indicated. In which cases, install specified breather-drain fittings.

I. Liquid tight flexible conduit shall be used to connect wiring to motors, limit switches, bearing thermostats, and other devices that may have to be removed for servicing. Unless otherwise indicated, maximum lengths of flex shall be six (6') feet.

J. Each flex connector shall be made-up tightly so that the minimum pull-out resistance is at least 150 lbs.

K. Empty conduits shall have pull-tape installed. Identify each terminus as to location of other end. Use blank plastic waterproof write-on label and write information on each label with waterproof ink. Cap exposed ends of empty conduit with plastic caps.

L. Conduit runs into boxes, cabinets, and enclosures shall be set in a neat manner. Vertical runs shall be set plumb. Conduits set cocked or out of plumb will not be acceptable.

M. Conduit entrances into equipment shall be carefully planned. Cutting away of enclosure structure, torching out sill or braces, and removal of enclosure structural members, will not be acceptable.

N. Use approved hole cutting tools for entrances into sheet metal enclosure. Use of cutting torch or incorrect tools will not be acceptable. Holes shall be cleanly cut and they shall be free from burrs, fagged edges, and torn metal.

O. All raceways shall be swabbed clean after installation. There shall be no debris left inside. All interior surfaces shall be smooth and free from burrs and defects that would injure wire insulation. All conduits shall be sealed after cable installation with electrical insulation putty.

P. All raceways labeled as “spare” or “future” on the construction documents and are indicated to be installed below grade and rise thru the finished floor beneath concrete construction to serve future equipment shall be capped level with the finished floor.

3.2 CONDUIT BODIES AND BOXES

A. Conduit bodies such as "LB", "T", etc., shall be installed in exposed runs of conduit wherever indicated and where required to overcome obstructions and to provide pulling access to wiring. Covers for such fittings shall be accessible and unobstructed by the adjacent construction.

B. Covers for conduit bodies installed shall be gasketed cast metal type.

C. All conduit boxes installed shall be cast metal type. Covers for all such boxes shall be gasketed cast metal type.

D. Install enclosures plumb

3.3 RACEWAY SUPPORT

A. All raceway systems shall be adequately and safely supported. Loose, sloppy and inadequately supported raceways will not be acceptable. Supports shall be installed at intervals not greater than those set forth under Article 300 of N.E.C., unless shorter intervals are otherwise indicated, or unless conditions require shorter intervals of supports.

B. Surface mounted runs of conduit on concrete or masonry surfaces shall be supported off the surface by means of aluminum slotted channels and conduit clamps. Attach each slotted channel support to concrete surface by means of two (2) 1/4" diameter stainless steel bolts into drilled expansion shields. Coat surface contacting concrete or masonry with zinc chromate.

C. Conduit runs that are installed along metallic structures shall be supported by means of beam clamps or other methods as may be indicated. Coat each beam clamp with PVC prior to installation.

D. Below-grade conduits shall be supported with plastic saddles prior to concrete pour.

3.4 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.5 CLEANING

A. After completing installation of exposed, factory-finished raceways and boxes, inspect exposed finishes and repair damaged finishes.

END OF SECTION

SECTION 16140

WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. This Section includes receptacles, connectors, switches, and finish plates.

1.3 DEFINITIONS

A. GFI: Ground-fault circuit interrupter.

B. TVSS: Transient voltage surge suppressor.

1.4 SUBMITTALS

A. Product Data: For each product specified.

B. Shop Drawings: Legends for receptacles and switch plates.

1.5 QUALITY ASSURANCE

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

B. Comply with NEMA WD 1.

C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 WIRING DEVICES

A. All wiring devices shall be specification grade and shall meet NEMA WD1 requirements. Furnish following types unless otherwise indicated.

B. Two-pole, 3-wire grounding, 15A/125V, NEMA 5-15R duplex receptacle shall be Arrow-Hart # 5662-S, Hubbel #5262, or equal.

C. Two-pole 3-wire grounding, 20A/125V, NEMA 5-20R duplex receptacle shall be Arrow-Hart#5739-S, Hubbel #5362, or equal.

D. GFI receptacle shall be duplex receptacle in a duplex body containing reset and test push-buttons. Furnish Square D "GFSR", or equal.

E. Two-pole, 3-wire grounding, #20A/250V NEMA 6-20R single receptacle shall be Arrow-Hart # 5861, Hubbel # 5461, or equal.

F. Single-pole, single throw 20A toggle switch shall be Arrow-Hart # 1791, Hubbel #1221, or equal.

G. Single-pole, double throw (three-way) 20A toggle switch shall be Arrow-Hart #1994, Hubbel # 1224, or equal.

H. Double-pole, single-throw 29A toggle switch shall be Arrow-Hart #1992, Hubbel # 1222, or equal.

I. Double-pole, single-throw 29A toggle switch shall be Arrow-Hart# 1992, Hubbell #1222, or Equal.

J. Single-pole, double-throw, momentary/centeroff, 20A toggle switch shall be Arrow-Hart # 1995, Hubbell #1556, or equal.

K. Door Switch, single-throw pressure sensitive shall be Pass & Seymour #1205, or equal.

2.2 FACE PLATES

A. Plant receptacle covers shall be zinc die cast with vertical duplex cover. Furnish Crouse-Hinds #TP7199 or approved equal.

B. Plant switch covers shall be zinc die cast vertical opening cover. Furnish Crouse-Hinds #TP7214 or approved equal.

C. Office areas receptacle and switch covers shall be nylon ivory colored with attachment screws painted to match cover. Furnish Leviton or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install devices and assemblies plumb and secure.

B. Install wall plates when painting is complete.

C. Install wall dimmers to achieve indicated rating after derating for ganging as instructed by manufacturer.

D. Do not share neutral conductor on load side of dimmers.

E. Arrangement of Devices: Unless otherwise indicated mount with long dimension vertical, and grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

3.2 CONNECTIONS

A. Connect wiring device grounding terminal to branch-circuit equipment grounding conductor.

B. Isolated-Ground Receptacles: Connect to isolated-ground conductor routed to designated isolated equipment ground terminal of electrical system.

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturers torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

A. Test wiring devices for proper polarity and ground continuity. Operate each device at least six times.

B. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.

C. Replace damaged or defective components.

3.4 CLEANING

A. Internally clean devices, device outlet boxes, and enclosures. Replace stained or improperly painted wall plates or devices.

END OF SECTION

SECTION 16345

SHORT-CIRCUIT/COORDINATION STUDY/ARC FLASH HAZARD ANALYSIS

PART 1 - GENERAL

1.1 SCOPE

A. The contractor shall furnish short-circuit and protective device coordination studies as prepared by the electrical equipment manufacturer or an approved engineering firm. The study shall be started and results submitted prior to ordering any distribution equipment.

B. Prior to any rough-in the contractor shall obtain at minimum an approval from the preliminary coordination study. Any installation prior to obtaining the approval shall be at the contractor's risk.

C. The contractor shall furnish an Arc Flash Hazard Analysis Study per the requirements set forth in NFPA 70E – Standard for Electrical Safety in the Workplace. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2015, Annex D.

D. The scope of the studies shall include all new distribution equipment supplied by the equipment Manufacturer under this contract.

1.2 REFERENCES

A. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

1. IEEE 141 – Recommended Practice for Electrical Power Distribution and Coordination of Industrial and Commercial Power Systems.
2. IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
3. IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis.
4. IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings.
5. IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.
6. IEEE 1584 – Guide for Performing Arc-Flash Hazard Calculations.

B. American National Standards Institute (ANSI):

1. ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.
2. ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures.

3. ANSI C37.010 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis.
4. ANSI C37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories.

C. The National Fire Protection Association (NFPA)

1. NFPA 70 – National Electrical Code, latest edition.
2. NFPA 70E – Standard for Electrical Safety in the Workplace.

1.3 SUBMITTALS FOR REVIEW/APPROVAL

A. The short-circuit and protective device coordination studies shall be submitted to the design engineer prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment drawings for manufacturing. If formal completion of the studies may cause delay in equipment manufacturing, approval from the engineer may be obtained for preliminary submittal of sufficient study data to ensure that the selection of device and characteristics will be satisfactory.

1.4 SUBMITTAL FOR CONSTRUCTION

A. The results of the short-circuit, protective device coordination and arc flash hazard analysis studies shall be summarized in a final report. Copies of the report, short-circuit input and output data, where required, shall be provided through SAWS CPMS.

B. The report shall include the following sections:

1. Executive Summary.
2. Descriptions, purpose, basis and scope of the study.
3. Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short circuit duties.
4. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip unit settings, fuse selection.
5. Fault current calculations including a definition of terms and guide for interpretation of the computer printout.
6. Details of the incident energy and flash protection boundary calculations.
7. Recommendations for system improvements, where needed.
8. One-line diagram.

C. Arc flash labels shall be provided in hard copy only at least 30 days prior to energizing the electrical equipment.

1.5 QUALIFICATIONS

A. The short-circuit, protective device coordination and arc flash hazard analysis studies shall be conducted under the supervision and approval of a Registered Professional Electrical Engineer skilled in performing and interpreting the power system studies.

B. The Registered Professional Electrical Engineer shall be a full-time employee of the equipment manufacturer or an approved engineering firm.

C. The Registered Professional Electrical Engineer shall have a minimum of five (5) years of experience in performing power system studies.

D. The equipment manufacturer or approved engineering firm shall demonstrate experience with Arc Flash Hazard Analysis by submitting names of at least ten actual arc flash hazard analysis it has performed in the past year.

1.6 COMPUTER ANALYSIS SOFTWARE

A. The studies shall be performed using ETAP Version 22 software program.

PART 2 - PRODUCTS

2.1 STUDIES

A. Contractor to furnish short-circuit and protective device coordination studies as prepared by equipment manufacturer or an approved engineering firm.

B. The contractor shall furnish an Arc Flash Hazard Analysis Study per NFPA 70E – Standard for Electrical Safety in the Workplace, reference Article 130.3 and Annex D.

2.2 DATA COLLECTION

A. A Contractor shall furnish all data as required by the power system studies. The Engineer performing the short-circuit; protective device coordination and arch flash hazard analysis studies shall furnish the Contractor with a listing of required data immediately after award of the contract. The Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.

B. Source combination shall include present and future motors and generators.

C. Load data utilized shall include proposed loads obtained from Contract Documents provided by Owner or Contractor. Raceway and conductor types and lengths shall be provided to interested parties performing the study by Contractor. Contractor shall obtain fault data from Power Company as required for the study.

2.3 SHORT-CIRCUIT AND PROTECTIVE DEVICE EVALUATION STUDY

A. Use actual conductor impedances if known. If unknown, use typical conductor impedances base on IEEE Standard 141-1993.

B. Transformer design impedances shall be used when test impedances are not available.

C. Provide the following:

1. Calculation methods and assumptions.
2. Selected base per unit quantities.
3. One-line diagram of the system being evaluated.
4. Source impedance data, including electric utility system and motor fault contribution characteristics. The use of infinite bus is unacceptable.
5. Tabulations of calculated quantities.
6. Results, conclusions and recommendations.

D. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each:

1. Electric utility's supply termination point.
2. Incoming switchgear.
3. Unit substation primary and secondary terminals.
4. Low voltage switchgear.
5. Motor control centers.
6. Standby generators and automatic transfer switches.
7. Branch circuit panelboards.
8. Other significant locations throughout the system.
9. VFD's

E. For grounded systems, provide a bolted line-to-ground fault current study for areas as defined for the three-phase bolted fault short-circuit study.

F. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to short circuit ratings.
2. Adequacy of switchgear, motor control centers, and panelboard bus bars to withstand short-circuit stresses.
3. Notify Owner in writing of circuit protective devices improperly rated for the calculated available fault current.

2.4 PROTECTIVE DEVICE COORDINATION STUDY

A. Proposed protective device coordination time-current curves (TCC) shall be displayed on log-log scale graphs.

B. Include on each TCC graph, a complete title and one-line diagram with legend identifying the specific portion of the system covered.

C. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.

D. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.

E. Plot the following characteristics on the TCC graphs, where applicable:

1. Electric utility's overcurrent protective device.
2. Medium voltage equipment overcurrent relays.
3. Medium and low voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
4. Low voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands.
5. Transformer full-load current, magnetizing inrush current and ANSI through-fault protection curves.
6. Conductor damage curves.
7. Ground fault protective devices, as applicable.
8. Pertinent motor starting characteristics and motor damage points, where applicable.
9. Pertinent generator short-circuit breaker in each motor control center and applicable panelboard.

F. Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.

2.5 ARC FLASH HAZARD ANALYSIS

A. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2015, Annex D.

B. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboards, busway and splitters) where work could be performed on energized parts.

C. The Arc-Flash Hazard Analysis shall include all significant locations in 240 volt and 208 volt systems fed from transformers equal to or greater than 1285 kVA where work could be performed on energized parts.

D. Safe working distances shall be based upon the calculated arc flash boundary considering an incident energy o 1.2 cal/cm².

E. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing item when performing incident energy calculations.

F. The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum and will assume a minimum motor contribution (all motors off). Conversely, the maximum calculation will assume a maximum contribution from the utility and will assume the maximum amount of motors to be operating. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable.

G. The incident energy calculation must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators should be decremented as follows:

1. Fault contribution from induction motors should not be considered beyond 3-5 cycles.
2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g. contributions from permanent magnet generators will typically decay from 10 per unit to 3 per unit after 10 cycles).

H. For each equipment location with a separately enclosed main device (where there is adequate separation between the lines side terminals of the main protective device and the work location), calculations for incident energy and flash protection boundary shall include both the line and load side of the main breaker.

I. When performing incident energy calculation on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.

J. Coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.

K. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584-2002 section B.1.2. Where it is not physically possible to move outside the flash protections boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilitzed.

2.6 REPORT SECTIONS

A. Input data shall include, but not be limited to the following:

1. Feeder input data including feeder type (cable or bus), size, length, number per phase, conduit type (magnetic or non-magnetic) and conductor material (copper or aluminum).
2. Transformer input data, including winding connections, secondary neutral-ground connection, primary and secondary voltage ratings, kVA rating, impedance, % taps and phase shift.
3. Reactor data, including voltage rating, and impedance.
4. Generation contribution data, (synchronous generators and Utility), including short-circuit reactance (X'd), rated MVA, rated voltage, three-phase and single line-ground contribution (for Utility sources) and X/R ratio.
5. Motor contribution data (inductin motors and synchronous motors), including short-circuit reactance, rated horsepower or kVA, rated voltage, and X/R ratio.

B. Short-circuit Output Data shall include, but not be limited to the following reports:

1. Low Voltage Fault Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:

a. Voltage.
b. Calculated fault current magnitude and angle.
c. Fault point X/R ratio.
d. Equivalent impedance.

2. Momentary Duty Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:
   a. Voltage.
   b. Calculated symmetrical fault current magnitude and angle.
   c. Fault point X/R ratio.
   d. Calculated asymmetrical fault currents.
      1) Based on fault point X/R ratio.
      2) Based on calculated symmetrical value multiplied by 1.6.
      3) Based on calculated symmetrical value multiplied by 2.7.
   e. Equivalent impedance.
3. Interrupting Duty Report shall include a section for three-phase and unbalanced built calculations and shall show the following information for each applicable location:
   a. Voltage.
   b. Calculated symmetrical fault current magnitude and angle.
   c. Fault point X/R ratio.
   d. No AC Decrement (NACD) ratio.
   e. Equivalent impedance.
   f. Multiplying factors for 2, 3, 5 and 8 cycle circuit breakers rated on a symmetrical basis.
   g. Multiplying factors for 2, 3, 5 and 8 cycle circuit breakers rated on a total basis.

C. Recommended Protective Device Settings:

1. Phase and Ground Relays:
   a. Current transformer ratio.
   b. Current setting.
   c. Time setting.
   d. Instantaneous setting.
   e. Recommendations on improved relaying systems, if applicable.
2. Circuit Breakers:
   a. Adjustable pickups and time delays (long time, short time, ground).
   b. Adjustable time-current characteristic.
   c. Adjustable instantaneous pickup.
   d. Recommendations on improved trip systems, if applicable.

D. Incident energy and flash protection boundary calculations.

1. Arcing fault magnitude.
2. Protective device clearing item.
3. Duration of arc.
4. Arc flash boundary.
5. Working distance.
6. Incident energy.
7. Hazard Risk Category.
8. Recommendations for arc flash energy reduction.

PART 3 - EXECUTION

3.1 FIELD ADJUSTMENT

A. Adjust relay and protective device settings according to the recommended settings table provided by the coordination study. Field adjustments to be completed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.

B. Make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.

C. Notify Owner in writing of any required major equipment modifications.

3.2 ARC FLASH WIRING LABELS

A. The contractor of the Arc Flash Hazard Analysis shall provide a 3.5 in. x 5 in. thermal transfer type label of high adhesion polyester for each work location analyzed.

B. All labels will be based on recommended overcurrent device settings and will be provided after the results of the analysis have been presented to the owner and after any system changes, upgrades or modifications have been incorporated in the system.

C. The label shall include the following information, at a minimum:

1. Location designation.
2. Nominal voltage.
3. Flash protection boundary.
4. Hazard risk category.
5. Incident energy.
6. Working distance.
7. Engineering report number, revision number and issue date.

D. Labels shall be machine printed, with no field markings.

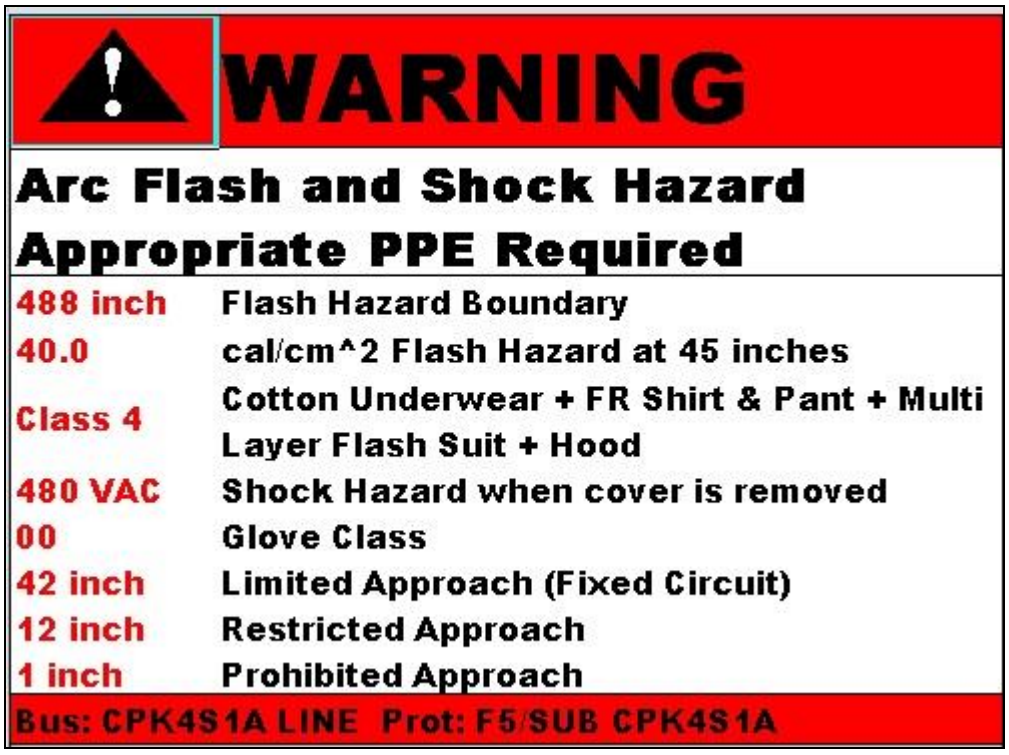
E. Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings.

1. For each 480 and applicable 208 volt panelboard, one arc flash label shall be provided.
2. For each motor control center, one arc flash label shall be provided.
3. For each low voltage switchboard, one arc flash label shall be provided.
4. For each switchgear, one flash label shall be provided.
5. For low voltage VFD’s, one flash label shall be provided.
6. For disconnect switches, one flash label shall be provided.

F. Labels shall be field installed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.

G. Provide date when arc flash study was performed.

H. Example of Arc Flash Warning Label:



3.3 ARC FLASH TRAINING

A. The contractor of the Arc Flash Hazard Analysis shall train the owner's qualified electrical personnel of the potential arc flash hazards associated with working on energized equipment (minimum 4 hours). The training shall be certified for continuing education units (CEU's) by the International Association for Continuing Education Training (IACET) or equivalent.

END OF SECTION

SECTION 16442

PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. This Section includes load centers and panel boards, overcurrent protective devices, and associated auxiliary equipment rated 600 V and less for the following types:

1. Lighting and appliance branch-circuit panel boards.
2. Distribution panel boards.
3. Transient voltage surge suppressor panel boards.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter (GFI).

C. RFI: Radio-frequency interference.

D. RMS: Root mean square.

E. SPDT: Single pole, double throw.

1.4 SUBMITTALS

A. Product Data: For each type of panel board, overcurrent protective device, TVSS device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:
   a. Enclosure types and details for types other than NEMA 250, Type 1.
   b. Bus configuration, current, and voltage ratings.
   c. Short-circuit current rating of panelboards and overcurrent protective devices.
   d. UL listing for series rating of installed devices.

e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

2. Wiring Diagrams: Diagram power, signal, and control wiring and differentiate between manufacturer-installed and field-installed wiring.

C. Field Tests Reports: Submit written test reports and include the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

D. Panelboard Schedules: For installation in panel boards. Submit final versions after load balancing.

E. Maintenance Data: For panel boards and components to include in maintenance manuals specified in Division 1. In addition to requirements specified in Division 1 Section ACloseout Procedures,@ include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Testing agency that is a member company of the International Electrical Testing Association and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the International Electrical Testing Association or National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

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

C. Comply with NEMA PB 1.

D. Comply with NFPA 70.

1.6 COORDINATION

A. Coordinate layout and installation of panel boards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, and encumbrances to workspace clearance requirements.

1.7 EXTRA MATERIALS

A. Keys: Six (6) spares of each type of panel board cabinet lock.

PART 1 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, the following:

1. Panel boards, Overcurrent Protective Devices, Controllers, Contactors, and Accessories:
   a. Siemens
   b. Square D Co.
   c. Eaton
   d. General Electric

2.2 FABRICATION AND FEATURES

A. Enclosures: Flush- and surface-mounted cabinets as indicated on drawings. NEMA PB 1, Type 1, to meet environmental conditions at installed location.

1. Outdoor Locations: Type 4X, gasketed, stainless steel with white enamel finish.

B. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.

C. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.

D. Finish: Manufacturer's white enamel finish over stainless steel.

E. Directory Card: With transparent protective cover, mounted inside metal frame, inside panelboard door.

F. Bus: Hard-drawn copper, 98 percent conductivity. Aluminum is NOT acceptable.

G. Main and Neutral Lugs:

1. Compression type suitable for use with conductor material on MLO panels.
2. Mechanical type suitable for use with conductor material on MCB panels.

H. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors; bonded to box.

I. Service Equipment Label: UL labeled for use as service equipment for panel boards with main service disconnect switches.

J. Future Devices: Mounting brackets, bus connections, and necessary appurtenances required for future installation of devices.

K. Feed-through Lugs: Compression type suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

2.3 PANEL BOARD SHORT-CIRCUIT RATING

A. UL label indicating series-connected rating with integral or remote upstream devices. Include size and type of upstream device allowable, branch devices allowable, and UL series-connected short-circuit rating.

B. Fully rated to interrupt symmetrical short-circuit current available at terminals.

C. See panel schedules on construction drawings for minimum ratings.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANEL BOARDS

A. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

B. Doors: Front mounted with concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.5 DISTRIBUTION PANEL BOARDS

A. Doors: Front mounted, except omit in fused-switch panelboards; secured with vault-type latch with tumbler lock; keyed alike. Square D I-Line or approved equal.

B. Main Overcurrent Protective Devices: Thermal magnetic circuit breaker.

C. Branch Overcurrent protective devices shall be one of the following:

1. For Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
2. For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

2.6 OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents. Breakers shall be fully rated for panel AIC rating.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. GFCI Circuit Breakers: Single- and two-pole configurations with 30-mA trip sensitivity.

B. Molded-Case Circuit-Breaker Features and Accessories. Standard frame sizes, trip ratings, and number of poles.

1. Lugs: Compression style, suitable for number, size, trip ratings, and material of conductors.
2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
4. Communication Capability: Circuit-breaker-mounted communication module with functions and features compatible with power monitoring and control system.
5. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
6. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
7. Auxiliary Switch: Two SPDT switches with Aa@ and Ab@ contacts; Aa@ contacts mimic circuit-breaker contacts, Ab@ contacts operate in reverse of circuit-breaker contacts.
8. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
9. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.

C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

2.7 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Portable Test Set: To test functions of solid-state trip devices without removal from panel board.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install panel boards and accessories according to NEMA PB 1.1. Provide 4-foot clearance in front of panel board. Coordinate with other equipment.

B. Mounting Heights: Top of trim 74 inches above finished floor, unless otherwise indicated. Mount with at least 6 inches of clearance below panel board.

C. Mounting: Plumb and rigid without distortion of box. Mount recessed panel boards with fronts uniformly flush with wall finish.

D. Circuit Directory: Create a directory to indicate installed circuit loads after balancing panel board loads. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable. Use manufacturers supplied card and permanent slot location.

E. Install filler plates in unused spaces.

F. Wiring in Panel board Gutters: Arrange conductors into groups and bundle and wrap with wire ties after completing load balancing.

3.2 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 16 Section AElectrical Identification.@

B. Panel board Nameplates: Label all panel boards with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws. Provide red nameplates for emergency or stand-by power branch fed panels. Nameplate shall include:

1. Normal Power
   a. Panel Name
   b. Voltage A277/480" or A120/208"
2. Generator Powered Panels
   a. Panel Name
   b. Voltage A277/480" or A120/208"
   c. Non-Hospital
      1) Non-emergency, “Stand-By Branch”

3.3 CONNECTIONS

A. Install equipment grounding connections for panel boards with ground continuity to main electrical ground bus.

B. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each panel board bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

B. Testing: After installing panel boards and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

1. Procedures: Perform each visual and mechanical inspection and electrical test indicated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

C. Balance Loads: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes as follows:

1. Measure as directed during period of normal system loading.
2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data-processing, computing, transmitting, and receiving equipment.
3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
4. Tolerance: Difference exceeding 20 percent between phase loads, within a panel board, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.5 ADJUSTING

A. Provide factory technician to set field-adjustable switches and circuit-breaker trip ranges.

3.6 CLEANING

A. On completion of installation, inspect interior and exterior of panel boards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION

SECTION 16940

INSTRUMENTATION HEAT TRACE SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK:

A. Furnish and install thermostatically controlled heat trace system for freeze protection.

B. The system shall include controls, control cabinet, cable, insulation and jacket as indicated on the Contract Drawings and as specified hereinafter.

C. Furnish and install all weather-tight LB fittings, liquid-tight connectors, liquid-tight flexible metal conduit and wiring, etc, to provide power and controls for a complete operating system.

D. Items to be protected by heat trace include:

1. Instrument fluid housings and all associated piping, valves, fittings, etc. This includes pressure switches, pressure gauges, pressure transmitters, process piping associated with gauges/transmitters and process piping.

1.02 SUBMITTALS:

A. Heat Trace Cable.

B. Heat Trace Cable Insulation and Jacket.

C. Heat Trace Thermostat.

D. Heat Trace Panel Wiring.

PART 2 - PRODUCTS

2.01 HEAT TRACE CABLE:

A. Heat cable shall be U.L. listed, self-regulating, with additional footage at all valves, instruments, and pipe supports, as recommended by the manufacturer. Maximum circuit lengths shall be in accordance with the manufacturer's recommendations.

B. Manufacturer: Heat cable shall be Raychem "5BTV1", 6 watts/ft at 40°F for operation at 120 volts, or equal product as manufactured by Chromalox or Thermon.

2.02 HEAT TRACE CABLE INSULATION AND JACKET:

A. The insulation shall be preformed cellular glass insulation, 1" thick minimum, non-absorptive, impermeable to moisture and impervious to hydrochloric acid.

B. A weather-resistant, watertight, protective finish or jacket shall be applied over all insulation as recommended and manufactured by the insulation manufacturer.

C. Manufacturer: Heat trace insulation shall be Pittsburg Corning "Foamglas", Armstrong Armaflex II pipe insulation, or approved equal.

2.03 HEAT TRACE THERMOSTAT (HTT) AND CONTACTOR (HTC):

A. Heat trace circuits shall be switched through a thermostat, set at 40°F, and a multipole contactor (HTC) as indicated on the Contract Drawings. The contactor shall be NEMA rated, 20 ampere, 120 volts, multipole, with 120-volt control coil. The thermostat shall be weatherproof, line-type, 120 volts.

B. Manufacturer: Heat trace thermostat shall be Thermon model B4X or Chromalox B-100.

PART 3 - EXECUTION

3.01 HEAT TRACE CABLE:

A. Spiral the heat cable around the pipe, criss-cross around valves, and attach cable to pipe with GT-66 glass fiber adhesive tape or plastic tie wraps.

B. All power connections to heat trace cable shall be made in watertight j-boxes or with power connection kits recommended by the cable manufacturer. Tees, splices, terminations, and cable shall be of the same manufacturer.

3.02 HEAT TRACE CABLE INSULATION:

A. Install insulation over the entire length of piping protected with heat cable. Insulation shall be mitered and nested to cover all tees, fittings, supports, valves, etc. Fitting covers may be preformed or field fabricated. The inner bore and joint surfaced shall be coated to fill the surface cells, and all joints shall be sealed as recommended by the manufacturer and secured in place with ½" wide stainless steel bands.

END OF SECTION

SECTI0N 17300

INSTRUMENTATION - GENERAL PROVISIONS

PART 1 - GENERAL

1.01 SCOPE:

A. Furnish all labor, materials and equipment required to provide, install, test and make fully operational, a Process Instrumentation and Control System as specified herein and as shown on the Drawings.

B. The work shall include designing, furnishing, installing and testing the equipment and materials detailed in each Section of Division 17.

C. Equipment furnished as a part of other Divisions and shown on the Electrical Drawings shall be integrated into the overall Process Instrumentation and Control System under this Division. Instrumentation specified in other Divisions shall meet the Specification requirements of this Division.

D. The Contractor shall provide the services of a Process Control Systems Integrator (PCSI) who shall perform all work necessary to select, furnish, configure, customize, debug, install, connect, calibrate, and place into operation all instrumentation and control hardware specified within this Division, except for application software programming, which is specified in Section 17305, Application Services. The PCSI shall coordinate with the Owner, Engineer and ASP (Application Services Provider, defined in paragraph 1.06 below) for all scheduling, installation, and startup services. The PCSI shall have qualifications as described herein.

E. The PCSI shall coordinate and schedule all required testing with the General Contractor, Owner, Engineer and Applications Services Supplier (ASP).

F. The work shall include the following:

1. Design, furnish and install new SCADA (PLC) Panels as shown on the contract drawings and detailed in the specification sections.
2. Furnish, install, configure and calibrate all instruments as shown in Specification 17310 FIELD INSTRUMENTS and Specification 17410 FIELD INSTRUMENT LIST.
3. Furnish, configure, calibrate and install all instruments as listed in the Instrument List (Specification Section 17310) and shown on the Drawings.
4. Surge suppression devices shall be provided at control panels interfacing the instruments and at the instruments as shown on the Drawings and specified in Division 17 Instrumentation specification sections.
5. Furnish and install all communications network devices required per the Contract Drawings.
6. Coordinate with the ASP and equipment suppliers to deliver a complete and fully functional process control system.

7. Coordinate all PCSI work giving consideration to specified construction sequencing constraints.
8. Make connections, including field connections and interfacing between instrumentation, controllers, control devices, control panels and instrumentation furnished under other Divisions. The PCSI shall coordinate his construction schedule and instrumentation and control interface with the supplier of instrumentation and control equipment specified under other Divisions.
9. Make wiring terminations for all field-mounted instruments furnished and mounted under other Divisions, including process instrumentation primary elements, transmitters, local indicators and control panels. Install vendor furnished cables specified under other Divisions.
10. Auxiliary and accessory devices necessary for system operation or performance to interface with existing equipment or equipment provided by other suppliers under other Sections of these specifications, shall be included whether or not they are shown on the Drawings. These devices include but are not limited to transducers, current isolators, signal conditioners or interposing relays.
11. Equipment shall be fabricated, assembled, installed, and placed in proper operating condition in full conformity with detail drawings, specifications, engineering data, instructions, and recommendations by the equipment manufacturer as approved by the Engineer.
12. Actual installation of the system will be performed by the PCSI's employees. The PCSI shall provide the on-site technical supervision of the installation.
13. The PCSI shall furnish equipment which is the product of one manufacturer to the maximum practical extent. Where this is not practical, all equipment of a given type shall be the product of one manufacturer.
14. All materials, equipment, labor, and services necessary to achieve the monitoring and control functions described herein shall be provided in a timely manner so that the monitoring and control functions are available when the equipment is ready to be placed into service.
15. All bidders shall visit the site of the project, prior to submitting a bid, and satisfy themselves as to any question that they might have, relating to existing equipment, condition or construction.
16. Each calibration certificate shall be signed and dated by an authorized representative of the CONTRACTOR. Three copies of each completed certificate shall be submitted to the ENGINEER.
17. Required calibration data are listed in Part 3 Testing.

1.02 RELATED SECTIONS:

A. Where references are made to the Related Work paragraph in each Specification Section, referring to other Sections and other Divisions of the Specifications, the Contractor shall provide such information or work as may be required in those references, and include such information or work as may be specified.

B. All Instrumentation work related to Process and Mechanical Divisions equipment that is

shown on the Instrumentation Drawings shall be provided under Division 17.

C. All instrumentation work provided under any Division of the Specifications shall fully comply with the requirements of Division 17.

D. Related Sections:

1. Section 17302 Process Instrumentation and Control System Testing
2. Section 17305 Application Services
3. Section 17310 Field Instruments
4. Section 17327 Panel Mounted Equipment
5. Section 17400 Control Loop Descriptions
6. Section 17405 Input/Output List
7. Section 17410 Field Instrument List
8. Section 17500 Programmable Logic Controller (PLC)

1.03 SUBMITTALS

A. Submit catalog data for all items supplied from this specification Section as applicable. Submittal shall include catalog data, functions, ratings, inputs, outputs, displays, etc. sufficient to confirm that the equipment provides every specified requirement. Any options or exceptions shall be clearly indicated.

B. Submittals for equipment specified herein, for other Sections or Divisions, shall be made as a part of equipment submittals furnished under other Sections or Divisions.

C. General Requirements:

1. Other Division 17 Sections have additional submittal requirements. Refer to other Division 17 Sections for details.
2. Submittals shall be submitted electronically through the SAWS CPMS. Shop drawings shall demonstrate that the equipment and services to be furnished comply with the provisions of these Specifications and shall provide a complete record of the equipment as manufactured and delivered.
3. Submittals shall be complete, giving equipment specifications, details of connections, wiring, ranges, installation requirements, and specific dimensions. Submittals consisting of only general sales literature shall not be acceptable.
4. The submittal Drawings' title block shall include, as a minimum, the PCSI's registered business name and address, Owner and project name, Drawing name, revision level, and personnel responsible for the content of the Drawing.
5. Each Section submittal shall be complete, contain all of the items listed in the Specification Section, and shall be clearly marked to indicate which items are applicable on each cut sheet page. All submittals shall list any exceptions to the Specifications and Drawings, and the reason for such deviation. Shop drawings, not so checked and noted, will be returned without review.
6. The Contractor shall check shop drawings for accuracy and compliance with the requirements of the Contract Documents prior to submittal to the Engineer. Errors and omissions on approved shop drawings shall not relieve the Contractor

from the responsibility of providing materials and workmanship required by the Specifications and Drawings. Shop drawings shall be stamped with the date checked and a Statement indicating that the shop drawings conform to Specifications and Drawings. Only one Specification Section submittal will be allowed per transmittal unless it has been indicated that grouping is permitted in the individual sections.

7. Material shall not be ordered or shipped until the shop drawings have been approved. No material shall be ordered or shop work started if shop drawings are marked "EXCEPTIONS NOTED", "RESUBMIT (RETURNED FOR CORRECTION)" or "REJECTED".
8. Shop Drawings, O&M Manuals, and other documentation, shall be submitted as listed in each of the individual specification Sections.
    a. Submit operations and maintenance data for equipment furnished under this Division. The manuals shall be prepared specifically for this installation and shall include catalog data sheets, drawings, equipment lists, descriptions, parts lists and operating and maintenance instructions.
    b. Manuals shall include the following as a minimum:
        1) A comprehensive index
        2) A complete "As-Built" set of approved shop drawings.
        3) A complete list of the equipment supplied, including serial numbers, ranges and pertinent data.
        4) A table listing of the "as left" settings for all timing relays and alarm and trip setpoints.
        5) System schematic drawings "As-Built", illustrating all components, piping and electric connections of the systems supplied under this Division.
        6) Detailed service, maintenance and operation instructions for each item supplied.
        7) Special maintenance requirements particular to this system shall be clearly defined, along with special calibration and test procedures.
        8) The operating instructions shall also incorporate a functional description of the entire system, with references to the systems schematic drawings and instructions.
        9) Complete parts list with stock numbers, including spare parts.
9. Record Drawings shall be promptly furnished when the equipment installation is complete. Payment will be withheld until Record Drawings have been furnished and approved. The PCSI shall provide markups on all Process and Instrumentation Contract Drawings.
10. At the time of delivery of the equipment, the Contractor shall have an approved shop drawing in his possession for the Owner’s Inspector and Owner’s Engineer’s verifications.

D. Installation experience documentation shall be submitted for approval with the Section Equipment Submittal.

E. Operations and Maintenance Manuals:

1. Operations and Maintenance manuals shall be constructed in accordance with Division 1 and shall include the following information:

a. Manufacturer's contact address and telephone number for parts and service.
b. Instruction books and/or leaflets
c. Recommended renewal parts list
d. Record documents for the information required by the Submittals section above.

1.04 REFERENCE CODES AND STANDARDS:

A. The equipment in this specification shall be designed and manufactured according to latest revision of the following standards (unless otherwise noted):

1. National Electrical Safety Code (NESC)
2. Occupational Safety and Health Administration (OSHA)
3. National Fire Protection Association (NFPA)
4. National Electrical Manufacturers Association (NEMA)
5. American National Standards Institute (ANSI)
6. Insulated Cable Engineers Association (ICEA)
7. International Society of Automation (ISA)
8. Underwriters Laboratories (UL)
9. UL 508, the Standard of Safety for Industrial Control Equipment
10. UL 508A, the Standard of Safety for Industrial Control Panels
11. UL 50, the Standard of Safety for Enclosures for Electrical Equipment
12. NFPA 79, Electrical Standard for Industrial Machinery
13. Factory Mutual (FM)
14. City of San Antonio, Texas Electrical Code
15. All equipment and installations shall satisfy applicable Federal, State, and local codes.
16. All meters, relays and associated equipment shall comply with the requirements of the National Electric Code and Underwriters Laboratories (UL) where applicable.
17. Each specified device shall also conform to the standards and codes listed in the individual device paragraphs.

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

C. All material and equipment, for which a UL standard exists, shall bear a UL label. No such material or equipment shall be brought onsite without the UL label affixed.

D. If the issue of priority is due to a conflict or discrepancy between the provisions of the Contract Documents and any referenced standard, or code of any technical society, organization or association, the provisions of the Contract Documents shall take precedence if they are more stringent or presumptively cause a higher level of performance. If there is any conflict or discrepancy between standard specifications, or codes of any technical society, organization or association, or between Laws and Regulations, the higher performance requirement shall be binding on the Contractor, unless otherwise directed by the Owner/Engineer.

E. In accordance with the intent of the Contract Documents, the Contractor accepts the fact that compliance with the priority order specified shall not justify an increase in Contract Price or an extension in Contract Time nor limit in any way, the Contractor's responsibility to comply with all Laws and Regulations at all times.

F. All control panels shall be constructed and the labeling shall be affixed in a UL 508 facility.

1.05 PROCESS CONTROL SYSTEMS INTEGRATOR (PCSI):

A. The Contractor shall provide the services of a Process Control Systems Integrator (PCSI) for work under this Division and other Divisions, as described in this Division and other Divisions.

B. Where shown on the Bid Documents, the Contractor shall name the proposed PCSI.
Qualifications:

1. The PCSI shall be a "systems house," regularly engaged in the design and installation of control and instrumentation systems and their associated subsystems as they apply to the municipal water or wastewater industry. For the purposes of this and other applicable Divisions, a "systems house" shall be interpreted to mean an organization that complies with all of the following criteria.
2. Employs a registered professional Control Systems Engineer or Electrical Engineer in the state of Texas to supervise or perform the work required by this Specification Section.
3. Employs personnel on this project who have successfully completed a manufacturer’s training course on the hardware configuration and implementation of the specific programmable controllers, computers, and software proposed for this project.
4. Has been in the water/wastewater industry performing the type of work specified in this specification section for a minimum of five (5) continuous years.
5. The PCSI shall maintain a fully equipped office/production facility with full-time employees capable of fabricating, configuring, installing, calibrating, troubleshooting, and testing the system specified herein. Qualified repair personnel shall be available and capable of reaching the facility within 24 hours.

C. Recommended PCSIs:

1. Prime Controls
   815 Office Park Circle
   Lewisville, Texas 75057
   Attention: Gary McNeil
   Telephone: 972.221.4849

2. Richardson Logic Control
   8115 Hicks Hollow
   McKinney, Texas 75071

Attention: Michel Cunningham
Telephone: 972.542.7375

3. Tesco Controls Inc.
2855 Trinity Square Drive, Suite 100
Carrollton, Texas 75006
Attention: Brian Adams
Telephone: 817.343.7163

4. Control Panels USA
16310 Bratton Lane, Suite 100
Austin, Texas 78728
Attn: Martin Salyer
Phone: 512.863.3224

5. Walker Industrial
408 W. Nakoma Dr.
San Antonio, TX 78216
Telephone: 210.824.9000

E. No other PCSI contractors will be accepted.

F. The listing of specific PCSI organizations above does not imply acceptance of their products and capabilities that do not meet the specified ratings, features and functions. PCSI's listed above are not relieved from meeting these specifications in their entirety.

1.06 APPLICATION SERVICES PROVIDER (ASP):

A. The PCSI shall procure the services of an Application Services Provider (ASP) for application software programming for the SCADA PLC and Human Machine Interface (HMI) computers as specified in Section 17305.

B. All other configuration, programming, and integration, including but not limited to, PLC configuration and/or programming, loading of software for process devices, Ethernet configuration and communications verification shall be performed by the PCSI as specified in other Sections.

C. Qualifications:

1. The ASP shall perform all work necessary to configure, customize, debug, install, connect, and place into operation all HMI and DCS software specified within this Division and other related divisions. The PCSI shall coordinate with the ASP all scheduling, installation, and startup services. The PCSI shall be on site at all times when the ASP is working on site.
2. The ASP shall meet the following qualifications and /or submit the following documentation as specified:
    a. Shall secure an independent performance bond and provide documentation

of same from a bonding agency.

b. Shall present an adequate Certificate of Insurance.
c. Shall submit resumes of team members who have completed training and certifications within the last three (3) years.
d. Shall submit a team organization chart.
e. The programmer shall have completed five (5) projects of this size or larger in dollar value and shall provide project names, Owner name, and valid and recently verified reference contacts name and contact information for each project.
f. Shall demonstrate five (5) years of experience working on projects in water or wastewater plant work.
g. Proposed staff shall have the following certifications:
    1) Allen-Bradley CompactLogix PLC's and programming
    2) The programmer, not the company, has worked with Studio 5000 version 32 or higher.
    3) The programmer, not the company, has worked with PlantPax version 4.5 or higher.

3. The ASP shall have completed a minimum of 64 hours of Allen Bradley CompactLogix PLC programming training within the last three (3) years and shall provide a list of training classes.
4. The ASP shall have complete one (1) PlantPax training class within the last three (3) years and shall provide a list of training classes.

D. Recommended ASPs:

1. Prime Controls
   815 Office Park Circle
   Lewisville, Texas 75057
   Attn: Gary McNeil
   Phone: 972.221.4849

2. Control Panels USA
   16310 Bratton Lane, Suite 100
   Austin, Texas 78728
   Attn: Martin Salyer
   Phone: 512.863.3224

3. Tesco Controls Inc.
   2855 Trinity Square Drive, Suite 100
   Carrollton, Texas 75006
   Attention: Brian Adams
   Telephone: 817.343.7163

4. Walker Industrial
   408 W. Nakoma Dr.
   San Antonio, TX 78216

Telephone: 210.824.9000

5. Signature Automation
   4347 W Northwest Hwy #120
   Dallas, Texas 75220
   Attn: Rick Hidalgo
   Phone: 469.248.6840

E. No other ASP vendors will be accepted.

1.07 QUALITY ASSURANCE:

A. The manufacturer of this equipment shall have produced similar instrumentation equipment for a minimum period of five (5) years. When requested by the OWNER/ENGINEER, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

B. The equipment as submitted shall be located as shown on the project plans and shall fit within this location. Equipment with does not fit in the space as shown on the project plans is not acceptable.

C. For the equipment specified herein, the manufacturer shall be ISO 9001 2000 certified.

1.08 ENCLOSURE TYPES FOR AREA CLASSIFICATIONS:

A. Unless otherwise specified herein or shown on the Drawings, enclosures and associated installations shall have the following ratings:

1. Provide NEMA 4X 316 Stainless Steel enclosures for outdoor, wet locations or specifically shown on the Drawings.
2. NEMA 1 or 1A enclosures will not be permitted, unless specifically stated on the Drawings.
3. All enclosures shall be lockable and provided with a padlock location.

1.09 CODES, INSPECTION AND FEES:

A. Equipment, materials and installation shall comply with the requirements of the local authority having jurisdiction.

B. Obtain all necessary permits and pay all fees required for permits and inspections.

1.10 RECORD DRAWINGS:

A. As the work progresses, legibly record all field changes on a set of Project Contract Drawings, hereinafter called the "Record Drawings". The Record Drawings and Specifications shall be kept up to date throughout the project.

B. Record Drawings shall accurately show the installed condition of the following items:

1. One-line Diagram(s)
2. Raceways and pull boxes
3. Conductor sizes
4. Panel Schedule(s)

5. Control Wiring Diagram(s) including all wire tags
6. Process Instrumentation Diagram(s)
7. Mounting Details

C. Submit a typical example of a schedule of control wiring raceways and wire numbers, including the following information:

1. Circuit origin, destination and wire numbers.
2. Field wiring terminal strip names and numbers with field connection wire color.

D. As an alternate, submit a typical example of point-to-point connection diagrams showing the same information, may be submitted in place of the schedule of control wiring raceways and wire numbers.

E. Submit the record drawings and the schedule of control wiring raceways and wire numbers (or the point-to-point connection diagram) to the Owner/Engineer.

F. The Contractor's retainage shall not be paid until the point-to-point connection diagrams have been furnished to and approved by the Owner/Engineer.

1.11 EQUIPMENT INTERCONNECTIONS:

A. Review shop drawings of equipment furnished under other related Divisions and prepare coordinated wiring interconnection diagrams or wiring tables. Submit copies of wiring diagrams or tables with Record Drawings.

B. Furnish and install all equipment interconnections.

1.12 MATERIALS AND EQUIPMENT:

A. Materials and equipment shall be new, except where specifically identified on the Drawings to be re-used.

B. The Contractor shall not bring onsite, material or equipment from a manufacturer, not submitted and approved for this project. Use of any such material or equipment, will be rejected, removed and replaced by the Contractor, with the approved material and equipment, at his own expense.

C. Material and equipment shall be UL listed, where such listing exists.

D. The Contractor shall be responsible for all material, product, equipment and workmanship being furnished by him for the duration of the project. He shall replace the equipment if it does not meet the requirements of the Contract Documents.

1.13 DELIVERY, STORAGE AND HANDLING:

A. Equipment shall be handled and stored in accordance with manufacturer's instructions. Two (2) copies of these instructions shall be included with the equipment at time of shipment, and shall be made available to the Contractor and Owner.

B. Shipping groups shall be designed to be shipped by truck, rail, or ship. Indoor groups shall be bolted to skids. Accessories shall be packaged and shipped separately.

C. Equipment shall be equipped to be handled by crane. Where cranes are not available, equipment shall be suitable for skidding in place on rollers using jacks to raise and lower the groups.

D. Equipment shall be installed in its permanent, finished location shown on the Drawings within seven (7) calendar days of arriving onsite. If the equipment cannot be installed within seven (7) calendar days, the equipment shall not be delivered to the site, but stored offsite, at the Contractor's expense, until such time that the site is ready for permanent installation of the equipment.

E. Where space heaters are provided in equipment, provide temporary electrical power and operate space heaters during jobsite storage, and after equipment is installed in permanent location, until equipment is placed in service.

1.14 EQUIPMENT IDENTIFICATION:

A. Identify equipment furnished under Division 17 with the name of the equipment it serves.
Control panels, Instruments, meters junction or terminal boxes, etc., shall have nameplate designations as shown on the Drawings.

B. Nameplates shall be engraved, laminated impact acrylic, black lettering on a white background, matte finish, not less than 1/16-in thick by 3/4-in by 2-1/2-in, Rowmark 322402. Nameplates shall be 316 SS screw mounted to all enclosures except for NEMA 4 and 4X. Nameplates for NEMA 4 and 4X enclosures shall be attached with double faced adhesive strips, TESA TUFF TAPE 4970, .009 X ½". Prior to installing the nameplates, the metal surface shall be thoroughly cleaned, with a 70% alcohol solution, until the metal surface residue has been removed. Epoxy adhesive or foam tape is not acceptable.

1.15 WARRANTY:

A. The Manufacturer shall warrant the equipment to be free from defects in material and workmanship for two (2) years from the date of acceptance of the equipment containing the items specified in this Section. Within such period of warranty the Manufacturer shall promptly furnish all material and labor necessary to return the equipment to new operating condition. Any warranty work requiring shipping or transporting of the equipment shall be performed by the CONTRACTOR at no expense

to the OWNER.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.01 PCSI COORDINATION MEETINGS:

A. The PCSI shall schedule and administer a minimum of three (3) mandatory Coordination Meetings during the submittal phase of the project. The PCSI shall make arrangements for the meetings and prepare and send a proposed agenda to all participants at least one (1) week before scheduled meetings. The PCSI shall be responsible for promptly preparing and distributing meeting minutes to all attendees.

B. The PCSI shall prepare meeting minutes and distribute them to all attendees and others affected by any decisions made at the meetings. The meeting minutes shall be distributed within one (1) week following the meeting.

C. The meetings shall be held at the General Contractor's field office at the project site and shall include, at a minimum, attendance by the Owner, Engineer, General Contractor's project engineer, PCSI project engineer, ASP's project engineer, and the electrical subcontractor.

1. The First Coordination Meeting shall be held in advance of the first Shop Drawing submittal. The purpose of the first meeting shall be for the PCSI to:
   a. Summarize their understanding of the project
   b. Discuss any proposed deviations, substitutions or alternatives
   c. Present the PCSI project schedule
   d. Schedule testing and delivery milestone dates
   e. Provide a forum for the PCSI to coordinate hardware and software related issues
   f. Request any additional information required from the Owner and/or Engineer.
   g. The PCSI shall bring a draft version of shop drawings to the meeting to provide the basis for the Owner/Engineer's input into their development.
2. The Second Coordination Meeting shall be held after the Field Instruments and Control Panel submittals have been reviewed and returned to the PCSI. The purpose of the second meeting shall be for the PCSI to:
   a. Discuss comments made during submittal process
   b. Refine schedule milestone dates
   c. Coordinate installation activities
   d. Discuss any remaining coordination requirements.
3. The Third Coordination Meeting shall be held no more than one month prior to site testing for each location. The purpose of the third meeting shall be to discuss any remaining coordination needs and requirements.
4. A typical agenda may include, but shall not be limited to, the following:

a. Review minutes of previous meetings
b. Review of work progress
c. Field observations, problems, and decisions
d. Identification of problems which may impede planned progress
e. Review of submittal schedule and submittal status
f. Review of offsite fabrications and delivery schedules
g. Maintenance of progress schedule
h. Corrective measures to regain projected schedules
i. Planned activities for subsequent work period
j. Coordination of projected progress
k. Maintenance of quality and work standards
l. Effect of proposed changes on progress schedule and coordination
m. Other business relating to work

3.02 INTERPRETATION OF DRAWINGS:

A. Raceways and conductors for switches and other miscellaneous low voltage power and signal systems as specified are not shown on the Drawings. Raceways and conductors shall be provided as required for a complete and operating system. Refer to riser diagrams for signal system wiring.

B. The Contractor shall run all conduit and wire to PLC Termination Cabinets, where designated on the Drawings. The conduit and wire, as shown on the interface drawings, may not necessarily be shown on the floor plan.

C. Install conductors carrying low voltage signals (typically twisted shielded pair cables) in raceways totally separate from all other raceways containing power or 120 volt control conductors, Refer to NEC article 725. DC and AC control wiring shall be installed in separate raceways.

D. Raceways and conductors for the fire alarm, sound and page party systems are not shown on the Drawings. Provide raceways and conductors as required by the system manufacturer for a complete and operating system. All raceways and power conductors shall be in accordance with Division 16. Raceways shall be installed concealed in all finished spaces and may be installed exposed or concealed in process spaces.

E. Redesign of electrical or mechanical work, which is required due to the Contractor's use of a pre-approved alternate instrumentation or control item, or arrangement of equipment and/or layout other than specified herein, shall be done by the Contractor at his/her own expense. Redesign and detailed plans shall be submitted to the Owner/Engineer for approval. No additional compensation will be provided for changes in the work, either his/her own or others, caused by such redesign.

3.03 INSTRUMENTATION EQUIPMENT PADS AND SUPPORTS:

A. Equipment pads and supports, of concrete or steel including structural reinforcing and foundations, are shown on the Structural Drawings.

3.04 SLEEVES AND FORMS FOR OPENINGS:

A. Provide and place all sleeves for conduits penetrating floors, walls, partitions, etc. Locate all necessary slots for Electrical and Instrumentation work and form before concrete is poured.

B. Obtain shop drawings and templates from equipment vendors or other subcontractors and locate the concealed conduit before the floor slab is poured.

C. Where setting drawings are not available in time to avoid delay in scheduled floor slab pours, the Owner/Engineer may allow the installations of such conduit to be exposed. Requests for this deviation must be submitted in writing. No additional compensation for such change will be allowed.

3.05 CUTTING AND PATCHING:

A. Cutting and patching shall be done in a thoroughly workmanlike manner. Saw cut all concrete and masonry prior to breaking out sections.

B. Core drill holes in concrete floors and walls as required. Contractor shall obtain written permission from the Owner/Engineer before core drilling any holes larger than 2 inches.

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

D. Do not cut joists, beams, girders, columns or any other structural members.

E. Cut opening only large enough to allow easy installation of the conduit.

F. Patching to be of the same kind and quality of material as was removed

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

H. Patching of waterproofed surfaces shall render the area of the patching completely waterproofed.

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

J. When existing conduits are cut at the floor line or wall line, they shall be filled with grout of suitable patching material.

K. Seal all openings, sleeves, penetrations and slots as specified in Section 16015.

3.06 INSTALLATION:

A. Any work not installed according to the Drawings and this Section shall be subject to change as directed by the Owner/Engineer. No extra compensation will be allowed for making these changes.

B. All dimensions shall be field verified at the job site and coordinated with the work of all other trades.

C. Equipment shall be protected at all times against mechanical injury or damage by water. Equipment shall not be stored outdoors. Equipment shall be stored in dry permanent shelters as required by each Specification Section. Do not install equipment in its permanent location until structures are weather-tight. If any apparatus has been subject to possible injury by water, Equipment shall be thoroughly dried out and tested as directed by the Owner/Engineer or shall be replaced at no additional cost at the Owner/Engineer's discretion.

D. Equipment that has been damaged shall be replaced or repaired by the equipment manufacturer, at the Owner/Engineer's discretion.

E. Repaint any damage to the factory applied paint finish using touch-up paint furnished by the equipment manufacturer. If the metallic portion of the panel or section is damaged, the entire panel or section shall be replaced, at no additional cost to the Owner.

F. Contractor shall coordinate with SAWS inspector to begin programming of PLC, Radio and top-end graphics as soon as the SCADA Panel has been installed on the lift station equipment rack.

3.07 MANUFACTURER'S SERVICE:

A. Provide manufacturer's services for testing and start-up of the equipment as listed in each individual Specification Section.

B. Testing and startup shall not be combined with training. Testing and start-up time shall not be used for manufacturer's warranty repairs.

C. Check interlocking, control and instrument wiring for each system and/or part of a system to prove that the system will function properly as indicated by schematics, wiring diagrams and Control Descriptions.

D. Testing shall be scheduled and coordinated with the Owner/Engineer at least two weeks in advance. Provide qualified test personnel, instruments and test equipment.

E. Refer to the individual Instrumentation Equipment Sections for additional specific testing requirements.

F. Make adjustments to the systems and instruct the Owner's personnel in the proper operation of the systems.

3.08 TESTING:

A. Test systems and equipment furnished under Division 17 and repair or replace all defective work. Make adjustments to the systems and instruct the Owner's personnel in the proper operation of the systems.

B. Make the tests and checks prior to energizing instrumentation equipment in accordance with Section 17302, and the individual Specification sections.

C. Testing shall be scheduled and coordinated with the Owner/Engineer at least two weeks in advance. Provide qualified test personnel, instruments and test equipment, including manufacturer's services, as specified in the individual Specification sections.

D. Where test reports show unsatisfactory results, the Owner/Engineer will require the removal of all defective or suspected materials, equipment and/or apparatus, and their replacement with new items, all at no cost to the Owner. The Contractor shall bear all cost for any retesting.

3.09 TRAINING:

A. The Contractor shall provide manufacturer's training as specified in each individual section of the Specifications.

END OF SECTION

SECTION 17302

PROCESS INSTRUMENTATION AND CONTROL SYSTEM TESTING

PART 1 - GENERAL

1.01 SCOPE:

A. The PCSI shall provide, in coordination with the ASP as required, all labor and materials necessary to coordinate and perform the testing of the Process Instrumentation and Control System as specified herein.

B. The Process Control Systems Integrator (PCSI) shall supervise and/or perform the requirements of this Section. As part of these services, the PCSI shall include, for those equipment items not manufactured by him, the services of an authorized manufacturer's representative to check the equipment installation and place that portion of the equipment in operation. The manufacturer's representative shall be thoroughly knowledgeable about the installation, operation, and maintenance of the manufacturer’s equipment.

C. The Contractor shall provide all test equipment necessary to perform the testing as specified herein.

D. All Process Instrumentation and Control System hardware and software shall be thoroughly tested to verify proper operation as an integrated system.

E. Any defects or problems found during the testing activities shall be corrected by the Contractor and then retested to demonstrate proper operation.

F. Check and confirm the proper installation of all instrumentation and control components and all cable and wiring connections between the various system components prior to placing the various processes and equipment into operation.

G. Conduct a complete system checkout and adjustment, tuning of control loops, checking operation functions, and testing of final control actions. All problems encountered shall be promptly corrected to prevent any delays in startup of the various unit processes.

H. The PCSI shall be responsible for initial operation of the Process Instrumentation and Control System and shall make any required changes, adjustment or replacements for operation, monitoring, and control of the various processes and equipment necessary to perform the functions intended.

I. All spare parts must be on site and accepted prior to commencement of field testing.

J. The Contractor shall provide the following documentation for use during the testing activities.

1. Complete panel schematic and internal point-to-point wiring interconnect drawings.
2. Complete electrical control schematics in accordance with JIC standards.
3. Complete panel layout drawings.
4. Complete field wiring diagrams.
5. Complete instrument loop diagrams.
6. Completed Calibration/Recalibration Certificates for all field and panel devices that

require adjustment or calibration.

K. Contractor shall provide one set of the above listed documentation for the Owner's personnel, one set for the Engineer’s use, one set for field use, and the required number of sets for the Contractor's use.

L. The drawings corrected and modified during testing shall form the basis for the "As-Built" record drawing requirement.

M. Contractor shall furnish to Engineer two copies of an installation inspection report certifying that all equipment has been installed correctly and is operating properly. The report shall be signed by authorized representatives of both Contractor and the system supplier.

1.02 TESTS – GENERAL:

A. The PCSI shall test all equipment prior to shipment to the project site. Unless otherwise specified in the individual specification sections, all equipment provided by the PCSI shall be tested as a single fully integrated system as far as possible.

B. At a minimum, the testing shall include the following:

1. Factory Testing
    a. Un-witnessed Factory Test (UFT)
        1) The Un-witnessed Factory Test shall be performed by the PCSI at his facility.
2. Field Testing
    a. Operational Readiness Test (ORT)
        1) The Operational Readiness Test shall be a joint test performed by the PCSI and ASP, with coordination as required, with the electrical subcontractor and other subcontractors or equipment suppliers if needed.
    b. Functional Demonstration Tests (FDT)
        1) The Functional Demonstration Tests shall be performed by the PCSI in coordination with the ASP as necessary to demonstrate the system operating in compliance with the requirements of the Contract Documents. The FDT(s) shall be conducted by the PCSI and witnessed by the Owner’s representative(s) and the Engineer.
    c. 30-Day Site Acceptance Tests (SAT)
        1) The SAT shall be a 30-day field test of the fully operating system as detailed below in this Section.

C. Each test shall be in the cause and effect format. The person conducting the test shall initiate an input (cause) and, upon the system's or subsystem's producing the correct result (effect), the specific test requirement shall be satisfied.

D. All tests shall be conducted in accordance with prior Engineer-approved procedures, forms, and check lists. Each specific test shall be described and followed by a section for sign off by the appropriate party after its satisfactory completion.

E. Copies of these sign off test procedures, forms, and check lists will constitute the required test documentation.

F. Provide all special testing materials and equipment. Wherever possible, perform tests using actual process variables, equipment, and data. Where it is not practical to test with real process

variables, equipment, and data, provides suitable means of simulation. Define these simulation techniques in the test procedures.

G. The General Contractor shall require the Integration Subcontractor to coordinate all testing with the Engineer, all affected Subcontractors, and the Owner.

H. The Engineer reserves the right to test or retest all specified functions whether or not explicitly stated in the prior approved Test Procedures.

I. The Engineer's decision shall be final regarding the acceptability and completeness of all testing.

J. No equipment shall be shipped to the Project Site until the Engineer has received all test results and approved the system as ready for shipment.

K. The PCSI shall furnish the services of servicemen, all special calibration and test equipment and labor to perform the field tests.

L. Contractor shall be responsible for verifying and adjusting contact logic, adjusting the antenna direction and simulating all alarms for the site.

L. Correction of Deficiencies:

1. All deficiencies in workmanship and/or items not meeting specified testing requirements shall be corrected to meet specification requirements at no additional cost to the Owner.
2. Testing, as specified herein, shall be repeated after correction of deficiencies is made until the specified requirements are met. This work shall be performed at no additional cost to the Owner.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.01 UN-WITNESSED FACTORY TESTS (UFT):

A. The entire system, except primary elements, final control elements, and field mounted transmitters, shall be interconnected and tested to ensure the system operates as specified. All analog and discrete input/output points not interconnected at this time shall be simulated to ensure proper operation of all alarms, monitoring devices/functions, and control devices/functions.

B. All panels and assemblies shall be inspected and tested to verify that they are in conformance with related submittals, specifications, and Contract Drawings.

C. During the tests all digital system hardware and software shall have operated continuously for five (5) days without a failure to verify the system is capable of continuous operation. The Un-Witnessed Factory Test results shall be submitted to the Engineer for approval prior to the scheduling of the Operational Readiness Test (ORT).

3.02 OPERATIONAL READINESS TESTS (ORT):

A. Prior to startup and the Functional Demonstration Test, the entire system shall be certified (inspected, tested, and documented) that it is ready for operation.

B. Loop/Component Inspections and Tests: The entire system shall be checked for proper installation, calibrated, and adjusted on a loop-by-loop and component-by-component basis to ensure that it is in conformance with related submittals and these Specifications.

1. The Loop/Component Inspections and Tests shall be implemented using Engineer approved forms and check lists.
    a. Each loop shall have a Loop Status Report to organize and track its inspection, adjustment, and calibration. These reports shall include the following information and check off items with space for sign off by the PCSI.
        1) Project Name
        2) Loop Number
        3) Tag Number for each component
        4) Check offs/sign offs for each component
    b. Tag/identification
    c. Installation
    d. Termination – wiring
    e. Calibration/adjustment – Check offs/sign offs for the loop
    f. Panel interface terminations
    g. I/O interface terminations
    h. I/O signal operation
    i. Inputs/outputs operational: received/sent, processed, and adjusted
    j. Total loop operation – Provide space for comments
    k. Each active Analog Subsystem element and each I/O module shall have a Component Calibration Sheet. These sheets shall have the following information, spaces for data entry, and a space for sign off by the PCSI:
        1) Project Name
        2) Loop Number
        3) Component Tag Number of I/O Module Number
        4) Component Code Number Analog System
        5) Manufacturer (for Analog system element)
        6) Model Number/Serial Number (for Analog system)
        7) Summary of Functional Requirements:
            a) Indicators: Scale
            b) Transmitters/Converters: Scale
            c) Computing Elements: Function
            d) Controllers: Action (direct/reverse) control Modes (PID)
            e) Switching Elements: Unit range, differential (FIXED/ADJUSTABLE), Preset (AUTO/MANUAL)
            f) I/O Modules: Input or output
2. Calibrations:
    a. Analog Devices: Required and actual inputs and outputs at 0, 25, 50, 75, and 100 percent of span, rising and falling.
    b. Discrete Devices: Required and actual trip points and reset points
    c. Controllers: Mode settings (PID)
    d. I/O Modules: Required and actual inputs or outputs for 0, 25, 50, 75, and 100 percent of span, rising and falling.
        1) Provide space for comments
        2) Space for sign off by the PCSI
3. The General Contractor shall require the PCSI to maintain the Loop Status Reports and

Component Calibration Sheets at the job-site and make them available to the Engineer/Owner at any time.

4. These inspections and tests do not require witnessing. However, the Engineer shall review and initial all Loop Status Sheets and Component Calibration Sheets and spot-check their entries periodically and upon completion of the Operational Readiness Test. Any deficiencies found shall be corrected.

3.03 FUNCTIONAL DEMONSTRATION TEST (FDT):

A. Prior to startup, the entire installed instrument and control system shall be certified that it is ready for operation. All preliminary testing, inspection, and calibration shall be complete as defined in the Operational Readiness Tests and be 100% ready for testing prior to SAWS personnel arrival at project site. The FDT will be a joint test by the PCSI and the Equipment suppliers.

B. Once the facility has been started up and is operating, a witnessed Functional Demonstration Test shall be performed on the complete system to demonstrate that it is operating and in compliance with these Specifications. Each specified function shall be demonstrated on a paragraph-by-paragraph and loop-by-loop basis.

C. Loop-specific and non-loop-specific tests shall be the same as specified under Functional Demonstration Tests except that the entire installed system shall be tested and all functionality demonstrated.

D. Updated versions of the documentation specified to be provided for during the tests shall be made available to the Engineer at the job-site both before and during the tests. In addition, one (1) copy of all O&M Manuals shall be made available to the Engineer at the job-site both before and during testing.

E. The daily schedule specified to be followed during the tests shall also be followed during the Functional Demonstration Test.

F. The system shall operate for 100 continuous hours without failure before this test shall be considered successful.

G. Demonstrate communication failure and recovery.

END OF SECTION

SECTION 17305

APPLICATION SERVICES

PART 1 - GENERAL

1.01 SCOPE:

A. The PCSI shall furnish the services of qualified personnel to perform the work as defined herein, in the Related Work Paragraph of this Section, and other Specification Sections as specified herein. The service personnel shall be referred to as the Application Services Programmer (ASP). The pre-qualified ASP shall be as specified is Section 17300.

B. It shall be the responsibility of the PCSI to obtain and provide any and all information required from other Divisions, as listed in the related work below, to complete the work under this Section.

C. The ASP shall be responsible for providing all new applications programming and configuration services of the Owner's existing SCADA control system to accomplish the control and monitoring functions as described in the Contract Documents. The ASP shall provide all programming functions including, but not limited to, control strategies and communications for the PRV station PLC controller and HMI. The ASP shall also provide all applications programming and configuration services necessary to produce the HMI (graphic displays, reports, trends, historical archive, etc.) as described in the contract specifications and drawings. All applications software development and programming shall be performed in accordance with the owner's pre-established programming standards.

D. The ASP shall provide all modifications to the control system database, control logic, graphic screens, etc. required to correctly reflect the removal of equipment and instruments, including, but not limited to pressure transmitters, flow meters and other equipment and instruments included under the scope of this Contract. All graphics have to be approved by SAWS (Production and the Programmer).

E. At a minimum the ASP shall:

a. Provide for and test communications and functionality between new instrumentation and PLC.

b. Configure and test data collection and interactivity between all software packages and Operator Workstations and Servers in order to provide a comprehensive working system of data collection, storage and reporting.

c. All Applications Software Development and Programming shall be performed in accordance with the Owner's pre-established programming conventions.

d. All Applications Software Development and Programming (i.e., screens, configurations, and associated attributes) shall be performed at the ASP facility before being loaded in the field on the existing Allen Bradley PlantPax system.

e. All Applications Software Development and Programming shall be performed by ASP approved personnel.

f. All commands issued at the Allen Bradley PlantPax Control System (equipment start/stop, reset, set point entry, etc.) shall be security protected.

g. ASP shall perform back-ups of the Allen Bradley PlantPax Control System prior to loading graphical screens, configurations, and associated attributes to SAWS Allen Bradley PlantPax Control System. The ASP shall coordinate with SAWS Programming Department (Alfredo Delagarza)..

h. ASP shall ensure that data is free of viruses, malware, adware, spyware, etc. or any other malicious programs prior to loading graphical screens, configurations, and associated attributes to SAWS Allen Bradley PlantPax system the ASP shall coordinate with SAWS Programming Department (Alfredo Delagarza).

1.02 RELATED WORK:

A. Mechanical Equipment Division

B. Electrical Equipment Division

C. Section 17300 Instrumentation General Provisions

D. Section 17302 Testing

E. Section 17310 Field Instruments

F. Section 17325 Control Panels

G. Section 17327 Panel Mounted Equipment

H. Section 17400 Control Loop Descriptions

I. Section 17405 Input/Output List

J. Section 17410 Field Instrument List

K. Section 17500 Programmable Logic Controller (PLC)

1.03 SUBMITTALS:

A. Pre-submittal Conference:

1. Prior to the Submittal Process, the Application Services Provider (ASP) shall hold workshops, in which the Engineer and Owner may observe the displays and control strategies prior to submitting database, trends, graphics, reports, and control strategies. No display generation, programming, etc. shall begin until standards have been approved.

2. Prior to commencement of any applications work, the ASP shall submit and receive approval from the Owner and Engineer for all required I/O Lists. Lists shall be submitted in Excel.

B. Submittal Process:

1. Submittals shall be made in accordance with the requirements of Division 1, Section 17300, and as specified herein.

2. All electronic submittals shall be submitted in an ISO/IEC 26300:2006 or Comma Separated Values (CSV) readable electronic file format on a CD-Rom and an 8 ½-inch by 11-inch hard copy. Programs shall be submitted in the native format of the PLC as suggested by the manufacturer.

C. Submittal Content:

1. Submittals shall contain the following:

a. Controller Programming:

1) I/O List with register assignments. I/O tags shall be assigned by the ASP and shall conform with SAWS existing I/O tagging format.
2) Diagrams of the process control functions by each strategy.
3) Listing of inputs to the control function.
4) A short narrative of each control strategy.
5) Listing of all Operator inputs and outputs to and from the control function. Any special displays related to the function shall be illustrated. A description of the operation of any display shall be described as it relates to the control function.
6) Cross references of all I/O, showing to which I/O modules or software modules, they are in.
7) Failure contingencies shall be described in detail.
8) An annotated program, submitted in electronic format.
9) PLC program
10) History file
11) Alarm file
12) PLC configuration file
13) Graphic file

b. Human Machine Interface Programming:

1) I/O List with register assignments. I/O tags shall be assigned by the ASP and shall conform with SAWS existing I/O tagging format.
2) Displays for each process area including all necessary pop ups.
3) Listing of data points on each display.
4) A short narrative of each control usage.
5) Listing of all Operator inputs and outputs to and from the control function. Any special displays related to the function shall be illustrated. A description of the operation of any display shall be described as it relates to the control function.
6) Cross references of all I/O, showing which software module at each point used.
7) Failure contingencies shall be described in detail.
8) A complete listing of all historical points.
9) Listing of all required configuration files for each SCADA client.
9) HMI program
11) Alarm file
12) HMI configuration file
13) Graphic file

2. Submit a proposed Schedule of Work.

1.04 REFERENCE CODES AND STANDARDS:

A. Instrumentation equipment, materials and installation shall comply with the National Electrical Code (NEC and with the latest edition of the following codes and standards:

1. National Electrical Safety Code (NESC)

2. Occupational Safety and Health Administration (OSHA)

3. NEMA ICS 1-101 Diagrams, Designations and Symbols

4. ANSI/ISA-5.06.01-2007 - Functional Requirements Documentation for Control Software Applications.

5. ISA-TR20.00.01-2001 - Specification Forms for Process Measurement and Control Instruments Part 1: General Considerations Updated with 27 New Specification Forms in 2004-2005.

6. ISA-5.4-1991 Instrument Loop Diagrams.

7. ISA-5.5-1985 Graphic Symbols for Process Displays.

8. ISA-5.1-1984 (R1992) Instrumentation Symbols and Identification.

9. 9SA-5.3-1983 Graphic Symbols for Distributed Control/Shared Display Instrumentation, Logic, and Computer Systems.

10. ISA-20-1981 Specification Forms for Process Measurement and Control Instruments, Primary Elements, and Control Valves.

11. ISA-5.2-1976 (R1992) Binary Logic Diagrams for Process Operations

12. NEMA ICS 6 Enclosures for Industrial Controls and Systems

13. National Fire Protection Association (NFPA)

14. National Electrical Manufacturers Association (NEMA)

15. American National Standards Institute (ANSI)

16. Insulated Cable Engineers Association (ICEA)

17. International Society of Automation (ISA)

18. Underwriters Laboratories (UL)

19. UL 508, the Standard of Safety for Industrial Control Equipment

20. UL 508A, the Standard of Safety for Industrial Control Panels

21. UL 50, the Standard of Safety for Enclosures for Electrical Equipment

22. NFPA 79, Electrical Standard for Industrial Machinery

23. Factory Mutual (FM)

24. NFPA 70 National Electrical Code (NEC)

25. NFPA 70E Standard for Electrical Safety in the Workplace

26. ANSI C37.90.2 Standard Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Transceivers

27. NEMA ICS 4 Terminal Blocks for Industrial Use

28. NEMA LS1 Low Voltage Surge Protection Devices

29. UL 1283 Standard for Safety-Electromagnetic Interference Filters

30. UL 1449 Third Edition Surge Protective Devices

31. City of San Antonio, Texas Electrical Code

B. All equipment and installations shall conform to applicable Federal, State, and local codes. All equipment shall comply with the requirements of the National Electric Code and Underwriters Laboratories (UL) where applicable. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 WARRANTY:

A. Provide 2 year equipment warranty which begins after final acceptance of facility. Refer to the requirements of Division 1.

1.06 SYSTEM FINAL DOCUMENTATION

A. Prior to final acceptance of the system and owner training, operating and maintenance manuals covering instructions on the operation and maintenance on each type of equipment shall be furnished in accordance with the Section 01730.

B. The documents shall be provided bound in three ring binders with Drawings reduced or folded for inclusion. In addition, documentation shall be provided in electronic format, either in MS Word or Excel, as applicable. Submit electronic files on CD or DVD.

C. As a minimum, the following information shall be provided:

1. A comprehensive index.

2. A complete "As Constructed" set of approved shop Drawings.
3. A complete list of the equipment supplied, including serial numbers, ranges, and pertinent data.

4. Full specifications on each item.

5. System schematic drawings "As Constructed," illustrating all components, piping and electrical connections of the systems supplied under this Section.

6. Detailed service, maintenance and operation instructions for each item supplied.

7. Special maintenance requirements particular to this system shall be clearly defined, along with special calibration and test procedures.

8. Operating instructions which incorporate a functional description of the entire system with references to the systems schematic Drawings and instructions.

9. Complete parts lists with stock numbers and name, address, and telephone number of the local supplier.

D. The final documentation shall be new documentation written specifically for this project, but may include standard and modified standard documentation. Modifications to existing hardware or software manuals shall be made on the respective pages or inserted adjacent to the modified pages. All standard documentation furnished shall have all portions that apply clearly indicated. All portions that do not apply shall be lined out.

E. The manuals shall contain all illustrations, detailed drawings, wiring diagrams, and instructions necessary for installing, operating, and maintaining the equipment. The illustrated parts shall be numbered for identification. All information contained therein shall apply specifically to the equipment furnished and shall only include instructions that are applicable. All such illustrations shall be incorporated within the printing of the page to form a durable and permanent reference book.

F. If the PCSI's ASP transmits any documentation or other technical information which he considers proprietary, such information shall be designated. Documentation or technical information which is designated as being proprietary will be used only for the design, construction, operation, or maintenance of the System and, to the extent permitted by law, will not be published or otherwise disclosed.

G. The requirements for the final documentation are as follows:

1. As built documentation shall include all previous submittals, as described in this Specification, updated to reflect the as built system as well as any corrections or modifications to the System resulting from the Factory and/or Functional Demonstration Tests.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.01 COORDINATION MEETINGS:

A. The ASP shall be responsible to coordinate the work with the PCSI and/or the Contractor. He shall schedule and administer a minimum of three (3) coordination meetings for the purpose of discussing progress of the work under this Section. The ASP shall make arrangements for the

meetings and prepare and send a proposed agenda to all participants at least two (2) weeks before scheduled meetings. The ASP shall be responsible for promptly preparing and distributing meeting minutes to all attendees.

B. The meetings shall be held at the Owner's designated location and shall include, at a minimum, attendance by the Owner, Engineer, General Contractor's project engineer, ASP, and PCSI if necessary.

1. The First Coordination Meeting shall be held in advance of the first ASP Shop Drawing submittal. The first meeting may run concurrent to a PCSI coordination meeting, if desired and timed to meet all other contract requirements. The purpose of the first meeting shall be for the ASP to:

    a. Summarize their understanding of the project
    b. Discuss any proposed deviations, substitutions or alternatives
    c. Present the ASP project schedule
    d. Schedule testing and delivery milestone dates
    e. Provide a forum for the ASP and Owner to coordinate hardware and software related issues
    f. Request any additional information required from the Owner and/or Engineer
    g. The ASP shall bring a draft version of shop drawings to the meeting to provide the basis for the Owner/Engineer's input into their development
    h. Discuss format of required reports to be developed

2. The Second Coordination Meeting shall be held after all ASP shop drawings have been reviewed and returned to the ASP. Attendance by the Owner, Engineer, General Contractor's project engineer, ASP, and PCSI shall be required. The purpose of the second meeting shall be for the ASP to:

    a. Discuss comments made during submittal process
    b. Refine schedule milestone dates
    c. Coordinate installation activities
    d. Discuss any remaining coordination requirements

3. A typical agenda may include, but shall not be limited to, the following:

    a. Review minutes of previous meetings
    b. Review of work progress
    c. Field observations, problems, and decisions
    d. Identification of problems which may impede planned progress
    e. Review of submittal schedule and submittal status
    f. Review of offsite fabrications and delivery schedules
    g. Maintenance of progress schedule
    h. Corrective measures to regain projected schedules
    i. Planned activities for subsequent work period
    j. Coordination of projected progress
    k. Maintenance of quality and work standards
    l. Effect of proposed changes on progress schedule and coordination
    m. Other business relating to work

3.02 TESTING:

A. Refer to Section 17302.

3.03 OPERATIONAL READINESS TEST (ORT):

A. Refer to Section 17302.

B. Each active Analog Subsystem element and each I/O module shall have a Component Calibration Sheet. These sheets shall have spaces for data entry, space for sign off by the ASP and the PCSI, and the following information:

1. Project Name

2. Loop Number

3. Component Tag Number of I/O Module Number

4. Component Code Number Analog System

5. Manufacturer (for Analog system element)

6. Model Number/Serial Number (for Analog system)

7. Summary of Functional Requirements:

   a. Indicators: Scale
   b. Transmitters/Converters: Scale
   c. Computing Elements: Function
   d. Controllers: Action (direct/reverse) control Modes (PID)
   e. Switching Elements: Unit range, differential (FIXED/ADJUSTABLE), Preset (AUTO/MANUAL)
   f. I/O Modules: Input or output

8. Calibrations:

   a. Analog Devices: Required and actual inputs and outputs at 0, 10, 50, and 100 percent of span, rising and falling
   b. Discrete Devices: Required and actual trip points and reset points
   c. Controllers: Mode settings (PID)
   d. I/O Modules: Required and actual inputs or outputs for 0, 10, 50, and 100 percent of span, rising and falling
   e. Space for comments
   f. Space for sign off by the General Contractor

3.04 FUNCTIONAL DEMONSTRATION TEST (FDT):

A. Refer to Section 17302.

3.05 30-DAY SITE ACCEPTANCE TEST (SAT):

A. Refer to Section 17302.

3.06 TRAINING:

A. General:

1. The cost of Owner training programs shall be included in the Contract price. The training and instruction, insofar as practicable, shall be directly related to the system being supplied. The training program shall represent a comprehensive program covering all aspects of the operation and maintenance of the system.

2. All instructors shall be intimately familiar with the operation and control of the Owner's facilities.

3. Training shall be provided to accommodate shift personnel. Coordinate with Owner.

4. Owner reserves the right to record (video and/or audio) all training sessions. All training tapes shall become the sole property of the Owner.

B. Maintenance Training

C. Refer to Section 17302 for additional training requirements

D. Scheduling of all training sessions shall be coordinated with the Owner:

1. Controller Software:

a. The training and instruction, insofar as practicable, shall be directly related the System being supplied. The training shall include a field training program consisting of hands-on instruction utilizing the Owner's System.

b. One 2-day training session shall be provided for the Owner's designated personnel on software and hardware operation and maintenance at the Owner's facility. Software training shall provide classroom and hands-on instruction such that a student with experience in process instrumentation can configure the system with no guidance or with only minimal supervision when attempting complex problems. The training shall cover the following subjects as a minimum:

1) System overview covering the basic system design and purpose
2) System hardware covering the specific hardware elements and specific equipment arrangements provided are covered.
3) Specific application configuration instruction shall cover the overall design and implementation of the applications as provided under this Contract The intent shall be to make the student fully knowledgeable in all aspects the system provided, along with methods for making additions, modifications, and deletions to the process system.
4) Development of new control loops and strategies
5) Complete system backup and reload procedures

c. These courses shall not be concurrent with those offered by the PCSI. The above listing is only a guide and is not intended to be complete.

2. Operator Interface Software

3. Refer to Section 17302 for additional training requirements.

4. Operator Training

    a. Refer to Section 17302 for additional training requirements.

5. PRV field training sessions shall include the following:

    a. PRV field training shall be structured specifically for operations type personnel. The ASP and PCSI shall be prepared to answer any questions the Operators may ask regarding PRV operation via the Control System. Training personnel shall be prepared to walk-through the logic used to control the equipment and how the Control System executes that logic. Training personnel shall be prepared to show the Operators how to operate the PRV from the Control System level in the event of Control Room equipment failure. Additionally, such topics as printing reports on demand, copying graphic displays, signing onto the system, creating graphic generated trends, etc. shall be discussed.
    b. The ASP and PCSI shall, at a minimum, have the following teaching aids available for distribution during PRV Operator field training sessions:

        1) Copies of all complete generated graphic displays and reports

6. Operator Interface Functions:

    a. Provide a minimum of two separate 2-day training sessions as scheduled by the Owner for the Owner's designated operations personnel on the detailed operation of the Operator Work Station Controls. This training should be conducted within two weeks of the completion of the Functional Demonstration Test at a time suitable to the Owner. This training shall be provided at the Owner's facility and as a minimum include the following:

        1) Specific training for the actual instrumentation configuration to provide a detailed understanding of how the equipment and components are arranged, connected, and set up for this Contract.

    b. Provide a minimum of four (4) days of instructor on-call tutoring services. After the completion of the training sessions described above, the instructor shall be at the site to provide these services.

END OF SECTION

SECTION 17310

FIELD INSTRUMENTS

PART 1 - GENERAL

1.01 SCOPE:

A. The CONTRACTOR shall furnish, install and test all field instruments, process control devices and appurtenances, as shown on the project plans, specified in the Related Sections and Divisions as specified herein.

B. Field instruments specified in other Divisions shall be manufactured in accordance with this Section and submitted as part of the equipment specified in the other Divisions.

C. The CONTRACTOR shall furnish to the ENGINEER certified calibration/recalibration (for existing Instruments) reports for field instruments and devices specified herein immediately upon completion of calibration:

1. Receipt of any calibration/recalibration certificate shall in no way imply acceptance of any work or instrument.

2. Each calibration/recalibration certificate shall be signed and dated by an authorized representative of the CONTRACTOR. Three copies of each completed certificate shall be submitted to the ENGINEER.

3. Required calibration data are listed in Part 3 Testing.

1.02 RELATED SECTIONS:

A. Division 16

B. Process Equipment Divisions

C. Mechanical Equipment Divisions

D. Section 17300 Instrumentation General Provisions

E. Section 17302 Process Instrumentation and Control System Testing

F. Section 17305 Application Services

G. Section 17327 Panel Mounted Equipment

H. Section 17400 Control Loop Descriptions

I. Section 17405 Input/Output List

J. Section 17410 Field Instrument List

K. Section 17500 Programmable Logic Controller (PLC)

1.03 SUBMITTALS:

A. Submit catalog data for all items supplied from this specification Section as applicable. Submittal shall include catalog data, functions, ratings, inputs, outputs, displays, etc. sufficient to confirm that the equipment provides every specified requirement. Any options or exceptions shall be clearly indicated.

B. Submittals for equipment specified herein, for other Sections or Divisions, shall be made as a part of equipment submittals furnished under other Sections or Divisions.

C. Installation experience documentation shall be submitted for approval with the Section Equipment Submittal.

D. Operations and Maintenance Manuals:

1. Operations and Maintenance manuals shall be constructed in accordance with Division 1 and shall include the following information:

a. Manufacturer's contact address and telephone number for parts and service.

b. Instruction books and/or leaflets

c. Recommended renewal parts list

d. Record documents for the information required by the Submittals section above.

1.04 REFERENCE CODES AND STANDARDS:

A. The equipment in this specification shall be designed and manufactured according to latest revision of the following standards (unless otherwise noted):

1. All meters, relays and associated equipment shall comply with the requirements of the National Electric Code and Underwriters Laboratories (UL) where applicable.

2. Each specified device shall also conform to the standards and codes listed in the individual device paragraphs.

1.05 QUALITY ASSURANCE:

A. The manufacturer of this equipment shall have produced similar instrumentation equipment for a minimum period of five (5) years. When requested by the OWNER/ENGINEER, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

B. The equipment as submitted shall be located as shown on the project plans and shall fit within this location. Equipment with does not fit in the space as shown on the project plans is not acceptable.

C. For the equipment specified herein, the manufacturer shall be ISO 9001 2000 certified.

1.06 WARRANTY:

A. The Manufacturer shall warrant the equipment to be free from defects in material and workmanship for two (2) years from the date of acceptance of the equipment containing the items specified in this Section. Within such period of warranty the Manufacturer shall promptly furnish all material and labor necessary to return the equipment to new operating condition. Any warranty work requiring shipping or transporting of the equipment shall be performed by the CONTRACTOR at no expense to the OWNER.

PART 2 - PRODUCTS

2.01 GENERAL:

A. All devices shall be Factory Mutual (FM) approved:

1. Explosion Proof for Class I division 1 group B, C, and D.

2. Dust-Ignition Proof for Class II and Class III, division 1, group E, F and G.

3. Factory Sealed.

B. Hardware:

1. All hardware used for outdoor instrument mounting shall be Stainless Steel.

C. Instrument Stand:

1. Aluminum C6X3.25 channel with aluminum ¼" x 6" x 8" floor plate, if required.

D. Process Pipe:

1. All tubing and fitting shall be made of 316 Stainless Steel.

2.02 PRESSURE TRANSMITTER (PRESSURE IN PSI):

A. Electronic Gage Pressure Transmitter:

1. Local and remote indication.

2. Provide with Ray self-cleaning pressure snubbers.

3. Input isolated with silicone filled stainless steel diaphragms.

4. Local indication LCD meter scaled in PSI and mounted integral to the transmitter. Transmitter operation ranges should operate at bottom 25% of full-scale range of transmitter.

5. Outdoor application:

a. NEMA 4 housing

b. View port for local indication

c. Stainless steel flanges

d. C channel mounting

6. Stainless Steel certification tag for Factory Mutual (FM) Explosion Proof rating.

7. Provide with glycerin-filled diaphragm seal.

B. Ratings:

1. Overpressure Limit without damage: 1500 psi

2. Input Range: 150 psi

3. Accuracy: +/- 0.075% of span

4. Analog Output: 4 – 20 mA

5. Power Supply: 24 Vdc

6. Operating Temperature Limits: -4° to 175°F

C. Manufacturer: Rosemount, Model: 2088, Model Number 2088G2S22A1B4E5M5.

2.03 FLOAT SWITCHES:

A. Electronic Level Transmitter.

1. Mercury free.

2. Polymer construction.

3. Intrinsically safe for Class I, Div. 1, Groups A, B, C, D;
Class II, Div. 1, Groups E, F, G.

4. Polyether Polyurethane or ETFE cable. Cable length shall be confirmed prior to procurement to ensure adequate length.

5. Form C contacts – NC-Common-NO.

B. Ratings:

1. Minimum differential 3.5”.

2. Power

C. Manufacturers and Models:

1. Anchor Scientific Eco-Float Type SE

2. Or Equivalent.

2.04 FLOW METER AND TRANSMITTER:

A. Electromagnetic Flow Tube and Transmitter.

1. Electromagnetic.

2. Indication at transmitter.

3. Shall be provided with external surge suppression equipment to protect 120 VAC input and IP/Ethernet communication port.

4. IP/Ethernet communication output and 4-20mA output.

5. Bi-Directional.

6. NSF61 rated or equivalent.

7. Equipment shall interface to IP/Ethernet protocol where necessary.

8. Equipment supplied must be 100% compatible with IP/Ethernet Protocol and suitable for conversion at a later date for Profibus or Foundation Fieldbus.

9. Totalizer readings shall be in MG and interface directly with IP/Ethernet monitoring and control systems. Flow readings shall be in MGD.

10. All meters will have a non-resettable totalizer except through direct interface password protection.

B. Ratings:

1. Minimum accuracy required: +/- 2.0%.

2. Power supply: 110 – 120 Vac

3. Ambient temperature: -5° – 140°F

C. Manufacturers and Models:

1. Endress & Hauser, Promag W500

2. Rosemount – 8750WA, DA1

PART 3 - EXECUTION

3.01 INSTALLER'S QUALIFICATIONS:

A. Installer shall be specialized in installing this type of equipment with minimum 5 years documented experience.

3.02 EXAMINATION:

A. Examine installation area to assure there is sufficient clearance to install the equipment.

B. Verify that the equipment is ready to install.

C. Verify field measurements are as instructed by the manufacturer.

3.03 INSTALLATION:

A. FLOWMETERS:

1. Prior to installation of the meters, CONTRACTOR shall ensure that the meter is compatible with OWNER'S communication instrumentation.

2. All flowmeters shall be set up and calibrated by the Manufacturer's field service representative. The Manufacturer shall certify all installations as correct and meeting the standards set forth by this specification.

3. Manufacturer shall provide a certified calibration report for each flowmeter.

4. Manufacturer shall provide one (1) copy of the calibration software to OWNER.

5. Manufacturer shall provide a minimum of a two (2) year warranty on each meter.

B. PRESSURE TRANSMITTERS AND PRESSURE SWITCHES:

1. Shall be installed with heat trace freeze protection around the fluid housing of the instrument and all piping, valves, and fittings.

2. Installation of the process line:

a. A ½" bore through the process line shall be done along the upper half of the radius of that line.

b. A ½" NPT weld a-let shall be installed over the bore

c. A ½" NPT block (root) valve shall be installed after the weld a-let for the isolation of the process from the pressure device.

d. A ½" NPT to ¼" NPT bushing will be installed on the isolation valve to bush down to allow for the installation of ¼" static or process lines from the process to the pressure measuring device.

e. A 4" expansion loop shall be made after a 1' straight run off the root valve.

f. A ¼" tubing isolation valve shall be installed and a calibration port shall be installed at the device for bleeding off pressure and calibrations can be performed.

3.04 HEAT TRACE SYSTEM:

A. Reference Section, 16940, INSTRUMENTATION HEAT TRACE SYSTEM.

3.05 CONDUIT AND IDENTIFICATION:

A. When the use of flexible conduit is required a minimum of 18" shall be provided but the flexible conduit shall not exceed 36".

B. All Instrumentation runs shall be the full length of the conduit no splices will be allowed.

C. The following nomenclature shall be used for identification:

1. tag # (0-10) for instrumentation info: tags, devices type and termination point

2. jb# (0-10) for junction box, power panel lighting panel and termination point

3. r# (0-10) for rack location and termination point

4. s# (0-10) for slot location and termination point

5. p# (0-10) for point location and termination point

D. Install stainless steel instrument labels with instrument ID, secured with safety wire.

3.06 RACEWAY SEALING:

A. Where raceways enter terminal boxes, junction boxes, or instrumentation equipment, all entrances shall be sealed with 3M 1000NS Watertight Sealant.

3.07 FIELD QUALITY CONTROL:

A. Inspect installed equipment for anchoring, alignment, grounding and physical damage.

B. Check tightness of all accessible electrical connections. Minimum acceptable values shall be specified in the manufacturer's instructions.

3.08 FIELD ADJUSTING:

A. Adjust all equipment for proper range and field conditions, as described in the manufacturer's instructions.

B. Any field adjustments, required for proper system operation, shall be included in the Final O&M Manuals.

3.09 TESTING:

A. Perform all electrical field tests recommended by the manufacturer.

B. Full testing (loop check) shall be done on all instrumentation and all SCADA I/O points and will be witnessed by the OWNER.

C. A calibration sheet shall be supplied for all the instruments and at the time of any instrument test.

1. Analog device calibration sheet shall include the following:

    a. Time of calibration

    b. Date of calibration

    c. Name of the person performing the calibration

    d. Name of the witness, OWNER

    e. Test equipment used and their calibration dates

    f. Device identification S/N, device name and tag number

    g. As found voltage reading

    h. As left voltage reading

    i. As found milliamp reading @ 0%, 25%, 50%, 75% and 100%

    j. As left milliamp reading @ 0%, 25%, 50%, 75% and 100%

    k. Calibration ranges

    l. I/O points

2. I/O point data sheet for each I/O analog and discrete through SCADA:

    a. Field point location

    b. Analog or Discrete

    c. Software point location

    d. Point function

    e. Time of verification

    f. Date of verification

    g. Name of the person verifying the point

    h. Name of the witness, OWNER

3.10 CLEANING:

A. Remove all rubbish and debris from inside and around the equipment. Remove dirt, dust, or concrete spatter from the interior and exterior of the equipment using brushes, vacuum cleaner, or clean, lint free rags. Do not use compressed air.

3.11 EQUIPMENT PROTECTION AND RESTORATION:

A. Touch up and restore damaged surfaces to factory finish, as approved by the manufacturer. If the damaged surface cannot be returned to factory specification, the surface shall be replaced.

3.12 MANUFACTURER'S CERTIFICATION:

A. A qualified factory-trained and certified representative shall certify in writing that the equipment has been installed, adjusted, including all settings as defined in the Contract Documents.

END OF SECTION

SECTION 17327

PANEL MOUNTED EQUIPMENT

PART 1 - GENERAL

1.01 SCOPE OF WORK:

A. This Section of the Specifications describes the requirements for panel mounted equipment to be furnished under other Sections of the Specifications as listed in the Related Work paragraph of this Section.

B. All equipment described herein shall be submitted and furnished as an integral part of equipment specified elsewhere in these Specifications.

C. Provide all flow rate displays configured to also display corresponding totalized flow.

1.02 RELATED WORK:

A. Section 17300 Instrumentation General Provisions

B. Section 17302 Testing and Commissioning

C. Section 17305 Application Services

D. Section 17310 Field Instruments

E. Section 17400 Control Loop Descriptions

F. Section 17405 Input/Output List

G. Section 17410 Field Instrument List

H. Section 17500 Programmable Logic Controller (PLC)

I. Section 16050 Basic Electrical Materials and Methods

1.03 SUBMITTALS:

A. Submittals for equipment specified herein shall be made as a part of equipment furnished under other Sections. Individual submittals for equipment specified herein will not be accepted and will be returned un-reviewed.

B. Submit catalog data for all items supplied from this specification Section as applicable. Submittal shall include catalog data, functions, ratings, inputs, outputs, displays, etc., sufficient to confirm that the equipment provides every specified requirement. Any options or exceptions shall be clearly indicated.

C. Operation and Maintenance Manuals:

1. Operation and Maintenance manuals shall include the following information:

a. Manufacturer’s contact address and telephone number for parts and service.

b. Instruction books and/or leaflets

c. Recommended renewal parts list

d. Record Documents for the information required by the Submittals above.

1.04 REFERENCE CODES AND STANDARDS:

A. The equipment in this specification shall be designed and manufactured according to latest revision of the following standards (unless otherwise noted):

1. NEMA/ISCI 109 Transient Over voltage Withstand Test

2. IEEE Std. 472/ANSI C37.90.2 Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Transceivers.

3. IEC 255.4 Surge Withstand Capability Tests.

4. NEMA/ICS 1 General Standard for Industrial Control Systems.

5. NEMA/ICS 4 Terminal Blocks for Industrial Use.

6. NEMA/ICS 6 Enclosures for Industrial Control Systems.

7. NEMA LS 1 Low Voltage Surge Protective Devices.

8. UL 1449 Third Edition – Surge Protective Devices

B. All equipment shall comply with the requirements of the National Electric Code and Underwriters Laboratories (UL) where applicable.

C. Each specified device shall also conform to the standards and codes listed in the individual device paragraphs.

1.05 QUALITY ASSURANCE:

A. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the OWNER/ENGINEER, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

B. Equipment submitted shall fit within the space or location shown on the Drawings. Equipment which does not fit within the space or location is not acceptable.

C. For the equipment specified herein, the manufacturer shall be ISO 9001 2000 certified.

1.06 WARRANTY:

A. The Manufacturer shall warrant the equipment to be free from defects in material and workmanship for two (2) year from date of acceptance of the equipment containing the items specified in this Section. Within such period of warranty the Manufacturer shall promptly

furnish all material and labor necessary to return the equipment to new operating condition. Any warranty work requiring shipping or transporting of the equipment shall be performed by the CONTRACTOR at no expense to the OWNER.

PART 2 - PRODUCTS

2.01 WIRE TROUGHS:

A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:

1. Panduit

2. Taylor

B. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.

2.02 DIN RAILS:

A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:

1. Phoenix Contact

2. Entrelec

3. Weidmuller

4. Allen Bradley

B. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.

2.03 DIGITAL INPUTS/OUTPUTS:

A. All digital inputs and outputs shall be fused with no isolators.

2.04 RELAYS AND TIMERS:

A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:

1. Square D

2. IDEC

3. Potter-Broomfield

4. Allen-Bradley

B. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.

C. Type:

1. Relays shall be type of shown in the project plans. The relay shall be equipped with an indicating light to indicate when its coil is energized.

2. Units shall be of the general purpose plug-in type.

3. Timing relays shall be Square D JCK-70 or equal.

4. Alternating relays shall be TimeMark Corporation Model 441 or equal.

D. Functional/Performance:

1. Coil voltage shall match supply voltage.

2. Contact arrangement/function shall be as required to meet the specified control function.

3. Mechanical life expectancy shall be in excess of 10,000,000 cycles.

4. Duty cycle shall be rated for continuous operation.

5. Units shall be provided with integral indicating light to indicate if relay is energized.

6. Solid state time delays shall be provided with polarity protection (DC units) and transient protection.

7. Time delay units shall be adjustable and available in ranges from .1 second to 4.5 hours.

8. Plug-in general purpose relay.

9. Blade connector type.

10. Contact material: Silver cadmium oxide.

11. Relay sockets are DIN rail mounted.

12. Internal neon or LED indicator is lit when coil is energized.

13. Clear polycarbonate dust cover with clip fastener.

14. Operating temperature: -20 to +150 °F.

15. UL listed or recognized.

16. Alternator relay shall have the capability to defeat non-operational pumps.

E. Ratings:

1. For 120VAC service provide contacts rated 10 amps at 120VAC, for 24VDC service provide contacts rated 5 amps at 28VDC, for electronic (milliamp/ millivolt) switching applicator provide gold plated contacts rated for electronic service.

2. Relays shall be provided with dust and moisture resistant covers.

F. Physical:

1. DIN Rail mounting base

2. Screw Terminals

G. Options/Accessories Required:

1. Provide mounting sockets with pressure type terminal blocks rated 300 volt and 10 amps.

2. Provide mounting rails/holders as required.

2.05 ANALOG SIGNALS:

A. All analog signal inputs and outputs shall be fused with no SPD's.

2.06 DIGITAL INDICATORS:

A. Digital indicators shall be NEWPORT Electronics Model 202A-P, ma process receiver, or Precision Digital Model PD 765-6RO.

2.07 POWER SUPPLIES:

A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:

1. IDEC Model # PS5R-VD24

B. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.

C. Design and fabrication:

1. Converts 120 VAC input to DC power at required voltage.

2. Sized as required by the load. Minimum 2.4 A output.

3. AC input: 120 VAC +10 percent -13 percent; 47 to 63 HZ.

4. Provision for output fail alarm contact.

5. All Power Supplies shall be redundant pairs.

2.08 ETHERNET SURGE PROTECTOR:

A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:

1. Transector ALPU PTP M 1101-959

2.09 SURGE PROTECTOR:

A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:

1. Phoenix Contact Model # 2856702

2.10 UNITERRUPTABLE POWER SUPPLY (UPS):

A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:

1. APC Smart Model SRT1500RMXLA

B. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.

C. Design and fabrication:

1. 1 2 0 V A C , 1500 VA

2.11 RADIO:

A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:

1. Cambium Networks Integrated High Gain 5 GHz PMP-450i Subscriber Part # C050045C002C
2. No Equals.

C. Design and fabrication:

1.	Power Supply:	10-30VDC
2.	Frequency:	5.8 GHz
3.	Operational Temperature Range:	-40°C to +70°C
4.	Transmit Power:	+28 dBm

D. Provide with the following:

1. Cambium Tilt Bracket Assembly, Part # N000045L002A

2.12 CELLULAR ROUTER:

A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:

1. Cisco System, Model IR1101-K9
2. Approved owner equal.

B. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.

C. Design and fabrication:

1. Power Supply: 24 or 48 VDC, 12 Watts
2. Ethernet Data Rate: 10/100/1000 Mbps
3. Operational Temperature Range: -40°C to +60°C
4. LTE Bands: 700 MHz (Band 13), 1700/2100 MHz (Band 4 AWS)
5. Interfaces: 4 x 10/100 BASE-T RJ45 ports, 2 TNC cellular antenna conn., WAN 1 Combo RJ45 and GE SFP port

D. Provide with the following:

1. Software:
    a. Cisco IOS Advanced IP Services
    b. Generic routing encapsulation (GRE) and multipoint GRE (MGRE)
    c. IEEE 802.1, IEEE 802.1Q VLANs, IEEE 82.3, SSH, SNMPv3, syslog, IGMP v3 Snooping, Command Line Interface
    d. Layer 2 Tunneling Protocol (L2TP)
    e. Layer 2 tunneling Protocol Version 3 (L2TPv3)
    f. Open Shortest Path First (OSPF)
    g. Enhanced Interior Gateway Routing Protocol (EIGRP)
    h. Virtual Route Forwarding (VRF) Lite
    i. 802.1x
2. Options:
    a. Extended service agreement with Next Business Day response. Full access to vendor device images, technical support and warranty.
    b. DIN rail mounting kit – Cisco part # IR1101-DINRAIL

2.12 MIDSPAN POWER INJECTOR:

A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:

3. Moxa Power Injector – Part #INJ-24A-T

4. Approved owner equal.

B. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.

C. Design and fabrication:

1. Power Supply: 24 or 48 VDC
2. Ethernet Interface:
   a. One 10/100/1000 Base-T Port, RJ45
   b. One PoE 10/100/1000 Base-T Port, RJ45
3. Operational Temperature Range: -40°F to 167°F

2.12 INDUSTRIAL SCADA ETHERNET SWITCH:

A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:

5. Cisco System, Model IE-2000-8TC-G-B
6. Approved owner equal.

B. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.

C. Design and fabrication:

1. Power Supply: 9-60 VDC,
2. Ethernet Data Rate: 10/100 Mbps
3. Operational Temperature Range: -40°C to +60°C
4. Copper Ports: 8 x 10/100 BASE-T ports minimum
5. RJ45 Ports: 8 Fast Ethernet
6. SFP Ports: 2 Gigabit Ethernet
7. Industrial Rated IEC/EN 61000-6-2
8. DIN Rail mounted

D. Provide with the following:

3. Software:
   a. Firmware Type: LAN Base
   b. IPv4 static routing, Port-Security, 802.1x, QoS, IEEE 1588 PTPv2, SNMP
   c. IEEE 802.1, IEEE 802.1Q VLANs, IEEE 82.3, SSH, SNMPv3, syslog, IGMP v3 Snooping, Command Line Interface
4. Options:
   a. Extend service agreement to 1 year with Next Business Day response.
   b. Provide Expansion Modules and SFP transceivers as required to meet connectivity requirement.
      i. Fiber connectivity – Single Mode (SM) SFP Transceiver
         1. Cisco part # GLC-LH-SM-RGD=

c. Full access to vendor device images, technical support and warranty.
d. With Cisco SMARTnet extended service agreement register to SAWS
    i. Part # CON-SNT-IE2K8TCG

2.13 NAMEPLATES:

A. Furnish nameplates for each device as indicated in Drawings. Nameplates shall be engraved, laminated impact acrylic, matte finish, black lettering on a white background, not less than 1/16-in thick by 1/2-in by 1-1/2-in, Rowmark 322402. Nameplates shall be attached to the backplate with double faced adhesive strips, TESA TUFF TAPE 4970, .009 X ½". Prior to installing the nameplates, the metal surface shall be thoroughly cleaned with 70% alcohol until all residues has been removed. Epoxy adhesive or foam tape is not acceptable.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. All equipment specified herein shall be factory installed, field adjusted, tested and cleaned as an integral part of equipment specified elsewhere in these Specifications.

END OF SECTION

SECTION 17328

SCADA PANEL

PART 1 - GENERAL

1.01 SCOPE OF WORK:

A. Design, furnish and install fully functional SCADA panel to manually or automatically operate the pump station as specified in the detailed requirements of this Section, and logic and schematics as shown on the Electrical and Instrumentation Drawings.

B. SCADA panel as specified in Electrical Equipment Division or Mechanical Equipment Divisions, except as specifically stated herein shall not be submitted under this Section.

C. Provide the following SCADA panel as depicted in the Drawings and as specified herein.

1.02 RELATED WORK:

A. Division 16

B. Section 17300 Instrumentation General Provisions

C. Section 17302 Testing

D. Section 17305 Application Services

E. Section 17310 Field Instruments

F. Section 17327 Panel Mounted Equipment

G. Section 17400 Control Loop Descriptions

H. Section 17405 Input/Output List

I. Section 17410 Field Instrument List

J. Section 17500 Programmable Logic Controller (PLC)

1.03 SUBMITTALS:

A. Submittal Process:

1. Submittals shall be made in accordance with the requirements of Section 01300, Section 17300 and as specified herein.

2. Submittals require information on related equipment to be furnished under this Specification, and described in the related Sections listed in the Related Work paragraph above. Incomplete submittals not containing the required information on the related equipment will be returned un-reviewed.

B. Submittal Content:

1. The original equipment manufacturer shall create all equipment shop drawings, including

all wiring diagrams, in the manufacturer's Engineering department. All equipment shop drawings shall bear the original equipment manufacturer logo, drawing file numbers, and shall be maintained on file in the original equipment manufacturers archive file system. Photocopies of the Engineer's ladder schematics are unacceptable as shop drawings.

C. Required Submittals:

1. Copies of previously Approved Related Work submittals

2. Documentation confirming that the Panel Assembly Facility is a UL-508 certified panel shop

3. Facsimile of the UL label that is to be applied to the completed panels

4. Shop Drawings:

   a. Shop Drawings shall include the following:

      1) Drawings shall be to scale and shall show the location of panel mounted devices, including doors, louvers, and sub panels
      2) Equipment outline drawings showing elevation, plan and interior views, front panel arrangement, dimensions, weight, shipping splits, conduit entrances and anchor bolt pattern. Indicate all options, special features, ratings and deviations from this Section's requirements.
      3) The first sheet of each Panel Drawing Packet shall contain a Bill of Materials for that panel. The Bill of Materials shall list all devices mounted within the panel, and shall include the tag number, description, manufacturer, and model number of each item.
      4) Following the Bill of Material shall be a listing, uniquely identifying each component of the Panel, and a description of the item used, i.e. devices by their assigned tag numbers, nameplate inscriptions, service legend, and annunciator inscriptions.
      5) Power and control schematics including external connections. Show wire and terminal numbers and color-coding.

   b. Interconnecting Wiring Diagrams:

      1) Provide interconnecting wiring diagrams showing electrical connections between equipment, consoles, panels, terminal junction boxes, and field mounted components.
      2) Diagrams shall show component and panel terminal board identification numbers, and external wire and cable numbers.
      3) Circuit names corresponding to the Circuit and Raceway Schedule shall be shown. The diagram shall include intermediate terminations between field elements and panels (e.g., terminal junction boxes, pull boxes, etc.).

5. Factory Tests:

   a. Submittals shall be made for factory tests as specified herein. Owner/Engineer approval of required factory tests is required prior to shipment of the equipment.

6. Field Tests:

a. Submittals shall be made for field tests as specified herein

7. Operation and Maintenance Manuals:

a. Operation and maintenance manuals shall include the following information:

1) Manufacturer's contact address and telephone number for parts and service
2) Instruction books and/or leaflets
3) Recommended renewal parts list
4) Record Documents for the information required by the Submittals paragraph above

D. Operation and Maintenance Manuals:

1. Operation and maintenance manuals shall include the following information:

a. Manufacturer's contact address and telephone number for parts and service
b. Instruction books and/or leaflets
c. Recommended renewal parts list
d. Record Documents for the information required by the Submittals paragraph above

1.04 REFERENCE CODES AND STANDARDS:

A. Instrumentation equipment, materials and installation shall comply with the National Electrical Code (NEC and with the latest edition of the following codes and standards:

1. National Electrical Safety Code (NESC)

2. Occupational Safety and Health Administration (OSHA)

3. NEMA ICS 1-101 Diagrams, Designations and Symbols

4. ANSI/ISA-5.06.01-2007 - Functional Requirements Documentation for Control Software Applications

5. ISA-TR20.00.01-2001 - Specification Forms for Process Measurement and Control Instruments Part 1: General Considerations Updated with 27 New Specification Forms in 2004-2005

6. ISA-5.4-1991 Instrument Loop Diagrams

7. ISA-5.5-1985 Graphic Symbols for Process Displays

8. ISA-5.1-1984 (R1992) Instrumentation Symbols and Identification

9. ISA-5.3-1983 Graphic Symbols for Distributed Control/Shared Display Instrumentation, Logic, and Computer Systems

10. ISA-20-1981 Specification Forms for Process Measurement and Control Instruments, Primary Elements, and Control Valves

11. ISA-5.2-1976 (R1992) Binary Logic Diagrams for Process Operations
12. NEMA ICS 6 Enclosures for Industrial Controls and Systems
13. National Fire Protection Association (NFPA)
14. National Electrical Manufacturers Association (NEMA)
15. American National Standards Institute (ANSI)
16. Insulated Cable Engineers Association (ICEA)
17. International Society of Automation (ISA)
18. Underwriters Laboratories (UL)
19. UL 508, the Standard of Safety for Industrial Control Equipment
20. UL 508A, the Standard of Safety for Industrial Control Panels
21. UL 50, the Standard of Safety for Enclosures for Electrical Equipment
22. NFPA 79, Electrical Standard for Industrial Machinery
23. Factory Mutual (FM)
24. NFPA 70 National Electrical Code (NEC)
25. NFPA 70E Standard for Electrical Safety in the Workplace
26. ANSI C37.90.2 Standard Withstand Capability of Relay Systems to Radiated Electromagnetic Interference From Transceivers
27. NEMA ICS 4 Terminal Blocks for Industrial Use
28. NEMA LS1 Low Voltage Surge Protection Devices
29. UL 1283 Standard for Safety-Electromagnetic Interference Filters
30. UL 1449 Third Edition Surge Protective Devices
31. City of San Antonio, Texas Electrical Code
32. All equipment and installations shall conform to applicable Federal, State, and local codes

1.05 QUALITY ASSURANCE:

A. The manufacturer of this equipment shall have produced similar equipment for a minimum period of five (5) years. When requested by the Owner/Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement

B. The control panels shall be assembled in a UL-certified panel shop, experienced in the

assembled of control panels for wastewater and water treatment systems. A submittal of the documentation, that certifies the panel fabrication shop is a UL-certified shop, is required

C. Equipment components and devices shall be UL labeled wherever UL standards exist for such equipment. The completed control panel shall be UL Labeled in accordance with UL 508 and 508A and other applicable UL standards. The panel shall also be UL labeled for the environment in which it is to be placed. A UL label shall be affixed to the inside of the external door by the panel fabrication assembly. Submit a facsimile of the UL label in the submittal information

D. Equipment submitted shall fit within the space shown on the Drawings. Equipment which does not fit within the space is not acceptable

1.06 DELIVERY STORAGE AND HANDLING:

A. Equipment shall be handled and stored in accordance with manufacturer's instructions. Two (2) copies of these instructions shall be included with the equipment at time of shipment, and shall be made available to the Contractor and Owner/Engineer.

B. Shipping groups shall be designed to be shipped by truck, rail, or ship. Accessories shall be packaged and shipped separately.

C. Within (5) five days after shipment of all equipment, Manufacturer shall ship all software, supplied under this Section of the Specifications, by Registered Mail or Approved Courier, to the Owner’s Representative, with a copy of the Shipment Manifest

D. Visibly damaged panels shall be returned to the Manufacturer’s UL 508 facility, for examination and damaged equipment replaced at no expense to the Owner.

E. Equipment shall be installed in its permanent finished location shown on the Drawings within seven (7) calendar days of arriving onsite. If the equipment cannot be installed within seven (7) calendar days, the equipment shall not be delivered to the site, but stored offsite, at the Contractor’s expense, until such time that the site is ready for permanent installation of the equipment.

F. Where space heaters are provided in equipment, provide temporary electrical power and operate space heaters during storage, and after equipment is installed in permanent location, until equipment is placed in service.

1.07 WARRANTY:

A. The Manufacturer shall warrant the equipment to be free from defects in material and workmanship for two (2) years from date of final acceptance of the equipment. Within such period of warranty the Manufacturer shall promptly furnish all material and labor necessary to return the equipment to new operating condition. Any warranty work requiring shipping or transporting of the equipment shall be performed by the Manufacturer, at no expense to the Owner.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. Subject to compliance with the Contract Documents, the following enclosure Manufacturers are acceptable:

1. Hoffman Enclosures

2. Rittal Enclosures

B. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.

2.02 RATINGS

A. Enclosure Ratings for Area Classifications:

1. Unless otherwise specified herein or shown on the Drawings, enclosures and associated installations shall have the following ratings:

2. Provide white enamel painted, NEMA 4X 316 Stainless Steel enclosures for outdoor, wet locations In addition NEMA 4X Aluminum enclosures will be allowed on an individual basis, but only where specifically designated herein or specifically shown on the Drawings.

B. The complete control panel assembly shall be UL certified or carry a UL listing for "Industrial Control Panels".

C. The SCADA panel shall meet all applicable requirements of the National Electrical Code.

D. For additional ratings and construction notes, refer to the Drawings.

E. The service voltage shall be as specified and as shown on the Drawings. The overall short circuit withstand and interrupting rating of the equipment and devices shall be equal to or greater than the overall short circuit withstand and interrupting rating of the feeder device immediately upstream of the Control Panel, but not less than 10,000 amperes at 120 volts single phase.

F. The Manufacturer shall produce and install on each panel, an Arc Flash Warning Label listing the various Flash Hazard Protection Boundaries, calculated from NFPA 70E, Annexes, as listed below:

1. Flash Hazard Protection Boundary

2. Limited Approach Boundary

3. Restricted Boundary

4. Restricted Boundary

5. Incident Energy Level

6. Required Personal Protective Equipment Class

7. Type of Fire Rated Clothing

G. Provide an Arc Flash Warning Label, printed in color and affixed to the front of each panel provided.

1. Shown below is a typical label. Size of each label shall be not less than 8 inches wide and 6 inches tall.

2.03 CONSTRUCTION:

A. General:

1. Refer to the Drawings for: schematics, actual layout and location of equipment and components; current ratings of devices, bus bars, components; protective relays, voltage ratings of devices, components and assemblies; and other required details.

B. Enclosures:

1. Free Standing:

a. Enclosures shall be of factory white enamel painted 316 stainless steel, rear and side panels, with lifting eyes, without knockouts or holes. Enclosures shall have fully sized rear and side panels. Panels shall have factory cutouts where required for environmental ducts. Enclosures shall not be less than 12 gauge metal. All enclosures shall have continuous hinged doors with handle latch, 3-point. All enclosures shall have bonding provisions on door. Enclosures shall be NEMA 12 rated if located in doors. Outdoor areas require a NEMA 4X 316 Stainless Steel rating.

3. Each enclosure less than 4 ft. wide shall be shall have one overhead interior LED light fixture, with Off/On switch, powered from a dedicated non UPS circuit. Each enclosure greater than 4 ft. wide shall have one overhead florescent light for every 4 ft. of length, or every fraction thereof.

4. Each enclosure shall have one, UPS powered, 150 watt receptacle.

5. Each enclosure shall have, factory installed, full sized removable back and side panels, on which control components shall be mounted. Back panel shall be secured to the enclosure with collar studs for wall mounted enclosures, and 316 SS hardware for free standing enclosures.

6. The enclosure outer door shall have a rear mounted pocket in the lower portion, which shall containing laminated copies of the panel schematics and wiring.

7. Electrical tables shall be laminated and adhered to the inside of the door.

8. All enclosures shall be lockable, and keyed alike.

9. Level and pressure process indicators shall be securely mounted on the exterior door. All controls and indicators shall be 30mm, clearly labeled to indicate function and shall be NEMA 12 rated. Auxiliary contacts shall be provided for remote run indication and indication of each status and alarm condition. Additional controls shall be provided as specified herein and as required by the detailed mechanical and electrical equipment

requirements.

C. Environmental Controls:

1. Enclosure Condensate Heaters:

a. A self-contained enclosure condensation heater with thermostat and fan shall be mounted inside the control panel, if panel is mounted outdoors or in a non-air-conditioned spaced.

1) Enclosure heaters shall be energized from 120 volt, single-phase power supply and sized to prevent condensation within the enclosure.
2) Locate enclosure heaters to avoid overheating electronic hardware or producing large temperature fluctuations on the hardware.
3) Enclosure heaters shall have an internal fan for heat distribution and shall be controlled with adjustable thermostats. The thermostat shall have an adjustment range of 40 degrees Fahrenheit to 90 degrees Fahrenheit. Provide a circuit breaker or fused disconnect switch within the enclosure.
4) Enclosure heaters shall be Hoffman type DAH.

b. Strip heaters may be provided if they are 240 volt rated, powered at 120 volts AC and do not have a surface temperature higher than 60°C. Strip heaters and thermostats shall be as manufactured by Chromalox.

1) Strip heaters shall be Chromalox, Type OT, 1.5-in wide, 240 Volts, single phase, 150 watts, energized at 120 volts, with rust resisting iron sheath, Catalog No. OT-715, Product Code No. 129314. Provide sufficient wattage in heaters to prevent condensation should the interior temperature of the enclosure drop below the dew point.
2) A control thermostat mounted inside the control Panel shall be Chromalox, Type WR, single stage, Catalog No. WR-80, Product Code No.263177.
3) The strip heater terminals shall be guarded by a protective terminal cover.
4) High temperature connecting lead wire shall be used between the thermostat and the heater terminals. Wire shall be No. 12 AWG stranded nickel-plated copper with Teflon glass insulation and shall be the product of Chromalox, Catalog No. 6-CFI-12, and Product Code No. 263783.

2. NEMA 4X Enclosure Air Conditioner:

a. NEMA 4X enclosures containing electronic devices or electrical equipment shall have air conditioners that will maintain the internal temperature at or below 85F at an ambient temperature of 105F without violating the NEMA 4X rating of the enclosure.
b. The panel builder shall provide panel internal heat rise calculations to show that the panel internal temperatures will be maintained below 85F at an ambient temperature of 105F.

1) For enclosures mounted indoors in non-air-conditioned spaces, include an ambient air temperature of 40 degree C and a humidity of 100% non-condensing
2) For enclosures mounted in direct sunlight add the appropriate solar heat gain component to the calculation, and raise the ambient temperature to 60 degrees C.
3) The calculation shall show all the internal and external heat gain loads, the expected internal temperature rise in degrees C above the specified ambient without

the air conditioner. Provide a calculation showing the expected temperature rise in degrees C above the specified ambient with the air conditioner running.

c. The air conditioner shall have the following features:

1) Use CFC-free R134a refrigerant
2) Have fully gasketed flanges on all four mounting edges for a watertight seal that maintains NEMA 4X rating of the panel.
3) Thermostatic low temperature control to provide energy efficient operation and prevents over-cooling.
4) EMI/RFI suppressor to minimize transient spikes during compressor on/off cycling.
5) Separated blower-driven evaporator and condenser air systems for closed loop cooling.
6) UL listed
7) Stainless steel enclosure
8) Internal corrosion resistant coating and/or galvanized steel components.
9) Low ambient kit
10) Short cycle protector
11) Provide an air conditioner manufactured by McLean.

2.04 PANEL EQUIPMENT:

A. Equipment Requirements:

1. The requirements for equipment, controls, meters, converters, etc, for the SCADA Panel, shall be as shown on the Drawings, panel schematics, and the functions specified in the Loop Descriptions.

2. The PLC shall be as specified in Section 17500 Programmable Logic Controller System.

3. All other equipment, controls, meters, converters that are designed as a part of the control panel, shall be as specified in Section 17327 Panel Mounted Equipment, Related Work Sections specified herein, as shown on the Drawings, panel schematics, and the functions specified in the Loop Descriptions.

4. Provide a main circuit protective device, DIN rail mounted, to protect the panel equipment.
5. Provide and install a 316 stainless steel-folding shelf and located on the control panel internal swing panel door. Folding shelf shall be catalog number ACSHELF1818SS as manufactured by Hoffman Enclosures.
6. Terminal blocks shall be single stack only. Cooper Bussman DP series or equivalent.
7. Wiring troughs shall be manufactured by Panduit or equivalent.

2.05 EQUIPMENT INSTALLATION:

A. Equipment Mounting:

1. The location of the installed equipment shall be as shown on the Panel Layouts on the Drawings.

2. Each piece of equipment shall be securely mounted to the backplate or side plate in accordance with the manufacturer's installation instructions. All mounting hardware shall

be from the front of the backplate or side plate with threaded screws. Attaching hardware shall not be installed from the rear of the backplate or side plate. Removal of any piece of equipment shall not require the removal or loosening of any other piece of equipment.

3. Operator interface equipment installed on the door shall be arranged as shown on the Drawings in accordance with the manufacturer's installation instructions. No penetrations of the door shall be made except for equipment mounting. Provide adequate clearance between pieces of equipment and door latching mechanisms.

B. Nameplates:

1. Furnish nameplates for each device as indicated in Drawings. Nameplates shall be engraved, laminated impact acrylic, matte finish, black lettering on a white background, not less than 1/16-in thick by 1/2-in by 1-1/2-in, Rowmark 322402. Nameplates shall be attached to the backplate with double faced adhesive strips, TESA TUFF TAPE 4970, .009 X ½". Prior to installing the nameplates, the metal surface shall be thoroughly cleaned with 70% alcohol until all residues has been removed. Epoxy adhesive or foam tape is not acceptable.

C. Wiring Trough and Terminal Block Installation:

1. Space between wiring troughs and equipment shall be such that space for terminal blocks is provided for termination of each conductor or group of conductors before connection to the equipment. Removal of equipment for service shall not leave any exposed conductors hanging unconnected.

2. Install the wiring troughs such that one may be removed without interference from the other. Troughs shall be installed such that trough covers may be removed without cover interference.

3. Install terminal blocks on DIN rail with adequate space for access to the terminal with clear view of the wire identification label. All incoming or outgoing wiring shall enter or leave the panel on terminal blocks. Terminal blocks or wiring troughs shall not be installed on the doors. Provide terminal blocks on side plates/backplate for all door mounted equipment.

4. In no case shall internal and external wiring share a wiring trough.

5. Provide 600 volt rated terminal blocks for any conductor carrying any voltage over 120 volts to ground.

6. Provide 600 volt rated strap screw terminal blocks for any power conductors carrying over 20 amps, at any voltage. Terminals shall be double sided and supplied with removable covers to prevent accidental contact with live circuits.

7. Power conductors carrying over 20 amps, at any voltage shall be terminated to strap-screw type terminal blocks with crimp type, pre-insulated, ring-tongue lugs. Lugs shall be of the appropriate size for the terminal block screws and for the number and size of the wires terminated. Do not terminate more than one conductor in any lug, and do not land more than two conductors under any strap-screw terminal point.

8. Terminals shall have permanent, legible identification, clearly visible with the protective cover removed. Each terminal block shall have 20 percent spare terminals, but not less than two spare terminals.

9. Do not land more than two conductors per terminal point. Use the manufacturer's provided bridge connectors to interconnect terminal blocks terminating common or ground conductors.

10. Twisted shielded pair or triad cables shall have each individual conductor and shield drain wire landed on individual terminal blocks. Use the manufacturer's provided bridge connectors to interconnect terminal blocks terminating the shield drain wire conductors.

11. Provide an AC ground bar bonded to the panel enclosure, if metal, with 20 percent spare terminals.

12. Provided ground terminal blocks for each twisted-shielded pair drain wire.

D. Internal Panel Wiring:

1. Power and control wiring shall be tinned stranded copper, minimum size No. 14 AWG, with 600 volt, 90 degree C, flame retardant, Type MTW thermoplastic insulation. Line side power wiring shall be sized for the full fault current rating or frame size of the connected device, and as shown on the Drawings.

2. Analog signal wires shall be 600 Volt Class, insulated stranded tinned copper, twisted shielded #16 AWG pair.

3. All interconnecting wires between panel mounted equipment and external equipment shall be terminated at numbered terminal blocks. Field wiring shall not be terminated directly on any panel-mounted device.

4. All wiring shall be tagged and coded with an identification number as shown on the Drawings. Coding shall be typed on a heat shrinkable tube applied to each end showing origination and destination of each wire. The marking shall be permanent, non-smearing, solvent-resistant type similar to Raychem TMS-SCE.

5. All wiring shall be enclosed in PVC wire trough with slotted side openings and removable cover. Plan wire routing such that no low twisted shielded pair cable conducting analog 4-20 mA signals or low voltage analog signals are routed in the same wire trough as conductors carrying discrete signals or power.

6. All control panel wiring shall use the following color code:

   a. Black: AC power at line voltage
   b. Red: switched AC power
   c. Orange: May be energized while the main disconnect is in the off position
   d. White: AC neutral
   e. Orange/white stripe or white/orange stripe: separate derived neutral
   f. Red/white stripe or white/red stripe: switched neutral
   g. Green or green w/ yellow tracer: ground/earth ground
   h. Blue: Ungrounded DC power
   i. Blue/white stripe or white/blue stripe: DC grounded common
   j. Purple: 480V AC 3 phase - phase A

k. Yellow: 480V AC 3 phase - phase B
l. Brown: 480V AC 3 Phase - phase C

E. Field Entrance Internal Wiring:

1. Field entrance internal wiring shall be neatly grouped by circuit and bound by plastic tie wraps. Circuit groups shall be supported so that circuit terminations are not stressed. In addition, low signal wiring (millivolt and milliamp) shall be bundle separately from the rest of the control wiring.

2. All field wiring shall be tagged and coded with an identification number. Coding shall be typed on a heat shrinkable tube applied to each end of the wire. The marking shall be a permanent, non-smearing, solvent-resistant type similar to Raychem TMS-SCE.

3. All conduit entering or leaving equipment shall be coordinated, in advance with the panel installer, so that the conduit entrances to the enclosure are directly below the termination area for immediate termination. Conduits shall not enter the top or side of the panel unless approved in writing by the Owner/Engineer.

F. PL⊐ Inputs and Outputs:
1. All PLC Analog inputs and outputs shall be individually fused for each channel. All Discrete inputs and outputs shall be buffered with relays from the field connections. Discrete points shall be fused for each circuit group with no less than one fuse per card.

2.06 FACTORY TESTING:

A. The entire control panel shall be completely assembled, wired, and adjusted at the factory and shall be given the manufacturer's routine shop tests and any other additional operational test to insure the workability and reliable operation of the equipment.

B. Factory test equipment and test methods shall conform to the latest applicable requirements of ANSI, IEEE, UL, and NEMA standards.

C. The operational test shall include the proper connection of supply and control voltage and, as far as practical, a mockup of simulated control signals and control devices shall be fed into the boards to check for proper operation.

D. Factory test equipment and test methods shall conform to the latest applicable requirements of ANSI, IEEE, UL, and NEMA standards, and shall be subject to the Owner/Engineer's approval.

PART 3 - EXECUTION

3.01 INSTALLER'S QUALIFICATIONS:

A. Installer shall be specialized in installing this type of equipment with minimum 5 years documented experience. Experience documentation shall be submitted for approval prior to beginning work on this project.

3.02 EXAMINATION:

A. Examine installation area to assure there is enough clearance to install the equipment. Housekeeping pads shall be included for the floor mounted panels as detailed on the Drawings.

B. Check concrete pads and base plates for uniformity and level surface.

C. Verify that the equipment is ready to install.

D. Verify field measurements are as instructed by manufacturer.

3.03 INSTALLATION:

A. The Contractor shall install all equipment per the manufacturer's recommendations and Contract Drawings.

B. Conduit hubs for use on raceway system pull and junction boxes shall be watertight, threaded aluminum, insulated throat, stainless steel grounding screw, as manufactured by T&B H150GRA Series.

C. Conduits entering a control Panel or box containing electrical equipment shall not enter the enclosure through the top.

D. Install required safety labels.

3.04 RACEWAY SEALING:

A. Where raceways enter junction boxes or control panels containing electrical or instrumentation equipment, all entrances shall be sealed with 3M 1000NS Watertight Sealant.

B. This requirement shall be strictly adhered to for all raceways in the conduit system.

3.05 FIELD QUALITY CONTROL:

A. Inspect installed equipment for anchoring, alignment, grounding and physical damage.

B. Check tightness of all accessible electrical connections. Minimum acceptable values are specified in manufacturer's instructions.

3.06 FIELD ADJUSTING:

A. Adjust all circuit breakers, switches, access doors, operating handles for free mechanical and electrical operation as described in manufacturer's instructions.

B. The breaker protective devices shall be set in the field by a qualified representative of the manufacturer, retained by the Contractor, in accordance with settings designated in a coordinated study of the system as required in Section 16345 Short Circuit/Coordination Study/Arc Flash Hazard Analysis.

3.07 FIELD TESTING:

A. Perform all electrical field tests recommended by the manufacturer. Disconnect all connections to solid-state equipment prior to testing.

B. Test all control logic before energizing the equipment.

3.08 CLEANING:

A. Remove all rubbish and debris from inside and around the panel. Remove dirt, dust, or concrete

spatter from the interior and exterior of the equipment using brushes, vacuum cleaner, or clean, lint free rags. Do not use compressed air.

3.09 EQUIPMENT PROTECTION AND RESTORATION:

A. Touch-up and restore damaged surfaces to factory finish, as approved by the manufacturer. If the damaged surface cannot be returned to factory specification, the surface shall be replaced.

3.10 MANUFACTURER'S CERTIFICATION:

A. A qualified factory-trained manufacturer's representative shall certify in writing that the equipment has been installed, adjusted, including all settings designated in the Power System Study, and tested in accordance with the manufacturer's recommendations.

B. The Contractor shall upload electronic copies to SAWS CPMS of the manufacturer's representative's certification.

END OF SECTION

SECTION 17400

CONTROL LOOP DESCRIPTIONS

PART 1 - GENERAL

1.01 SCOPE OF WORK:

A. This section describes proposed equipment and system components and their intended operation via control loop descriptions which will be used for the programming integration into the SAWS SCADA System.

1.02 RELATED WORK:

A. Division 16, Electrical

B. Division 17, Instrumentation

1.03 ACRONYMS:

A. Comp – Computer

B. HMI – Human Machine Interface at SAWS Production Control Room

C. LP- Lift Pump

D. MCC – Motor Control Center

E. MG – Million Gallon

F. PLC – Programmable Logic Controller

G. RTD – Resistance Temperature Detectors

H. SCADA – Supervisory Control and Data Acquisition

I. PCP – Pump control panel

1.04 TERMS AND DEFINITIONS:

A. SCADA Panel – The panel located on-site at the SAWS PRV Vault.

B. Local Operation – Describes the manual operation of a device or piece of equipment at the Facility which includes SCP, MCC, and local equipment panels.

C. Remote Operation – Describes the operation of a device or piece of equipment from the SAWS Control Room.

1.05 GENERAL DESCRIPTION:

A. The equipment that controls the operating strategy of the SAWS PRV vault includes:

1. One (1) Pressure Transmitter for the supply pressure to the PRV.

2. O n e (1) Pressure Transmitter for the discharge pressure from the PRV.

3. One (1) Flow Transmitter for the discharge water flow from the PRV.

PART 2 - PRODUCTS

2.01 PRESSURE TRANSMITTERS: SYSTEM PRESSURE

Tag No.: PIT-100, PIT-101

Local (Manual)

- None. (The operator can read the pressure transmitter from SCADA Panel.)

Remote Manual

- None.

Remote Automatic

- None.

SCADA Interface

- The PLC sends a signal to the control room indicating the pressure at the installed location.

2. MAGNETIC FLOW METER: SYSTEM WATER FLOW

Tag Nos.: FIT-100

Local (Manual)

- None. (The operator can read the flow transmitter from SCADA Panel.)

Remote Manual

- None.

Remote Automatic

- None.

SCADA Interface

- The PLC sends a signal to the control room indicating the water flow at the installed location.

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 17405

INPUT/OUTPUT LIST

PART 1 - GENERAL

1.01 SCOPE:

A. This Section includes the Input/Output List.

1.02 RELATED SECTIONS:

A. Section 17300 Instrumentation General Provisions including coordination meeting required between various parties involved with controls programming.

B. Section 17400 Control Loop Descriptions

1.03 SUBMITTALS:

A. Refer to Section 17305 Applications Services and Section 17300 Instrumentation General Provisions.

1.04 SYSTEM DESCRIPTION:

A. The Input/Output List provides the minimum physical signal requirements of the control loops represented in the Contract Documents. Additional software integrated signals as required to fully implement the strategies as described in these specifications shall be included.

B. The Input/Output List is not intended to be an inclusive listing of all elements and appurtenances required to execute loop functions, but is rather intended to supplement and complement the drawings and other specification sections. The Input/Output List shall not be considered equal to a bill of materials.

C. Provide instrumentation hardware and software as necessary to perform control functions specified herein and as shown on drawings.

1.05 INPUT OUTPUT LISTING:

A. The Input/Output List follows in Appendix A.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 INSTALLATION:

A. All inputs and outputs listed shall be programmed in the system as specified herein and shall be installed, field adjusted and tested as an integral part of equipment specified elsewhere in these Specifications.

END OF SECTION

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SECTION 17500

PROGRAMMABLE LOGIC CONTROLLER

PART 1 - GENERAL

1.01 SCOPE OF WORK:

A. This Section of the Specifications describes the requirements for a Programmable Logic Controller (PLC) to be furnished under other Sections of the Specifications as listed in the Related Work paragraph of this Section.

B. All equipment described herein shall be submitted and furnished as an integral part of equipment specified elsewhere in these Specifications.

1.02 RELATED WORK:

A. Section 16010 Basic Electrical Requirements

B. Section 17300 Instrumentation General Provisions

C. Section 17302 Process Instrumentation and Control System Testing

D. Section 17305 Application Services

E. Section 17310 Field Instruments

F. Section 17327 Panel Mounted Equipment

G. Section 17400 Control Loop Descriptions

H. Section 17405 Input/Output List

I. Section 17410 Field Instrument List

1.03 SUBMITTALS:

A. Submittals for equipment specified herein shall be made as a part of equipment furnished under other Sections. Individual submittals for equipment specified herein will not be accepted and will be returned un-reviewed.

B. Shop Drawings:

1. Bill of Materials

2. Catalog Cuts

3. Component Data Sheets

4. Panel Construction Drawings, including wiring and component layout

5. List of Labels and Tags

C. Submit control loop drawings complete with rack, card slot and point configuration.

D. Submit catalog data sheets for all software licenses provided under this Specification Section.

E. Operation and Maintenance Manuals:

1. Operation and Maintenance manuals shall include the following information:

a. Manufacturer's contact address and telephone number for parts and service.
b. Instruction books and/or leaflets
c. Recommended renewal parts list
d. Record Documents for the information required by the Submittals above.
e. Copy of the software license data including serial numbers, license key, etc.
f. Complete set of as-built control loop and wiring drawings in "11x17" format.

1.04 REFERENCE CODES AND STANDARDS:

A. PLC equipment, materials and installation shall comply with the National Electrical Code (NEC and with the latest edition of the following codes and standards:

1. National Electrical Safety Code (NESC)

2. Occupational Safety and Health Administration (OSHA)

3. NEMA ICS 1-101 Diagrams, Designations and Symbols

4. ANSI/ISA-5.06.01-2007 - Functional Requirements Documentation for Control Software Applications.

5. ISA-TR20.00.01-2001 - Specification Forms for Process Measurement and Control Instruments Part 1: General Considerations Updated with 27 New Specification Forms in 2004-2005.

6. ISA-5.4-1991 Instrument Loop Diagrams.

7. ISA-5.5-1985 Graphic Symbols for Process Displays.

8. ISA-5.1-1984 (R1992) Instrumentation Symbols and Identification.

9. ISA-5.3-1983 Graphic Symbols for Distributed Control/Shared Display Instrumentation, Logic, and Computer Systems.

10. ISA-20-1981 Specification Forms for Process Measurement and Control Instruments, Primary Elements, and Control Valves.

11. ISA-5.2-1976 (R1992) Binary Logic Diagrams for Process Operations.

12. NEMA ICS 6 Enclosures for Industrial Controls and Systems

13. National Fire Protection Association (NFPA)

14. National Electrical Manufacturers Association (NEMA)

15. American National Standards Institute (ANSI)

16. Insulated Cable Engineers Association (ICEA)

17. International Society of Automation (ISA)

18. Underwriters Laboratories (UL)

19. UL 508, the Standard of Safety for Industrial Control Equipment

20. UL 508A, the Standard of Safety for Industrial Control Panels

21. UL 50, the Standard of Safety for Enclosures for Electrical Equipment.

22. NFPA 79, Electrical Standard for Industrial Machinery

23. Factory Mutual (FM)

24. NFPA 70 National Electrical Code (NEC)

25. NFPA 70E Standard for Electrical Safety in the Workplace

26. ANSI C37.90.2 Standard Withstand Capability of Relay Systems to Radiated Electromagnetic Interference From Transceivers.

27. NEMA ICS 4 Terminal Blocks for Industrial Use.

28. NEMA LS1 Low Voltage Surge Protection Devices.

29. UL 1283 Standard for Safety-Electromagnetic Interference Filters.

30. UL 1449 Third Edition Surge Protective Devices

31. Texas Electrical Code

32. All equipment and installations shall conform to applicable Federal, State, and local codes.

B. All equipment shall comply with the requirements of the National Electric Code and Underwriters Laboratories (UL) where applicable.

C. Each specified device shall also conform to the standards and codes listed in the individual device paragraphs.

1.05 QUALITY ASSURANCE:

A. The manufacturer of this equipment shall have produced similar equipment for a minimum period of five (5) years. When requested by the OWNER/ENGINEER, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

B. Requirements of the CONTRACTOR:

1. Have a local office within one hundred (100) miles of the City of San Antonio or have technicians available on-site within 4 hours of emergency notification.

2. Be able to provide resumes, project experience history and references for all employees that will be qualified to work on the SCADA system.

3. Have a local full time staff of employees that have developed and commissioned a minimum of three new Allen Bradley based systems within the past twelve months. Must have a minimum five years' experience designing, installing and commissioning SCADA systems.

4. Have a minimum of three full time employees qualified to perform the SCADA system configuration work.

5. All proposals submitted to the San Antonio Water System must be accompanied by documentation supporting the qualifications of the CONTRACTOR as detailed above. The San Antonio Water System reserves the right to reject any proposal if the above qualifications are not met.

C. Equipment submitted shall fit within the space or location shown on the Drawings. Equipment which does not fit within the space or location is not acceptable.

D. For the equipment specified herein, the manufacturer shall be ISO 9001 2000 certified.

1.06 WARRANTY:

A. The Manufacturer shall warrant the equipment to be free from defects in material and workmanship for 2 years from date of acceptance of the equipment containing the items specified in this Section. Within such period of warranty the Manufacturer shall promptly furnish all material and labor necessary to return the equipment to new operating condition. Any warranty work requiring shipping or transporting of the equipment shall be performed by the CONTRACTOR at no expense to the OWNER.

PART 2 - PRODUCTS

2.01 PROGRAMMABLE LOGIC CONTROLLER (PLC) SYSTEM:

A. The PLC shall be a complete system that includes but is not limited to the following:

1. PLC processor
2. PLC modules, chassis, and power supply
3. All connection cables
4. Connection bases
5. 25% spare capacity on all I/O modules

B. Approved Products – NO SUBSTITUTIONS:

DESCRIPTION	MANUFACTURER	PART NUMBER
Power Supply Module	Allen Bradley	Embedded
PLC	Allen Bradley	5069-L330ER & 5069-RTB64-SCREW (CompactLogix 5380, up to 16 I/O Modules)
16 Channel Digital Input Module	Allen Bradley	5069-IB16 & 5069-RTB18-SCREW (DC sinking input, max 16 channel)
16 Channel Digital Output Module	Allen Bradley	5069-OB16 & 5069-RTB18-SCREW (DC source output, max 16 channel) or 5069-OW16 & 5069-RTB18-SCREW (Relay output, max 16 channel)
8 Channel Analog Input Module	Allen Bradley	5069-IF8 & 5069-RTB18-SCREW (voltage or current, max 8 channel)
8 Channel Analog Output Module	Allen Bradley	5069-OF8 & 5069-RTB18-SCREW (voltage or current, max 8 channel)
Network Interface Controller	Allen Bradley	5069-AENTR & 5069-RTB5-SCREW (can only be used as remote I/O adapter)

C. Communications:

Allen Bradley:
Communication shall be IP/Ethernet Protocol.

D. Programming – Local PLC:

1. The PLC shall use the latest version of STUDIO 5000 Full Edition ENE Configuration software for programming the CPU. The PLC shall use the latest version of Studio 5000 Full.

2. PLC Programming shall be performed by Applications Service Provider (ASP).

E. Programming – Top End:

1. Programming shall be performed by Applications Service Provider (ASP).

2.02 120 VAC UNINTERRUPTIBLE POWER SUPPLY (UPS)

A. Provide power conditioning during normal power operation.
   1. Lightning and surge protection: Tested to ANSI/IEEE C62.41 Category A.
   2. RF noise isolation: EMI/RFI suppression.
   3. On-Line input range: 100-142 Vac, output 112-128 Vac.

B. Upon loss of feeder power to UPS, maintain power to the load for a minimum of 2 hours with 4 msec transfer time. Contractor to submit load calculation of proposed components and indicate the size of UPS needed for a 2 hour run time.

C. Ratings:

   1. Volt – Ampere Capacity: Shall be sized to run all devices in SCADA panel for 2 hours.
   2. Nominal Input Voltage: 120 Vac.
   3. On-Battery Output Voltage: 120 Vac +/- 10%.
   4. On-Battery Frequency: 60 Hz. Stepped sine wave.
   5. Ambient Operating Temperature: 0-40 degrees C.

D. Battery shall be a sealed maintenance-free lead acid type with 3-year minimum life.

F. UL Compliance: UPS shall conform to UL Standards and have an applied UL listing.

G. Manufacturer: APC Smart Model SRT1500RMXLA.

2.03 DC POWER SUPPLY:

A. 24 Vdc Control Power shall be provided by a single-output DC Power Supply.

B. Ratings:

1. Input Voltage: 120 Vac, + 10% voltage adjustment.
2. Output Voltage: 24 Vdc single output.
3. Output Current: 1.3 amperes, overload protected.
4. Ambient Operating Temperature: -10-60 degrees C.

C. UL Compliance: Power Supply shall conform to UL Standards and have an applied UL listing.

D. Manufacturer: IDEC, Model PS5R-SC24.

2.04 ADDITIONAL SPARE PARTS:

A. Provide the following spare parts for the PLC in the quantities specified:

1. One-half dozen replacement fuses, all types and sizes

B. Spare parts shall be boxed or packaged for long term storage. Identify each item with manufacturer's name, description and part number on the exterior of the package.

PART 3 - EXECUTION

3.01 INSTALLATION

A. All equipment specified herein shall be factory installed, programmed, field adjusted, tested and cleaned as an integral part of equipment specified elsewhere in these Specifications.

END OF SECTION

SPECIFICATION 17405
APPENDIX A

I/O LIST						
Booster Pump Status/Control						
Item. No.	P&ID	Parameter	Digital Input	Digital Output	Analog Input	Analog Output
1		SUPPLY PRESSURE – ZONE 1			X	
2		DISCHARGE PRESSURE – ZONE 1			X	
4		DISCHARGE WATER FLOW – ZONE 1			X	
5		6” PRV VALVE OPEN – ZONE 1	X			
6		6” PRV VALVE CLOSED – ZONE 1	X			
7		6” AUTO/OFF POSITION – AUTO – ZONE 1	X			
8		6” REMOTE CLOSE – ZONE 1		X		
9		4” PRV VALVE OPEN – ZONE 1	X			
10		4” PRV VALVE CLOSED – ZONE 1	X			
11		4” AUTO/OFF POSITION – AUTO – ZONE 1	X			
12		4” REMOTE CLOSE – ZONE 1		X		
13		SUPPLY PRESSURE – ZONE 2			X	
14		DISCHARGE PRESSURE – ZONE 2			X	
15		DISCHARGE WATER FLOW – ZONE 2			X	
16		6” PRV VALVE OPEN – ZONE 2	X			
17		6” PRV VALVE CLOSED – ZONE 2	X			
18		6” AUTO/OFF POSITION – AUTO – ZONE 2	X			
19		6” REMOTE CLOSE – ZONE 2		X		
20		4” PRV VALVE OPEN – ZONE 2	X			
21		4” PRV VALVE CLOSED – ZONE 2	X			
22		4” AUTO/OFF POSITION – AUTO – ZONE 2	X			
23		4” REMOTE CLOSE – ZONE 2		X		
24		SCADA RTU CABINET TEMPERATURE			X	
25		POWER FAIL	X			
26		UPS IN BYPASS	X			
27		UPS FAIL	X			

SECTION 17410

FIELD INSTRUMENT LIST

PART 1 - GENERAL

1.01 SCOPE:

A. This Section includes a summary of the Field Instrument List.

1.02 RELATED SECTIONS:

A. Section 17300 Instrumentation General Provisions including coordination meeting required between various parties involved with controls programming.

B. Section 17400 Control Loop Descriptions

1.03 SUBMITTALS:

A. Refer to Section 17305 Applications Services and Section 17300 Instrumentation General Provisions.

1.04 SYSTEM DESCRIPTION:

A. The Field Instrument List provides a summary of the major process instrumentation requirements as utilized within the control loops represented in the Contract Documents. Additional instruments shall be provided as required to fully implement the strategies as described in these specifications and as recommended by the process and mechanical equipment division suppliers.

B. The Field Instrument List is not intended to be an inclusive listing of all elements and appurtenances required to execute loop functions, but is rather intended to supplement and complement the drawings and other specification sections. The Field Instrument List shall not be considered equal to a bill of materials.

C. Provide instrumentation hardware and software as necessary to perform control functions specified herein and as shown on drawings.

1.05 FIELD INSTRUMENT LIST:

A. The Field Instrument List follows in Appendix A.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 INSTALLATION:

A. All field instruments listed shall be supplied as specified herein and shall be installed, field adjusted and tested as an integral part of overall control systems specified elsewhere in these Specifications.

END OF SECTION

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FIELD INSTRUMENT LIST						
Item No.	**P&ID**	**Instrument Tag**	**Description**	**Instrument Type**	**Instrument Range or Setpoint**	**Comments**
1		PIT-101, 102	Supply Pressure	Pressure Transducer	0 – 150 PSIG	
2		PIT-201, 202	Discharge Pressure	Pressure Transducer	0 – 150 PSIG	
3		FIT-100, 200	Discharge Flow	Flowmeter	0 – 2.5 MGD	