



CITY OF ST. PETE BEACH

PUBLIC SERVICES DEPARTMENT

Pump Station No. 1 & 2 Rehabilitation

2013-2014 CIP

St. Pete Beach, Florida

Technical Specifications

October 2013

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2013 CIP

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SECTION 1 - GENERAL

1.01 LOCATION OF THE WORK SITE AND ACCESS

The Pump Station No. 1 Rehabilitation Project is located on Boca Ciega Drive southeast of 87th Avenue in St. Pete Beach, Pinellas County, Florida. The Pump Station No. 2 Rehabilitation Project is located at the northeast corner of 55th Avenue and Gulf Blvd. in St. Pete Beach, Pinellas County, Florida. Access to the Work sites shall be over streets, and walkways. Any damage to existing pavement surface and base or other surface improvements outside the Contract Pay Limits, attributable to the Contractor's activities, shall be restored to like-new condition by the Contractor at the Contractor's expense.

1.02 SCOPE OF WORK

The Contractor shall furnish all labor, material, equipment and incidentals necessary for the rehabilitation of Pump Station No. 1 & 2, including, but not limited to, by-pass pumping, demolition of the existing wet wells, salvage of equipment as indicated on the plans, construction of a new pump station wet well, odor control unit, submersible pumps, associated force main piping and valves, valve vault, access hatches, backup generator, pre-fabricated building, control panel and associated electrical equipment, and instrumentation. The work shall also include furnishing all labor, material, and equipment necessary for site restoration including but not limited to fill replacement, grading, pavement, and concrete curb.

All work shall be performed as described in the Contract Documents and as shown on the Plans. Estimated quantities and Contract Pay Items are listed in the Proposal.

1.03 PLANS AND SPECIFICATIONS

Where the Plans and Specifications are not in agreement, the Plans shall govern. The Contractor shall furnish all labor, equipment, and materials to construct the Project and all miscellaneous and appurtenant work complete in place as specifically described and included under said each Contract Pay Item as shown, specified, or directed by the Engineer in accordance with the obvious or expressed intent of the Contract.

1.04 FIELD ENGINEERING

The Contractor shall establish and provide all vertical and horizontal control points for this Project including benchmarks. The Contractor shall provide the field layout surveying necessary to properly construct the Work as indicated on the Plans.

All field layout surveying shall be performed under the supervision of a Professional Land Surveyor (Chapter 472, Florida Statutes). The Contractor shall submit the name and registration number of Surveyor as directed by the Engineer. The Engineer reserves the right to check all survey staking and to require adjustments or re-staking by the Contractor in the event that conflicts or errors are detected.

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Water pressure pipelines that are 8-inch or less diameter shall be installed with the required cover using horizontal control stakes provided by the Contractor. Storm drains, sanitary sewers, sanitary pressure pipelines, and water pressure pipelines greater than 8-inch diameter shall be installed using an approved method for line and grade control. Methods for line and grade control shall be submitted to the Engineer for approval, as specified for shop drawings. Sketches shall be provided by the Contractor showing vertical adjustment necessary for pressure pipelines to adequately clear storm drains and other utilities, unless otherwise shown on the Plans.

1.05 SAFEGUARDING SURVEY MARKS

The Contractor shall safeguard all existing property monuments, benchmarks, and other survey marks adjacent to and within the Project limits, and shall bear the cost of re-establishing them if disturbed or destroyed.

1.06 INSPECTION AUTHORITY

The City or Engineer has ultimate responsibility for contract administration and inspection for this Project. The City or Engineer may assign field inspection responsibilities to a Design Professional and/or City Inspector. Each step of construction is subject to approval by the City or Engineer prior to proceeding with a subsequent step.

During the progress of the Work and up to the date of final acceptance, the Contractor shall at all times afford representatives of the City, the County, the State, the Department of Environmental Protection, the Department of Labor, or any other agency with jurisdiction, every reasonable, safe, and proper facility for observation of the Work done or being done at the site, and also the manufacture or preparation of materials and equipment at the place of such manufacture or preparation.

The Project line of authority will be presented at the Preconstruction Conference.

1.07 PROJECT SCHEDULE

The Contractor shall submit an electronic version in PDF form. Project schedule in accordance with *General Conditions* articles headed "Project Schedule" and "Progress Charts" and as supplemented herein.

Scheduling and progress reporting shall be accomplished by the use of a bar chart to provide a clear and concise comparison of progress.

1.08 MATERIALS AND EQUIPMENT

All materials, appliances, and types of construction shall be in accordance with the Technical Specifications and shall, in no event, be less than that necessary to conform to the requirements of any applicable laws, ordinances, and codes.

All materials and equipment to be incorporated into the Work shall be new, unused, and correctly designed. They shall be of standard first grade quality, produced by expert workmen, and be intended for the use for which they are offered. Materials or equipment which, in the opinion of the Engineer, are inferior or of a lower grade than indicated, specified, or required, will not be accepted.

1.09 MANUFACTURER

The names of proposed manufacturers, manufacturers' representatives, suppliers, and dealers who are to furnish materials, equipment, or other fittings, shall be submitted by the Contractor to the Engineer for approval. Such approval must be obtained before Shop Drawings will be accepted for review. All transactions with the manufacturer and subcontractors shall be through the Contractor. Any two or more pieces of material or equipment of the same kind, type, or classification and being used for identical types of service, shall be made by the same manufacturer.

1.10 SAMPLES

The Contractor shall, when required, submit to the Engineer for approval, typical samples of material and appliances. The samples shall be properly identified by tags and shall be submitted sufficiently in advance of the time when they are to be incorporated into the Work so that rejections thereof will not cause delay. A letter of transmittal from the Contractor requesting approval shall accompany all such samples.

1.11 EQUIVALENT QUALITY

In the Contract Documents, whenever an article, material, apparatus, equipment, or process is called for by trade name or by name of a patentee, manufacturer, or dealer, or by reference to catalog of a manufacturer or dealer, it shall be understood as intending to mean and specify the article, material, apparatus, equipment, or process designated, or any equal thereto in quality, finish, design, efficiency, and durability, and equally serviceable for the purposes for which it is intended.

Whenever material or equipment is submitted for approval as being equal to that specified, the submittal shall include sufficient information and data to demonstrate that the material or equipment conforms to the Contract requirements. The decision as to whether or not such material or equipment is equal to that specified shall be made by the Engineer.

Upon rejection of any material or equipment submitted as the equivalent of that specifically named in the Contract, the Contractor shall immediately proceed to furnish the designated material or equipment.

Neither the approval by the Engineer of alternate material or equipment as being equivalent to that specified, nor the furnishing of the material or equipment specified, shall in any way relieve the Contractor of responsibility for failure of the material or equipment, due to faulty design, material, or workmanship, to perform the functions required of them by the Contract Documents.

1.12 MATERIAL AND EQUIPMENT DELIVERY AND STORAGE

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In conformance to the *General Conditions* article headed "Material and Equipment Delivery" the Contractor shall deliver materials in ample quantities to ensure the most speedy and uninterrupted progress of the Work to complete the Work within the allotted time. The Contractor shall also coordinate deliveries in order to avoid delay in, or impediment of, the progress of the Work of any related contractor. The Contractor shall provide space for storage of materials and equipment.

Pipe strung along roads and rights-of-way shall be placed in a manner that will not endanger or restrict pedestrian or vehicular traffic.

1.13 SERVICE OF MANUFACTURER'S REPRESENTATIVE

The Contract amount shall include but is not limited to the cost of furnishing a competent and experienced representative of the equipment manufacturer who shall assist the Contractor, when required, to install, adjust, test, and place in operation the equipment in conformity with the Contract Documents. After the equipment is placed in operation, the representative shall make all adjustments and tests required by the Engineer to prove that the installed equipment is in proper and satisfactory operating condition. The representative shall instruct personnel as may be designated by the Engineer in the proper operation and maintenance of such equipment.

1.14 CONTAMINANTS CONTAINMENT/DISPOSITION

- A. Prior to the installation of well points for dewatering, the Contractor shall visually inspect the Work area for indications of existing ground water monitoring, wells, or metal caps at grade. The Contractor shall review the Work area for monitoring wells or abandoned fuel tanks, and shall notify the Engineer in writing if any of the above items exist.

During dewatering activities, contractor to test water for contaminants before discharge. If the water is odorous, contaminated, or discolored (excluding tannic acid or iron), the Contractor shall stop the dewatering activities and shall notify the Engineer in writing of such, and request direction.

- B. When Work activities encounter or expose any abnormal condition that may indicate the existence of a hazardous or toxic waste, Work activities shall stop in the vicinity of the abnormal condition and the Contractor shall notify the Engineer immediately. The presence of tanks or barrels; discolored earth, metal, wood, or groundwater; visible fumes; abnormal odors; excessively hot earth; smoke; or other conditions that appear abnormal, may be signs of hazardous or toxic wastes and shall be treated with extraordinary caution.

Every effort shall be made by the Contractor to minimize the spread of any hazardous or toxic waste into uncontaminated areas.

The Contractor's operations shall not resume until directed in writing by the Engineer.

Disposition of the hazardous or toxic waste will be made in accordance with the requirements and regulations of any City, County, State, or Federal agency having jurisdiction. Where the Contractor performs work necessary to dispose of hazardous or toxic waste, and the Contract does not include Pay Items for disposal, payment may be made as provided in the *Contract Standards: General Conditions* section headed "Unforeseen Subsurface Conditions."

1.15 PREVENTION, CONTROL, AND ABATEMENT OF EROSION AND WATER POLLUTION

The Contractor shall be responsible for prevention, control, and abatement of erosion, siltation, and water pollution resulting from construction of the Project until final acceptance of the Project.

The Contractor shall implement all appropriate turbidity management practices at the point of discharge into a storm sewer, gutter, or other conveyance to ensure that state water quality standards are not violated at the point where the storm drain, gutter, or other conveyance discharges into a surface water.

All necessary provisions shall be taken to ensure compliance with the water quality standards of the State of Florida. Attention is called to Chapter 62-302, Florida Administrative Code, and in particular, the requirements that turbidity shall not exceed 29 NTUs above background level. Adequate silt containment procedures and equipment shall be used to control turbidity, at no additional cost to the City.

1.16 MAINTENANCE OF STORM DRAINAGE SYSTEM

The Contractor shall be responsible at all times to maintain the operation of existing stormwater facilities, or, when existing stormwater facilities are removed, to provide equivalent capacity alternate forms of stormwater removal adequate to prevent upstream flooding in excess of existing conditions. This responsibility shall include but is not limited to the installation of temporary connections, bypass pumping, or other temporary means necessary until the new drainage system is fully operational.

1.17 SPILL OR DISCHARGE OF WASTEWATER OR RECLAIMED WATER

The discharge of wastewater or effluent (reclaimed water) into waters of the State and/or into canals, ditches, and ponds that are connected to waters of the State is prohibited. Any spill or discharge of wastewater or reclaimed water shall be immediately reported to the Engineer, the City's Project Manager (363-9254), and the City's Emergency Dispatch Center (363-9200). In the event of a spill or discharge, the Contractor shall immediately control, contain, and stop the spill or discharge and shall repair any damage to the City's facilities.

The Contractor shall be responsible for any penalties and costs charged to the City by the FDEP and for all costs incurred by the City as a result of the Contractor's actions or as a result of the Contractor's negligence. The fines, and anticipated costs, which may be incurred by the City as a result of the Contractor's actions or negligence, shall be paid to the City within 30 days, or the costs incurred will be deducted from the total Contract amount.

1.18 SEQUENCE OF OPERATION

A. General - Pipeline Work

It is the intent of the City that all pipeline work associated with the Project be installed to completion in a timely and orderly manner so as to minimize inconvenience to the Public.

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The Contractor shall include in the Project Schedule a Sequence of Operations conforming to the following order:

1. Store or string pipe materials at locations and in a manner as approved by the Engineer. Pipe and pipe materials shall not be stored or strung in residential areas more than 3 weeks in advance of pipe installation unless otherwise approved by the Engineer.
2. Ensure that proper pump bypassing is coordinated with the City in order to continue functionality of existing utility service.
3. Backfill installed pipe in accordance with the Technical Specifications as soon as practical.
4. Test the installed pipe, if required, in accordance with the Technical Specifications. Make repairs as necessary.
5. Disinfect the installed pipe, if required, in accordance with the Technical Specifications.
6. Restore the ground surface in accordance with the Technical Specifications.

B. General – Pump Station and Miscellaneous

It is essential that any Project Work conducted at Pump Station sites be sequenced to minimize obstruction of normal daily operations of the Pump Station.

The Contractor shall include in the Project Schedule a Sequence of Operations conforming to the following order:

1. Store equipment and materials at locations and in a manner approved by the Engineer.
2. Ensure that proper pump bypassing is coordinated with the City in order to continue functionality of existing utility service.
3. Confine work and personnel to designated areas in accordance with the Specifications
4. Clean up work areas daily so as to present a safe and neat appearing Work site

C. Utility Companies may be present on the Work site adjusting their facilities and installing new facilities. The Contractor's work shall be scheduled in such a manner as to minimize conflicts with various utility companies.

D. The Contractor shall clean up the site for each phase of Work in accordance with the Contract Documents before proceeding to a subsequent phase of Work, unless otherwise approved by the Engineer.

E. No Time Extension

If the Engineer orders construction, or a phase of construction, to be stopped due to the Contractor's neglect to adhere to the Sequence of Operations as outlined herein, the Stop Work Order shall not constitute a basis for extension of time.

1.19 WORK IN STREETS AND HIGHWAYS

All Work within streets and highways shall be subject to the regulations and requirements of the appropriate agencies. Streets and highways are under the jurisdiction of City of St. Pete Beach for this Project.

Methods and materials of construction used in restoration within such streets and highways shall conform to the requirements, inspection, and approval of the duly authorized representatives of the appropriate agency having jurisdiction. Restoration Work shall include but not limited to: removal and replacement of pavement, sidewalk, curb, and gutter; replacement of storm sewer facilities; excavation and backfilling; and storage of materials and equipment.

1.20 WORK IN PRIVATE PROPERTY

In the event that, in the opinion of the Contractor, obtaining a temporary construction easement outside the limits of the right-of-way, of City-owned property, or of the easement(s) obtained by the City is necessary or desirable, it shall be the sole responsibility of the Contractor to obtain such easement from the owner of the property. If such easement is obtained by the Contractor it shall contain provision to hold the City harmless from any operations of the Contractor within the easement limits. The Contractor shall not conduct construction operations on private property outside the limits of the right-of-way, of City-owned property, or of the easement(s) obtained by the City unless a copy of the Temporary Construction Easement Agreement is filed with the Engineer.

Upon completion of Work in easements, the Contractor shall restore the property, including all fences or other structures disturbed by his operations, as nearly as possible to the condition in which he found it.

1.21 PERMITS

Construction projects performed for the City will require licenses and permits in the same manner as private construction projects within the City.

The Contractor shall secure, at his expense, all licenses and permits, and shall comply with all applicable laws, regulations, and codes as required by the State of Florida and/or the City of St. Pete Beach whether performed by the Contractor or by others. The Contractor must be registered to complete such work within Pinellas County.

City permits for this Project will include:

- Demolition
- Building
- Plumbing
- Electrical
- Mechanical
- Parking, Paving, Landscaping

1.22 FIELD OFFICE AND APPURTENANT STRUCTURES

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General: No field office or appurtenant structures by the Contractor, any subcontractor, or any material supplier, will be allowed on the Project site.

Space on City property or rights-of-way proposed to be used for storage and a field office for the Contractor shall be approved by the Engineer prior to installation providing such uses will not interfere in any manner with the construction of the Work or the operation of existing facilities.

1.23 CONTRACTOR'S SIGN

No sign by the Contractor, any subcontractor, or any material supplier, will be allowed on the Project site.

1.24 MOBILIZATION

Mobilization shall include but is not limited to all preparatory work and operations necessary to begin the Project, including moving of personnel, equipment, traffic control, and all else necessary to commence work. The cost of bonds, insurance, shop drawings, and preconstruction expenses shall also be included.

If a separate Pay Item is included for mobilization, payment will be as specified for that Pay Item. If no Pay Item is included, costs for mobilization shall be included with the costs for the major Work items included in the Proposal.

1.25 WATER PURCHASE

Water used in connection with this Project must be coordinated with Pinellas County.

1.26 TRAFFIC CONTROL

The Contractor shall provide required traffic controls under City observation. The Contractor shall notify the City's Project Manager a minimum of 2 working days prior to any construction affecting traffic flow. A Maintenance of Traffic plan drawing shall be submitted for review by the Engineer prior to each lane closure or opening during the course of construction. All traffic control devices utilized during construction shall be provided by the Contractor and meet the requirements set forth in the latest revision of U.S. Department of Transportation Federal Highway Administration's "Manual on Uniform Traffic Control Devices for Streets and Highways" and the Florida State Department of Transportation's "Design Standards." Failure or refusal, on the part of the Contractor, to install, maintain and/or position traffic control devices promptly, fully, and in an acceptable manner, shall be sufficient cause for the City, after 24-hour notice, to perform the traffic control with its own organization, or to contract with any other individual, firm, or corporation to perform the required traffic control. All costs and expenses incurred thereby shall be charged against the defaulting Contractor, and the amount thereof deducted from any money due, or which may become due him, or shall be charged against the Contract Bond. Any Work performed as described by this paragraph, shall not relieve the Contractor in any way of his responsibility for the Work performed by him.

Traffic shall be performed so that vehicular traffic shall be maintained on with at least one 10-foot wide lane in each direction at all times. An acceptable detour route shall be developed by the Contractor to redirect traffic when and where necessary, with the approval of the Transportation Special Events Division. Temporary lanes shall be constructed with a minimum 1-inch thick asphaltic concrete surface over a 6-inch thick limerock base compacted to 98% of the maximum density in accordance with AASHTO T-180.

Failure of the Contractor to comply with any of the above traffic control requirements may result in issuance of a stop work order until the violation is corrected.

1.27 TREE PROTECTION

Particular care shall be taken by the Contractor to protect trees during construction by erecting approved barricades to prevent unnecessary damage to trunk and roots during construction. Such barriers shall protect the area within the dripline.

The Contractor shall prune all branches that interfere with construction in accordance with American Forestry Association Standards. Roots over 2-inch diameter shall be preserved wherever possible. If root pruning is required, roots shall be cut cleanly.

Temporary soil deposits, concrete block, concrete wash, or solvents shall not be placed within the dripline. The grade within the dripline shall be preserved. If adjacent grade is altered, protective measures such as those described in the Florida State Division of Forestry "Tree Protection Manual for Builders and Developers" shall be constructed to protect the tree(s) from deleterious effects of the grade change.

1.28 TREE REMOVAL AND REPLACEMENT

The Contractor shall obtain any necessary tree removal permit, shall furnish and replace trees as required, and shall perform this Work in a manner conforming to all applicable provisions of said regulations or permit.

The cost of tree removal and obtaining the tree removal permits shall be included in the cost of the appropriate associated Contract Pay Item under which the Work is to be performed. The Contractor shall remove trees as required and approved by the Engineer whether or not said trees are shown on the Plans. Trees that have to be removed, except for Australian pine, Brazilian pepper, punk, and other exempt species, shall be replaced as directed. Replacement trees shall be of native species at least 8 feet tall and at least 3-inch caliper diameter.

1.29 UTILITIES

Prior to construction, the Contractor shall familiarize himself with the location of all existing utilities and facilities within the Project Site and with the applicable provisions of the *General Conditions* article headed "Convenience and Safety."

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The Contractor shall notify utility companies at least 48 hours, excluding Saturdays, Sundays, and legal holidays, prior to excavation. Utility companies shall be contacted by calling the utility notification center "Sunshine" at 1-800-432-4770. The City will furnish to the Contractor the available records of City utilities. The Contractor shall locate and mark all City utilities for his reference and for use by utility companies. The Contractor shall act as the City's agent for locating and marking City underground utilities within the Project limits, in accordance with the Florida Underground Facilities Damage Prevention and Safety Act (FS 556).

In all cases where existing utility lines may be interfered with by the Work, the Contractor shall give a minimum of 48 hours notice to the owners of such utilities to permit them to relocate the lines prior to construction. Existing utilities have been shown on the Plans insofar as information is reasonably available. However, it will be the Contractor's responsibility to preserve all existing utilities whether shown on the Plans or not.

1.30 NEIGHBORHOOD NOTIFICATION

Not less than 7 days prior to the commencement of Work in the right-of-way, the Contractor shall notify all residents and businesses along the construction route with a printed door hanger notice indicating the scheduled date of construction, the type of construction, and the Contractor's and Superintendent's name, address, and telephone number. The notice shall contain wording indicating that the property owners or businesses should remove from the right-of-way any bush, flower, planting, landscaping materials, etc., that they wish to save. The door hanger text and a list of residents and businesses to which the notification has been delivered shall be compiled and submitted to the Engineer prior to the Contractor commencing Work in a particular block. After such notification, any such item remaining in the right-of-way and requiring removal shall be removed and disposed of by the Contractor. Restoration of such items will not be required of the Contractor, except for sodding of disturbed yard and parkway areas. However, the Contractor shall exercise reasonable caution in order to avoid damaging such items where possible.

1.31 SHOP, FIELD, AND LABORATORY TESTING

The Engineer may require testing by certified personnel of certain materials to be incorporated in the Work, such as: soils density, pavement, concrete pipe and appurtenances, and welds.

In the event any such testing is required by the Engineer, a detailed description will be found in these Technical Specifications concerned with the specific item of Work.

Where reference is made in the DOT-SSRBC for design mixes, tests of materials, or work performed, or where in the opinion of the Engineer, tests are required to ascertain compliance with the Specifications, the Contractor shall have such tests made by an approved testing laboratory. No additional payment will be made for these tests.

1.32 SALVAGED MATERIALS

The Contractor shall not proceed with demolition of existing materials or equipment without approval from the Engineer for the method of disposal.

All materials which are not returned to the City yard shall be disposed in an approved disposal site. The Engineer may request confirmation of the site's approval for disposal of the specific materials.

Salvaged materials shall be loaded on Contractor trucks and returned to the Public Services yard at 7581 Boca Ciega Drive, St. Pete Beach, Florida. The City will designate the specific location at the yard for placement of salvaged materials by the Contractor.

The following materials shall be removed and returned by the Contractor: pumps and pump rails, and all other materials as directed by the Engineer.

1.33 AS-BUILT DRAWINGS

- A. **General:** For all elements of construction, the Contractor shall furnish the Engineer one set of marked-up Contract Plans blue-line prints showing as-built conditions, as specified in the *General Conditions* section headed "As-Built Drawings."

The drawings shall show the name, address, and phone number of the Contractor. Each drawing shall be certified by a responsible representative of the Contractor and dated.

The as-built drawings shall reflect any differences from the original Contract Plans in the same level of detail and units of dimension as the Plans.

- B. **Potable Water and Reclaimed Water Distribution Systems:** The as-built drawings shall conform as follows.

Pipeline 2-inch and larger shall be dimensioned to the face of the curb or other approved landmark. If the Work is done prior to the installation of curbs, the dimensions may be taken from known property lines.

All valves, hydrants, fittings, meters, taps, thrust blocks, harnessed joint pipe, and all other appurtenances shall be shown on intersection drawing sketches and on the as-built drawings. Pipe material shall also be shown.

Stations and elevations shall be shown for pipeline 6-inch and larger for all horizontal and vertical changes in the pipeline alignment or grade. Valves, outlets, fittings, and other appurtenances shall be stationed.

Intersection drawings shall be sketched at a scale of one inch equals 30 feet and submitted on 8-1/2-inch by 11-inch paper sheets with the Contractor's monthly request for partial payment, or prior to placing the pipeline into service, whichever occurs first. A typical intersection drawing example may be requested from the Engineer.

- C. **Sanitary and Storm Sewer Piping Systems:** The as-built drawings shall conform as follows:

Manholes, inlets, headwalls and other drainage structures shall be dimensioned from the face of curb or roadway centerline, or construction baseline, and stationed along the baseline. New service connections and replaced service connections shall be dimensioned to the nearest downstream manhole.

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All dimensions shown on the Plans shall be verified. All manhole, inlet and other drainage structure top and invert elevations shall be recorded. Top elevations for manholes shall be the north rim elevation. Inlets shall have recorded curb type, curb top, and gutter elevations. Invert elevations, direction, and size shall be recorded for every pipe/culvert connecting to a structure (including conflict pipes). All drainage structure inside dimensions shall be recorded. Special structures such as headwalls/endwalls and weir/control boxes shall have recorded all pipe/culvert invert elevations, direction, and size as well as flow lines for weirs and dimensions of oil skimmers and other devices.

All pipe materials shall be recorded, and all areas of special construction shall be noted.

- D. **Paving:** The as-built drawings shall conform as follows.

The as-built drawings shall show all changes to the horizontal and vertical alignment in the plan, profile, and cross sections. Drawings shall indicate changes in elevations for curbs and roadway crowns, base type and thickness, curb type, limits of new sidewalk, driveway replacement (including paving materials used), and other surface features.

- E. **Electrical and Control Wiring:** The as-built drawings shall conform as follows.

The as-built drawings shall include all changes to the original Contract Plans. The as-built drawings shall also include the size, color, and number of wires and conduit. For Projects where this information is too voluminous to be contained on the blue-line prints, the Contractor shall prepare supplemental drawings, on same size sheets as the blue-line prints, showing the additional conduit runs, 1-line diagrams, ladder diagrams, and other information. The wiring schematic diagrams shall show termination location and wiring identification at each point on the ladder diagram.

END OF SECTION

SECTION 2 - EXCAVATION AND BACKFILL

2.01 GENERAL

The Work in this section includes furnishing all labor, materials, tools, and equipment for excavation and backfill of roadways, sidewalks, curbs, driveways, pipelines, and structures. The Work also includes removing and disposing of leftover material, and furnishing and placing off-site fill.

Bidders shall examine the site of the Work, make their own additional soil borings and tests, and make their own determination of the character of materials and the conditions to be encountered on the Work; their Proposal shall be based upon their own investigation.

2.02 TRENCH SAFETY

The Contractor shall be responsible for maintaining safety at each excavation. The Contractor shall adhere to the Florida Trench Safety Act (FS 90-96), OSHA trench excavation safety standards (29 CFR, Subpart P, 1926.650), and OSHA trench excavation shielding, sloping, or sheeting requirements. Inspections required by OSHA trench excavation safety standards shall be provided by the Contractor's "competent person," as defined by OSHA 29 CF, Subpart P, 1926. The Contractor's "competent person" shall be identified at the Project preconstruction meeting.

The Contractor certifies by submitting the bid and subsequently executing this Contract, that all trench excavation done within his control shall be accomplished in strict adherence with OSHA trench safety standards, the Florida Trench Safety Act, and public safety.

The Contractor also agrees to produce or obtain, prior to award of the subcontracts, identical certification from subcontractors who will perform trench excavation, and to retain such certification for at least 3 years following Final Acceptance.

The Contractor shall consider all available geotechnical information when designing the trench excavation safety system. If sufficient geotechnical information is not available, the Contractor may obtain such to support the requirements set forth above, at no additional cost to the City.

2.03 WORK IN WETLANDS, MANGROVES, AND PRESERVATION AREAS

Strict adherence to all permits is required. Damage to wetlands, periodically wet areas, mangroves, and preservation areas is prohibited. Any such damage by the Contractor shall be duly rectified at no additional cost to the City and as approved by the regulatory agencies.

2.04 CLEARING AND GRUBBING

All clearing and grubbing Work shall conform to all applicable requirements of DOT-SSRBC Section 110 "Clearing and Grubbing" except as modified herein.

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The Contractor shall remove only those trees and bushes necessary to complete the specified Work. Not all the trees and bushes have been located or shown on the Plans. The Contractor shall flag those trees and bushes to be removed. All other trees and bushes shall be protected as specified in Technical Specifications section headed "General," subsection headed "Tree Protection."

All roots, stumps, and other debris shall be removed to a depth not less than 12 inches below a bearing surface. The disturbed surface shall be backfilled, graded, and compacted as specified.

No tree or bush shall be removed without the approval of the Engineer. The Contractor shall obtain all necessary City or County permits for each tree to be removed. Tree removal shall conform to the provisions of the Technical Specifications section headed "General," subsection headed "Tree Removal and Replacement."

2.05 ROADWAY EXCAVATION

The extent of excavation shall be as shown on the Plans or otherwise approved by the City, and shall include roadway excavation and/or filling and grading, together with the removal of trees, bushes, existing asphalt, concrete, or other material, as required to facilitate construction and restoration as directed by the City.

All excavation Work shall conform to all applicable requirements of DOT-SSRBC Section 120 "Excavation and Embankment" except as modified herein.

2.06 TRENCH EXCAVATION

Mechanical excavation shall be terminated at least 2 inches above the proposed pipe bed and trench bottom, then shaped and compacted so as to provide uniform bearing on the barrel of the pipe. Particular care shall be taken to recess the bottom of the trench at the bell of the pipe to relieve the bell of all load.

A minimum trench width shall be maintained, allowing room for the jointing and proper compaction of the backfill. If material is encountered that is unsuitable in the opinion of the Engineer, it shall be removed by the Contractor and replaced with acceptable material compacted in place as specified. In the event the Contractor excavates below the elevation required without approval, the Contractor shall backfill with approved materials compacted to obtain a suitable trench bottom, all to the satisfaction of the Engineer and at no additional cost to the City.

The amount of open trench shall be limited so that no more than 100 feet of open trench in advance of the backfilling operation will remain at the end of that working day. All open trench shall be protected by the Contractor with barriers, warning devices, and traffic control devices, which shall be kept in the correct position, properly directed, anchored when required, and clearly visible at all times. The barriers, warning devices, and traffic control devices shall be suitably lighted at all times when vehicular traffic lights are required.

2.07 STRUCTURE EXCAVATION

Excavation shall be of the size and depth required for construction of structures and their foundations. Unsuitable material encountered shall be removed to the depth required to obtain sound foundation material or as ordered by the Engineer. Over-excavated areas shall be filled with approved backfill material compacted as specified, at no additional cost to the City.

Unsuitable existing soil shall be removed and replaced with compacted material, as approved by the Engineer and as specified in the subsection herein headed "Excavation of Unsuitable Material."

2.08 EXCAVATION OF UNSUITABLE MATERIAL

Unsuitable material shall include rock, concrete, and boulders. Unsuitable soft material shall include logs, muck, other soft soils, organic soils, and other soils as specified or as ordered by the Engineer to be unsuitable.

All excavation of unsuitable material shall conform to all applicable requirements of DOT-SSRBC Section 120 "Excavation and Embankment" except as modified herein.

Unsuitable material encountered below or within the roadway stabilized subgrade, the trench bottom, or a structure bottom, shall be removed by the Contractor to the limits established by the Engineer and disposed of from the Work area at an approved disposal area. Unsuitable material shall be replaced with approved material and compacted as specified.

No additional payment will be made for backfill material obtained from any source and used to replace any unsuitable material except as otherwise specified.

2.09 SHEETING, SHIELDING, AND SLOPING

All excavations shall be properly sheeted, shielded, or sloped to the required slope to furnish safe working conditions, to prevent shifting of material, to prevent damage to structures or other Work, and to avoid delay to the Work, all in accordance with applicable safety and health regulations. The minimum sheeting and shielding for trench excavations shall meet the general trenching requirements of the Florida Trench Safety Act and OSHA standards.

The sheeting and shielding shall be of adequate strength and quantity for the purpose intended. Any sheeting extending below the level of above the top of pipeline shall be cut off as ordered by the Engineer and left in place. In addition, the Engineer may order the Contractor to cut off and leave in place any sheeting, shielding, or other approved support where required to protect construction, property, or existing facilities or utilities.

Damages resulting in the installation or removal of sheet piling shall be rectified by the Contractor at no additional cost to the City.

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2.10 DEWATERING

All pipeline and appurtenances shall be laid entirely in a dry trench. All foundations and structure walls shall be constructed or installed in a dry excavation.

Before commencing any excavation at the site of the Work, the Contractor shall submit to the Engineer for review, the methods, equipment, and arrangement of facilities proposed for dewatering and disposal of water at the site and of all water entering any excavation or other part of the Work from any source whatsoever.

Water discharged from dewatering equipment shall be carried into surface drainage facilities except water quality treatment systems and shall not be discharged into sanitary sewer lines. The Contractor shall prevent water from puddling in streets or on private properties. The depositing of dirt in storm drains and ditches and staining of existing facilities shall not be permitted.

Adequate standby facilities shall be provided to ensure that the excavation will be kept dry in the event of power failure or mechanical breakdown. Facilities for the removal and disposal of water shall be of sufficient capacity to keep the excavation dry under all circumstances with one-half of the facilities out of service. If well points are used, provision shall be made for removing and resetting individual well points without taking the system of which they are a part out of service.

The City reserves the right to require the Contractor to replace noisy equipment in order to keep disturbance to a minimum.

The cost of dewatering and disposal of water shall be included in the unit quantity for each appropriate item bid.

Refer to the Technical Specifications Section headed "General," subsection headed "Contaminants Containment/Disposition," for requirements concerning encountered groundwater contaminants.

2.11 BORROW MATERIAL

Any borrow excavation Work shall consist of the excavation and satisfactory utilization of material from areas provided by the Contractor when necessary material is not available from the normal excavation or grading operations. This Work shall conform to DOT-SSRBC Section 120 "Excavation and Embankment" except as modified herein.

If additional fill material is required, it shall be City approved material supplied and compacted by the Contractor. All compaction under roadway, alley, driveway, curb, walk, or other improved surface shall be to a density as specified. Unless otherwise directed by the City, all material not required for construction shall be removed from the premises and disposed of by the Contractor.

2.12 BEDDING MATERIAL

Where shown, ordered, or required, the Contractor shall place bedding material prior to placing pipelines, structures, or slabs. Bedding material may be either excavated approved native sand, concrete sand, gravel, or reclaimed concrete.

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Off-site bedding material shall be sand or gravel. Sand bedding material shall be a clean concrete sand of uniform gradation between sieve sizes No. 4 and No. 50. All particles shall pass a 3/8-inch sieve and no particles shall pass a No. 100 sieve.

Gravel bedding material shall meet the requirements of ASTM C33 and shall be coarse aggregate, DOT Size No. 67 (3/4-inch to No. 4) or approved equal.

Reclaimed concrete bedding material shall be graded to meet the size requirements as specified for gravel bedding.

Bedding material, where required, shall be placed in lifts and compacted in a manner to achieve the specified density as described elsewhere.

If gravel bedding is used, an impermeable groundwater barrier shall be placed at 100-foot intervals in the gravel bedding.

The impermeable groundwater barrier shall consist of a 10 mil sheet of polyethylene covering the full cross sectional area of the gravel, embedded 6 inches into the trench sides and bottom, and extending to the top of the gravel. The barrier shall be offset a minimum of 2 feet from any culvert or pipe joint. Ends and splice points shall be lapped a minimum of 12 inches.

2.13 STRUCTURAL SLAB BEDDING

Structural slabs for manhole bases, footings, and similar structures shall be placed on approved compacted bedding material and leveled as specified and/or as shown.

2.14 BACKFILL COMPACTION

All backfill shall be compacted as specified herein and shall meet the following minimum density as determined by the AASHTO T-180 method for backfill outside the right-of-way and in City streets, and by the AASHTO T-99 method if in County or State right-of-way.

AASHTO T-180 Method C or D will be used for stabilized subgrade and base compaction tests, and Method A or B will be used for backfill testing, or as directed by the Engineer or jurisdiction.

	T-180	T-99
Roadway stabilized subgrade	98%	N/A*
Roadway base	98%	N/A*
Curb base	98%	N/A
Sidewalk and driveway base	98%	N/A
Pipe bedding	98%	100%
Pipe backfill - under pavement	98%	100%
Pipe backfill - under grass	95%	100%
Structure base slabs	100%	N/A
Structure backfill	98%	N/A

*Roadway stabilized subgrade and base material shall meet LBR requirements as specified in the construction plans.

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2.15 BACKFILLING OF TRENCH

Backfilling shall be accomplished with suitable material, and shall commence only after the pipelines have been laid and tentatively accepted by the City. The space between the pipe and the sides of the trench shall be packed full by hand-shoveled earth free from lumps or debris.

The backfill material shall be placed in 6-inch lifts and compacted, using approved tampers to the required compaction, to a point 12 inches over the top of the pipe. The remaining backfill (under areas other than roadways) shall be placed in uniform lifts not greater than 12 inches thick (or less as approved for mechanical equipment available) and tamped to the required compaction. Backfill under roadways shall be compacted in 6-inch lifts.

2.16 BACKFILLING STRUCTURES

Backfill around structures shall be of suitable job-excavated material, suitable off-site fill material, or other material approved by the Engineer. Such backfill shall extend from the bottom of the excavation or top of bedding to the bottom of pavement base course, the bottom of the subgrade for lawns or lawn replacement, the top of the existing ground surface, or to such other grades as may be shown or required.

The backfill shall be placed in uniform lifts not greater than 12 inches thick, and thoroughly compacted in place.

2.17 BACKFILLING UNDER ROADWAYS

Backfill placed under roadways and other paved surfaces shall be compacted in 6-inch lifts and thoroughly compacted in place, with suitable equipment as specified herein.

2.18 DISPOSING OF LEFTOVER MATERIAL

The Contractor shall bring the surface to the same level as existed prior to the excavation. All leftover material shall be hauled from the site and disposed of by the Contractor. Leftover material shall not be stored in or along rights-of-way or easements.

2.19 ADJACENT FACILITIES

The Contractor shall be responsible for the protection, removal, and replacement of all adjacent structures, utilities, trees, shrubbery, curbs, culverts, headwalls, fences, signs, and other miscellaneous structures encountered during the course of the Work.

2.20 TEMPORARY SUPPORTS

Temporary supports for 16-inch and larger pressure and gravity pipes shall be designed by the Contractor and submitted to the City as required by the *Contract Standards: General Conditions* section headed "Shop Drawings and Submittals." Temporary supports that include a structural beam, or other such member(s), shall be designed, signed and sealed by a Professional Engineer.

2.21 FLOWABLE FILL

Where shown on the Plans, or where ordered by the Engineer, the Contractor shall backfill a void area or an excavation with flowable fill. Flowable fill may be shown, or ordered, to fill abandoned pipes, abandoned underground steel storage tanks, trench backfill, washout area under structural slabs or behind walls, or other similar locations.

Flowable fill shall be produced and delivered to the site. Placing of flowable fill shall be by chute, pumping, or other approved methods. Flowable fill shall be placed to the designated fill line without vibration. The Contractor shall take all necessary precautions to prevent any damage caused by hydraulic pressure of the fill during placement prior to hardening. Flowable fill shall not be used for pipe bedding and backfill in the zone from the bottom of a pipe to 12 inches above the top of pipe.

Flowable fill shall consist of materials conforming to DOT-SSRBC Sections as follows:

Cement (Type I or II)	Section 921	“Portland Cement and Blended Cement”
Fly ash (Type F)	Section 929	“Fly Ash, Slag, Microsilica and Other Pozzolanic Materials for Portland Cement Concrete”
Fine aggregate (sand)	Section 902	“Fine Aggregate”
Water	Section 923	“Water for Concrete”

The Contractor shall submit a proposed design mix that will produce a flowable fill meeting the strength requirements specified herein, using the following materials:

	Pounds per cubic yard
Cement (Type I or II)	50 - 200
Fly ash (Type F)	0 - 2,000
Fine aggregate (sand)	2,500 - 3,000
Water	325 - 550

Note: 6-inch to 10-inch slump

Flowable fill material shall be proportioned to produce a 28-day compressive strength approximately as follows:

	Pounds per square inch
Pipe trench backfill	50 - 150
Fill abandoned pipes or tanks	30 - 150
Under slabs, behind walls	300 - 1000

Note: Density in place 115 to 145 pounds per cubic foot.

Not more than 60 minutes shall elapse between the start of moist mixing and the placement of the flowable fill.

Flowable fill placed on slopes shall have a reduced slump with a reduction in water, and shall be able to be shaped as required.

The Contractor shall place the flowable fill in such a manner as to eliminate all cavities.

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Flowable fill shall not be placed in salt water. When within a tidal area, the flowable fill shall be placed immediately after the salt water has receded.

When flowable fill is used adjacent to ductile iron pipe, the pipe shall be polyethylene encased.

END OF SECTION

SECTION 3 - CONCRETE, MASONRY, AND REINFORCING STEEL

3.01 GENERAL

The Work in this section includes furnishing, placing, finishing, and curing all reinforced and plain concrete, prestressed concrete, reinforcing steel, welded wire fabric, brick, masonry block, mortar, and related work. Brick used for paving and hexagon block used for sidewalks are not included in this section.

3.02 PORTLAND CEMENT CONCRETE

Portland cement concrete shall conform to the applicable requirements of the DOT-SSRBC Sections 346, 347, and 921.

Class IV concrete shall be used for all concrete in contact with, or over, salt or brackish water.

Concrete used for structures in contact with sewage shall be mixed from Type II portland cement containing the lowest calcium thiosulfate available as specified in AASHTO M 85.

Concrete shall meet the following minimum 28-day compressive strength:

Miscellaneous concrete (thrust blocks, pipe encasement, etc.)	2,500 psi
Concrete curb/gutter/sidewalk/pavement	3,000 psi
Cast-in-place/precast structures	4,000 psi
Prestressed structures	5,000 psi

3.03 REINFORCING STEEL

Reinforcing steel shall conform to ASTM A 615, Grade 60 deformed bars and to the applicable requirements of DOT-SSRBC Sections 415 and 931.

Reinforcing steel shall not be coated, except as specifically specified on the Plans.

All welded wire fabric shall conform to ASTM A 497 (deformed) or ASTM A 185 (plain) and to the applicable requirements of DOT-SSRBC Article 415-6.

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3.04 FIBROUS CONCRETE REINFORCEMENT

Fibrous concrete reinforcement may be used, where shown or approved, in lieu of welded wire fabric for shrinkage and thermal contraction/expansion in concrete pavement, driveway, and sidewalk.

Fibrous concrete reinforcement shall conform to ASTM C 1116, ASTM C 94, and ASTM E 119-83.

Fibrous concrete reinforcement shall be 100 percent virgin polypropylene fibrillated material mixed with concrete at a minimum of 1.5 pounds per cubic yard of concrete.

3.05 PLACEMENT OF REINFORCEMENT

Reinforcing steel placement shall conform to the applicable requirements of DOT-SSRBC Articles 350-7 and 415-5.

The following minimum concrete cover shall be provided for all reinforcement:

Concrete cast against and permanently exposed to earth	3-inch
Concrete exposed to earth or weather	
Primary reinforcement	2-inch
Stirrups, ties, and spirals	1 1/2-inch
Concrete deck slabs, top and bottom	2-inch
Concrete not exposed to earth or weather	
Primary reinforcement	1 1/2-inch
Stirrups, ties, and spirals	1-inch

For bundled bars, the minimum concrete cover shall be equal to the equivalent diameter of the bundle, but need not be greater than 2-inch, except against and permanently exposed to earth, in which case the minimum cover shall be 3-inch.

Minimum concrete cover shall be increased in corrosive environment areas.

3.06 PLACEMENT OF CONCRETE

Placement of portland cement concrete shall conform to the applicable requirements of DOT-SSRBC Article 400-7.

Unless specific permission is granted prior to each occurrence, no concrete shall be delivered to the job site before 7:30 a.m. or after 4:30 p.m.

No concrete shall be placed until the reinforcing steel placement has been inspected and approved by the Engineer.

3.07 CURING OF CONCRETE

Curing of portland cement concrete shall conform to the applicable requirements of DOT-SSRBC Article 520-8.

3.08 FINISHING OF CONCRETE

Finishing of portland cement concrete shall conform to the applicable requirements of DOT-SSRBC Article 400-15.

3.09 CONCRETE BRICK

Concrete brick for use in drainage structures and where shown on the Plans shall be approximately 3 5/8-inch by 7 5/8-inch by 2 1/4-inch in size and shall conform to ASTM C 55, Grade N-II or S-II.

3.10 CLAY BRICK

Brick shall be sound, hard, and uniformly burned regular and uniform in shape and size or compact texture and conforming to ASTM C 32, "Specification for Sewer and Manhole Brick (Made from Clay or Shale) Grade MS or MM."

3.11 MASONRY BLOCK

Load bearing units shall be hollow or solid, as shown on the Plans, and shall conform to ASTM C 90, Type I, 8-inch by 16-inch or 4-inch by 16-inch nominal face dimension.

Non-load bearing units shall conform to ASTM C 129, Type I, 8-inch by 16-inch or 4-inch by 16-inch nominal face dimension.

Horizontal continuous joint reinforcement shall be provided at every other joint. Reinforcement shall be a minimum of #9 gage steel, Grade 50. Wire shall be hot-dip galvanized, conforming to ASTM A 153, Class B-2 (1.5 ounce per square foot of wire surface) for zinc coating after prefabrication into units. Mortar coverage shall be not less than 5/8-inch on joint faces exposed to exterior, and not less than 1/2-inch elsewhere.

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3.12 MORTAR

Mortar shall consist of a mixture of cementitious materials, aggregate, and water. All proportions shall be by volume and/or weight. Masonry cement shall conform to ASTM C 91 and C 270. Fine aggregate and portland cement shall conform to the applicable requirements of DOT-SSRBC Sections 902 and 921 respectively.

Mortar shall have a minimum compressive strength of 1,500 psi.

3.13 GROUT

Grout shall be identical to mortar in all respects.

END OF SECTION

SECTION 4 - PIPING MATERIALS: DUCTILE IRON PIPE

4.01 GENERAL

The Work in this section includes furnishing all ductile iron pipe, fittings, joints, and appurtenant materials. All castings furnished shall have been cast in the United States of America unless complete certification is furnished in accordance with the latest edition of ANSI/AWWA C 110.

Standards referenced in this section are the latest revision of the following specifications:

ANSI/AWWA C104	"Cement Mortar Lining for Ductile-Iron Pipe and Fittings for Water"
ANSI/AWWA C110	"Ductile-Iron and Gray Iron Fittings, 3-Inch through 48-Inch, for Water and Other Liquids"
ANSI/AWWA C111	"Rubber-Gasket Joints for Ductile-Iron and Pressure Pipe and Fittings"
ANSI/AWWA C115	"Flanged Ductile-Iron Pipe with Threaded Flanges"
ANSI/AWWA C150	"Thickness Design of Ductile-Iron Pipe"
ANSI/AWWA C151	"Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids"
ANSI/AWWA C153	"Ductile-Iron Compact Fittings, 3-Inch through 24-Inch, for Water and Other Liquids"
ASTM D 1248	"Polyethylene Plastics Molding and Extrusion Materials"

4.02 PIPE

A. General

All ductile iron pipe shall be designed in accordance with ANSI/AWWA C150. Pipe shall be minimum pressure class as follows:

Size	Pressure Class
3-inch through 18-inch	350
20-inch through 24-inch	300
30-inch through 48-inch	200

For threaded flanged pipe the minimum thickness shall be the nominal thickness as shown on Table 15.1 of ANSI/AWWA C115.

Thickness shall be designed for Laying Condition Type 2: Flat-bottom trench backfill lightly consolidated to centerline of pipe.

Pipe shall be manufactured in accordance with ANSI/AWWA C151.

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The pressure rating, metal thickness class, net weight of pipe (without lining) length of pipe, name of manufacturer, "DI" or "DUCTILE," and country where cast, shall be clearly marked on each length of pipe.

B. Lining

1. **Potable Water Lines and Reclaimed Water Lines:** Ductile iron pipe and fittings for use in potable and reclaimed water lines shall be cement mortar lined. Cement lining shall conform to ANSI/AWWA C104, and seal coated with approved bituminous seal coat in accordance with ANSI/AWWA C151. Seal coating shall be UL listed or NSF approved for use in potable water mains.

2. **Sanitary Force Mains and Gravity Sanitary Pipe:** Ductile iron pipe and fittings for sanitary sewer force mains and gravity sewer pipe shall be polyethylene, polyurethane, or epoxy lined.

Epoxy lining shall be 40 mil minimum thickness (multi-pass process) and shall be Protecto 401 Ceramic Epoxy, as manufactured by the Protecto Division of Vulcan Painters, Inc., or approved equal.

Polyethylene lining shall be factory furnished with a fusion bonded polyethylene liner of 60 mil minimum thickness conforming to ASTM D1248, such as Polybond Plus as furnished by American Cast Iron Pipe Co, or approved equal.

Polyurethane lining shall be factory applied conforming to Corropipe, as manufactured by Madison Chemical Industries, Inc., or an approved equal. Material shall be applied in conformance with the manufacturer's recommendation and shall be a 40 mil final dry film thickness.

3. **Storm Drain Gravity Pipe:** Ductile iron pipe and fittings for storm drain gravity pipe shall be epoxy lined as per sanitary pipe or cement mortar lined as per water pipe, at the Contractor's option.

4.03 FITTINGS

Ductile iron fittings shall conform to ANSI/AWWA C110 or ANSI/AWWA C153.

Fittings shall be suitable for a minimum water pressure plus water hammer as follows:

Size	Type	Pressure Rating
3-inch through 12-inch	DI	350
14-inch through 24-inch	DI	350
30-inch through 48-inch	DI	250

Fittings shall be coated outside with petroleum asphaltic coating, 1 mil minimum thickness.

Fittings shall be lined as specified herein headed "4.02 Pipe."

Anchor couplings equal to McWayne Clow F-1211 for fire hydrant assemblies may be substituted with an anchoring tee equal to Catalog No. A-10180 locked hydrant tee as manufactured by American Ductile Iron Pipe Co. or hydrant tee with rotatable MJ gland as manufactured by U.S. Pipe Co. in place of the MJ tee and anchor coupling as shown, at the Contractor's option.

4.04 JOINTS - BURIED PIPE AND FITTINGS

Joints for ductile iron pipe and fittings shall conform to ANSI/AWWA C111, except as otherwise specified. All pipe and fittings shall be furnished complete with joint accessories necessary for installation conforming to ANSI/AWWA C111. No additional payment will be made for joint accessories, including retainer glands, unless otherwise specified.

The Contractor shall furnish and install all necessary materials, equipment, and appurtenances required to complete the work.

- A. **Unrestrained Joints:** Joints for unrestrained pipe shall be push-on joint. Joints for fittings, when installed with unrestrained pipe, shall be mechanical joint with DI retainer glands, as specified herein for restrained joints.
- B. **Restrained Joints:** All joints in restrained pipe systems shall be of the same type (pipe and fittings), except valves shall be mechanical joint with DI retainer glands as specified.
 - 1. **12-inch and Smaller:** Joints for restrained pipe and fittings, 12-inch and smaller, shall be one of the following:
 - a. Push-on restrained joint utilizing a retainer ring, equal to U.S. Pipe TR Flex. It shall be UL listed, FM approved, or shall be certified by an approved laboratory that the restrained joint will not separate at the specified test pressure.
 - b. Push-on restrained joint using a locking type gasket, equal to Field-Lok, as manufactured by U.S. Pipe and Foundry, Inc. It shall be UL listed, FM approved, or shall be certified by an approved laboratory that the restrained joint will not separate at the specified test pressure.
 - c. Mechanical joint with DI retainer glands shall be furnished with retainer glands equal to Series 1100 Megalug, as manufactured by EBAA Iron Inc., Stargrip 3000 as manufactured by Star Pipe Products, or DI MJ Gripper Gland as manufactured by U.S. Pipe and Foundry Co. for use with ductile iron pipe. All retainer glands shall be UL listed, FM approved, or shall be certified for 350 psi pressure rating with a 2:1 safety factor.
 - 2. **Larger than 12-inch:** Joints for restrained pipe and fittings larger than 12-inch shall be as follows:
 - a. Restrained pipe joints shall be modified push-on restrained joint, equal to U.S. Pipe TR Flex, and shall be UL listed or FM approved.
 - b. Fittings joints shall be equal to U.S. Pipe TR Flex or shall be mechanical joint with DI retainer glands. Retainer glands shall be equal to Series 1100 Megalug or Stargrip

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3000 for 16-inch and larger pipe. All retainer glands shall be UL listed, FM approved, or certified for 350 psi pressure rating (for 16-inch) and 250 psi pressure rating (for larger than 16-inch) with a 2:1 safety factor.

- c. Valve joints shall be mechanical joint with DI retainer glands as specified herein for larger than 12-inch fittings joints.

4.05 JOINTS - EXPOSED PIPE AND FITTINGS

Joints for exposed ductile iron pipe and fittings shall be restrained, except as otherwise noted on the Plans. Joints for exposed pipe in plants and in vaults shall be flanged where noted on the Plans.

Joints for exposed pipe and fittings 12-inch and smaller shall be modified push-on restrained joint using a retainer ring, or modified push-on joint using a locking type gasket, as specified herein headed "4.04 Joints - Buried Pipe and Fittings."

Joints for exposed pipe and fittings larger than 12-inch shall be modified push-on restrained joint using a retainer ring as specified herein headed "4.04 Joints - Buried Pipe and Fittings."

SECTION 5 - PIPING MATERIALS: PVC PRESSURE PIPE

5.01 GENERAL

The Work in this section includes furnishing all Polyvinyl Chloride (PVC) pressure pipe and fittings. PVC pressure pipe includes all PVC pressure pipe 2-inch through 36-inch.

Standards referenced in this Section are the latest revision of the following specifications:

ANSI/AWWA C900	"Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4-Inch through 12-Inch, for Water Distribution"
ANSI/AWWA C905	"Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings 14-Inch through 48-Inch, for Water Transmission and Distribution"
ANSI/AWWA C110	"Ductile-Iron and Gray-Iron Fittings, 3-Inch through 48-Inch for Water"
ANSI/AWWA C111	"Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings"
ANSI/AWWA C153	"Ductile-Iron and Gray-Iron Fittings, 3-Inch through 48-Inch for Water"
ASTM D 1784	"Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds"
ASTM D 1785	"Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120"
ASTM D 2241	"Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)"
ASTM D 3139	"Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals"

5.02 PIPE

- A. **Two-inch Pipes:** All 2-inch PVC pipe shall meet ASTM D 1784 specification for rigid PVC compounds and ASTM D 2241 specification for PVC plastic pipe. PVC pipe shall be suitable for use at maximum hydrostatic working pressure of 160 psi at 73°F. Pipe shall have a standard dimension ratio (SDR) 26 and bear the NSF Seal for potable water pipe.
- B. **Four-inch Through 12-inch Pipes:** PVC pressure pipe 4-inch through 12-inch shall meet the requirements of ANSI/AWWA C900, with outside diameter dimensions of ductile iron pipe. All 4-inch through 12-inch PVC pressure pipe shall be Class 150 and DR18 with a pressure rating of 188 psi.

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- C. **14-inch Through 36-inch Pipes:** PVC pressure pipe 14-inch through 36-inch shall meet the requirements of ANSI/AWWA C905, with outside diameter dimensions of ductile iron pipe. All 14-inch through 36-inch PVC pressure pipe shall be Class 100 and DR25 with a pressure rating of 133 psi.
- D. **UV Resistant PVC Pipe:** All PVC piping exposed to sunlight shall contain titanium dioxide for UV resistance, and shall conform to ASTM D 1784 and ASTM D 1785 (IPS). The Contractor shall submit the manufacturer's certificate of conformance to the City. Pipe shall be marked with manufacturer's identification.

5.03 FITTINGS

- A. **Two-inch Pipes:** Gasketed joint standard dimension ratio (SDR) 21 PVC or galvanized steel fittings shall be used with all 2-inch PVC pipe. PVC adapters, Harco as manufactured by the Harrington Corporation or approved equal, shall be used for jointing to 2-inch gate valves, galvanized fittings, and existing threaded pipe.
- B. **Four-inch Through 36-inch Pipes**
 - 1. **Molded PVC Pressure Fittings:** Fittings for 4-inch through 8-inch sanitary sewer pressure pipe shall be molded PVC pressure fittings, unless DI fittings are directed by the Engineer. Molded PVC fittings shall meet the requirements of ANSI/AWWA C900, and shall be Harco Class 150 as manufactured by the Harrington Corporation, or approved equal, as directed by the Engineer.
 - 2. **DI Fittings:** Fittings for pipe larger than 8-inch shall be DI. DI fittings for 4-inch through 36-inch PVC pressure pipe shall conform to ANSI/AWWA C110 or C153 and shall conform to the Technical Specifications section headed "Piping Materials: Ductile Iron Pipe."
- C. Where flanged fittings are shown, specified, or directed by the Engineer, adapter flanges shall be used on plain end PVC pipe. Adapter flanges shall be suitable for PVC pipe and be equal to Uni-Flange Series 900 as manufactured by Ford/Uni-Flange, Wabash, Indiana.

5.04 JOINTS

Pipe joints shall be plain end, rubber gasket push-on joints, unless otherwise shown. Push-on joints shall meet the requirements of ASTM D 3139.

Joints to DI fittings shall be rubber gasket mechanical joints with retainer glands, unless otherwise shown. All retainer glands shall be UL listed or FM approved. The retainer glands shall be installed in accordance with the manufacturer's recommendations.

Mechanical joints shall meet the requirements of ANSI/AWWA C111.

5.05 MARKINGS AND COLOR CODING

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In addition to the standard markings required by ANSI/AWWA C900 and C905, the letters NSF denoting National Sanitation Foundation approval shall be included in the marking system, on each pipe length and fitting.

PVC pipe shall be manufactured of solid color as specified, or white with continuous colored ink lettering. The applicable color codes, with light color stabilant, are as follows:

Pipe Use	Color Coding
Potable Water	Safety Blue
Sanitary Sewer	Safety Green
Reclaimed Water	Safety Purple

UV resistant PVC pipe shall be solid color as specified above, or white with colored lettering as specified above.

5.06 HARNESSING

Ductile iron fittings with mechanical joints used with PVC pipe that require harnessing, shall be provided with ductile iron retainer glands such as Series 2000 PV Megalug as manufactured by EBAA Iron Inc., Stargrip 4000 as manufactured by Star Pipe Products, or approved equal.

PVC push-on joints for pipe in casings, for joints to PVC pressure fittings, or where shown, shall be harnessed using a ductile iron retainer for push-on joint PVC pipe, such as Series 1600 as manufactured by EBAA Iron Inc. , Series 1100 as manufactured by Star Pipe Products, or approved equal.

END OF SECTION

SECTION 6 - SANITARY SEWER CONSTRUCTION

6.01 GENERAL

The Work in this section includes construction of sanitary sewer gravity pipes, force mains, manholes, and appurtenances.

Sanitary Sewers are to be constructed at locations indicated on the Plans. The City reserves the right, however, to make minor changes in grade and/or alignment as the Work progresses.

All Work shall be fully completed within the established limits as outlined for the various Pay Items listed in the Proposal. It is not the intent of the City to allow additional compensation for obstructions, interferences, or similar contingencies on this Project.

All force main pipe and fittings shall be furnished and installed in accordance with the applicable requirements of the Technical Specifications sections headed "Piping Materials: Ductile Iron Pipe," "Piping Materials: PVC Pressure Pipe," and "Pressure Pipe Construction."

At the ends of the sections where adjoining pipelines have not been completed and are not ready to connect, temporary bulkheads or plugs (as specified herein) approved by the Engineer shall be installed. All such bulkheads or plugs shall be removed when they are no longer needed or when ordered by the Engineer.

All pipelines shall be tested and closed circuit television video (CCTV) inspected. Any leak or defect shall be repaired and re-televised. Tests shall be conducted in accordance with these Specifications.

PVC pipe for gravity sewers shall be tested for allowable deflection. Tests shall be conducted in accordance with the requirements of these Specifications.

Connections between dissimilar gravity pipe materials or diameters shall be made as specified herein.

Connections between pressure pipes shall be made with solid sleeves as specified herein.

The ends of all new sanitary laterals shall be marked by witness posts or protruding galvanized pipe, as directed by the Engineer. Witness posts shall be 4-inch diameter PVC pipe filled with concrete; 4 to 5 feet of the pipe shall be exposed and wrapped with green tape. The 1-inch diameter galvanized pipe shall protrude 1 inch above grade.

The following Standards are referenced in this section:

- | | |
|------------|--------------------------------------------------------------------------------------------------------|
| ASTM C 12 | "Practice for Installing Vitrified Clay Pipe Lines" |
| ASTM C 76 | "Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe" |
| ASTM C 443 | "Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets" |
| ASTM C 478 | "Standard Specification for Precast Reinforced Concrete Manhole Sections" |

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ASTM C 1107	"Standard Specification for Packaged Dry, Hydraulic-Cement Grout (NonShrink)"
ASTM D 2321	"Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications"
ASTM D 3034	"Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings"
ASTM D 3753	"Standard Specification for Glass-Fiber-Reinforced Polyester Manholes"
ASTM F 477	"Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe"
ASTM F 679	"Standard Specification for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings"
UNI-B-6-98	"Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe" Uni-Bell Plastic Pipe Association, Dallas, Texas

6.02 DATA TO BE SUBMITTED

The Contractor shall submit shop drawings in accordance with the General Conditions, Article 36, for the following materials:

- Piping materials
- Fittings and couplings
- Grouting rings
- Pipe-to-manhole connectors
- Precast manholes
- Fiberglass manholes
- Castings
- Wall sleeves
- Special construction methods
- Interior cementitious coating (including applicator's certification from manufacturer)

6.03 MATERIALS

All materials shall be furnished by the Contractor, unless otherwise noted on the Plans. All materials shall be new and of the best quality available. Materials not specifically specified shall confirm to applicable provisions of the DOT-SSRBC.

A. **Piping Materials:** Sanitary sewer pipe shall either be green in color or shall be white with continuous colored green ink lettering or shall be continuously painted green along the top 1/3 of the pipe with 2-part high-build epoxy-polyamide paint. All sanitary sewers shall be installed accompanied by green-colored metallic identification tape laid 1 foot above the pipe, cut every 10 feet.

1. Ductile iron pipe and fittings for force mains or gravity sewers shall conform to the Technical Specifications section headed "Piping Materials: Ductile Iron Pipe."
2. PVC gravity sewer pipe and fittings 4-inch through 15-inch, intended for non-pressure service, shall comply with ASTM D 3034, Type PSM, with a dimension ratio of 35 and a minimum stiffness of 46 psi; or, at the direction of the Engineer, pipe with a dimension ratio of 26 and a minimum pipe stiffness of 115 psi shall be used. Joints and gaskets shall comply with ASTM F 477. PVC fittings for use on 4-inch through 15-inch PVC pipe shall be Harco Gasketed PVC Sewer Fittings as manufactured by Harrington Corp. or approved equal.

PVC gravity sewer pipe and fittings 18-inch through 27-inch, intended for non-pressure service, shall comply with ASTM F 679, with T-1 wall thickness and a minimum pipe stiffness of 46 psi. Joints and gaskets shall comply with ASTM F 477.

3. PVC pressure pipe and fittings for force mains or gravity sewers shall conform to the Technical Specifications section headed "Piping Materials: PVC Pressure Pipe." Fittings shall be PVC or ductile iron as specified, as directed by the Engineer.
4. High Density Polyethylene (HDPE) pressure pipe for force mains shall conform to the Technical Specifications section headed "Piping Materials: HDPE Pressure Pipe."

B. Other Materials

1. Castings for manholes and cleanouts shall be cast iron of the sizes, shapes, and catalog references shown on the Plans. Where no reference is made on the Plans, castings shall be equivalent in quality to those manufactured by U.S. Foundry. Unless otherwise noted, all castings shall be designed for an HS-20 truck loading. Castings shall be marked "Sanitary Sewer."
2. Concrete, reinforcing, and masonry for precast, cast-in-place, or site assembled manholes and structures shall conform to the Technical Specifications section headed "Concrete, Masonry, and Reinforcing Steel."
3. Precast manholes shall be manufactured as specified herein and in accordance with the sizes and details shown on the Plans, and with the approved shop drawings.
4. Fiberglass Reinforced Polyester (FRP) manholes shall be manufactured in accordance with ASTM D 3753, the sizes and details shown on the Plans, and the approved shop drawings.

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6.04 CONNECTIONS TO EXISTING SANITARY SEWERS

The Contractor shall connect new sanitary sewers to existing sanitary sewers as shown on the Plans and as specified.

All connections to existing sanitary sewers shall be by Flex-Seal Adjustable Repair Coupling Series MR-ARC with Series 316 stainless steel shear rings as manufactured by Mission Rubber Company or approved equal. All couplings shall be centered between pipe ends and shall be tightened at both ends by Series 316 stainless steel clamps or approved equal.

The Engineer shall be notified at least 2 working days prior to making final connections. The time at which the connections are to be made shall be subject to approval by the Engineer.

6.05 CONSTRUCTION OPERATIONS

Pipes shall be laid in open cut, except when another method, such as jacking, augering, directional drilling, or tunneling, is shown on the Plans, specified, or ordered.

- A. No excavations shall be left open over a weekend. All pavement openings shall be completely repaired within 7 days of opening.
- B. Sanitary sewers may be constructed in short tunnels to protect trees, shrubs, and existing surface or subsurface utilities and structures. Short tunnels shall be constructed to the lengths shown on the Plans, specified, or directed by the Engineer. No separate payment will be made for short tunnels.
- C. Temporary fences, where required, shall be "wood and wire fence" or other suitable fencing as approved by the Engineer.
- D. In the course of the Work, it will be necessary to install the sanitary sewer under or closely adjacent to existing culverts and other storm and water main facilities. Where so indicated on the Plans, the Contractor shall remove storm drains to permit construction of the sanitary sewer and shall then reconstruct the storm drain. Where removal and reconstruction are not indicated on the Plans, the Contractor shall protect all existing storm and water main facilities which are shown on the Plans or located in the field during the course of the Work.
- E. Sewers crossing water mains may be required to be constructed of ductile iron pipe, PVC pressure pipe, or heavy wall PVC pipe (SDR 26) as ordered by the Engineer, to conform to DEP and Pinellas County Public Health Unit requirements.

Sanitary sewers and service laterals which cross under the new water pipe with less than 18 inches clear vertical separation, or which cross over the new water pipe, shall be replaced with ductile iron pipe or PVC pressure pipe, or heavy wall PVC pipe (SDR 26) for 10 feet on both sides of the new water main, or as directed by the Engineer.

- F. All ground surfaces disturbed by the Contractor shall be restored to their original condition in conformance to the Technical Specifications section headed "Surface Restoration."

- G. Sanitary sewers shall not be cut or pumped around without an approved sanitary sewer pump-around plan and submittal of same, a minimum of 72 hours prior to implementation, to the Water Resources Department Dispatch, 893-7261. The pump-around plan shall include size of pipes and pumps, and discharge location.

6.06 LAYING AND JOINTING PIPELINES

- A. Ductile iron pipelines, PVC pressure pipelines, and HDPE pressure pipelines for force mains shall be laid and jointed as specified in the Technical Specifications section headed "Pressure Pipe Construction." Retainer glands used for PVC force mains shall be UL listed or FM approved and shall have factory certification for pressures up to 188 psi.
- B. PVC, concrete, and FRPMP gravity pipelines shall be laid in conformance to applicable requirements of ASTM C 12 for concrete pipe, ASTM D 2321 for PVC pipe, and ASTM D 3262 and D 4161 for FRPMP.
- C. **Line and Grade:** Sewers shall be laid to exact line and grade using approved methods consistent with common practice and approved by the Engineer. All line and grade controls shall be furnished by the Contractor.
- D. **Pipe:** Before the pipe is jointed in the trench, the outside of the spigot end and the inside of the bell shall be thoroughly cleaned, wiped, and brushed out to ensure that no dirt or foreign material gets into the finished line. Each pipe shall be inspected for defects and cracks prior to being lowered into the trench. Any cracked or otherwise rejected pipe shall be immediately removed from the site. All pipeline work must be performed in the presence of the Engineer. When work is not in progress, water shall be kept out of the pipe, and the pipe shall be kept closed by means of a test plug.
- E. **Service Connections:** Service lateral connections shall conform to the Details and shall be installed as indicated or as directed by the Engineer. The Contractor shall locate and record the exact position of such service lateral connections and include actual data on the As-Built Drawings to be furnished to the City.
- F. **Watertight Plugs:** Watertight plugs of an approved type shall be installed in the ends of all pipe at times when pipe laying is not in progress or as ordered to prevent any contaminated material or vermin from entering the pipe.
- G. Excavation and backfilling shall conform to the Technical Specifications section headed "Excavation and Backfill."

6.07 MANHOLE CONSTRUCTION

- A. **Brick Manholes:** Brick manholes shall be constructed in accordance with the details shown on the Plans and these Specifications. Twenty-four hours shall elapse between the pouring of the slab and the beginning of laying the brick work.
 - 1. **Base Slabs:** Bases shall be cast in place on a level, compacted trench bottom.
 - 2. **Mortar:** Brick shall be laid in mortar that has been machine mixed for a minimum of 1.5 minutes before water is added, and then mixed until a homogeneous mixture is obtained.

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Mortar of improper consistency and/or partly set shall not be used in the Work. The brick shall be laid with 3/8-inch nominal mortar joint, and care shall be taken to produce true and smooth alignments, particularly for the inside surfaces.

3. **Brick:** Clay brick shall be as specified in the Technical Specifications section headed "Concrete, Masonry, and Reinforcing Steel."
 4. **Exterior and Interior Brick Surface:** Exterior and interior brick surface of manholes shall be given a 3/4-inch application of cement plaster. This plaster shall be the same type mix as the mortar in which the bricks are laid, and it shall be applied in 2 applications. Any visible seepage through the manhole walls shall be corrected by the Contractor.
 5. **Inverts:** Inverts shall be formed using poured-in-place concrete conforming to the Technical Specifications section headed "Concrete, Masonry, and Reinforcing Steel" and shall have a minimum strength of 2,500 psi. Invert pipe (stub out) shall not extend more than 6 inches outside manhole walls (as measured to back of bell), and shall be grouted with the same mortar used for making mortar joints.
 6. **Exterior Epoxy Coating:** A protective coal tar epoxy coating of Carboline (formerly Kop-Coat) Bitumastic 300-M, or approved equal, shall be applied to the exterior surfaces of manholes. One coat shall be applied to the outside and shall yield a final dry film thickness of 9 mils.
 7. **Interior Cementitious Coating:** A dense and durable concrete lining of 100 percent pure fused calcium-aluminate cementitious lining of SewperCoat PG as manufactured by Lafarge Calcium Aluminates, shall be applied in accordance with manufacturer's recommendations, to all interior surfaces of manholes including walls, benches, flow channels, and inverts. Lining shall have a final minimum thickness of 1/2 inch.
 8. **Manhole Wall Penetrations:** New brick manholes shall have a grouting ring. New wall penetrations and repair penetrations, for connections to existing manholes, shall be core-drilled and a grouting ring shall be installed. Grouting ring shall be WS Series Waterstop Grouting Ring as manufactured by Press-Seal Gasket Corporation or Engineer approved equal. Installation shall be in accordance with manufacturer's recommendations. Non-shrink grout shall comply with ASTM C 1107. Material shall be 1107 Advantage Grout manufactured by Dayton Superior, Burke Multi-purpose Grout as manufactured by Burke Company, or approved equal.
- B. **Precast Concrete Manholes:** Precast manholes shall be constructed in accordance with the details shown on the Plans. Full shop drawing information including design, materials, fabrication details, and installation methods of the proposed precast manholes shall be submitted to the Engineer as specified.
1. **Base Slabs:** Base slabs for precast manholes 48-inch in diameter shall have a minimum thickness of 8 inches as detailed on the Plans. The diameter of the base slab shall be as detailed on the Plans. Reinforcement shall be placed with 2 inches of concrete cover over the top row of steel. Base slabs for precast manholes shall be cast with the lower manhole section and placed on a level, compacted trench bottom.
 2. **Riser Sections:** Riser sections, grade rings, and tops shall comply with ASTM C 478 with the exception that Article No. 11 shall be deleted. Base riser sections shall be provided with

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preformed pipe holes to fit the connectors. The tops of pipe holes shall not be within 4 inches of the bell or socket portion of the riser.

3. **Riser Joints:** Riser joint shall conform to ASTM C 443, to the manufacturer's recommendations and as shown on the Plans. Riser shall be jointed with rubber, plastic, or preformed bituminous joint sealing compound equal to Ram-Nek as manufactured by K.T. Snyder.
 4. **Manhole Sizes:** Manhole sizes up to 10 feet in depth (invert to bottom of brick adjustment ring) shall be a minimum of 48-inch inside diameter for 18-inch diameter and smaller pipe. Manholes over 10 feet in depth shall be the specified diameter for a minimum of 6 feet above the manhole invert; the remaining portion may, at the Contractor's option, be reduced to 48-inch diameter. In no case shall the manhole diameter be less than that required to adequately enclose the sewer pipe.
 5. **Tops:** Tops shall have a minimum opening 24 inches in diameter for pipes 18-inch and smaller and 32-inch minimum for pipes 21-inch and larger, with an 8-inch wide flange at the top. For Type I manholes, only concentric cones are acceptable.
 6. **Top Grades:** Top grades of precast manholes shall be established so that a minimum of 3, but no more than 6, courses of brick are placed under the ring and cover casting.
 7. **Inverts:** Inverts shall be formed using poured-in-place concrete conforming to the Technical Specifications section headed "Concrete, Masonry and Reinforcing Steel" and shall have a minimum strength of 2500 psi.
 8. **Drop Inlets:** Drop inlets shall be provided where directed by the Engineer or shown on the Plans, and such drop inlets shall conform to details shown on the Plans.
 9. **Exterior Epoxy Coating:** Coating shall be applied to the outside surfaces of precast manholes as specified for brick manholes.
 10. **Interior Cementitious Coating:** Coating shall be applied to the inside surfaces of precast manholes as specified for brick manholes.
 11. **Manhole Wall Penetrations:** Manhole wall penetrations for precast manholes shall be as specified for brick manholes.
 12. **Pipe-to-Manhole Connections (for New Precast):** Pipe-to-manhole connections shall be made with a flexible watertight connector such as Kwik Seal or PSX: Positive Seal as manufactured by Press-Seal Gasket Corporation, or Kor-N-Seal I connectors for pipe sizes up to 15-inch and Kor-N-Seal II connectors for pipe sizes 15-inch through 30-inch as manufactured by NPC Inc. Pipe-to-manhole connection shall be installed by the precaster for new manholes, unless specified otherwise.
- C. **Fiberglass Reinforced Polyester (FRP) Manholes:** The construction of FRP manholes shall conform to the details on the Plans. Full shop drawing information including design, materials, fabrication details, and installation methods of the proposed fiberglass manholes shall be submitted to the Engineer as specified.

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FRP manhole shall be a one piece unit consisting of a watertight base and corbel section with a concentric cone, as manufactured by LF Manufacturing, Containment Solutions, or an approved equal.

A minimum wall thickness of 1/2 inch shall be maintained. All manholes shall have a U/V inhibitor that is homogeneous with the resin mixture.

All FRP manholes shall have a minimum 20 year manufacturer's warranty against corrosion and structural defects.

All FRP manholes shall have a minimum AASHTO HS-20 axle loading.

1. **Base Slabs:** FRP manhole base slabs shall be precast or cast-in-place concrete and shall conform to the thickness specified in the details on the Plans. Cast-in-place concrete base slab reinforcement shall be placed with 3 inches of concrete cover in accordance with the Technical Specifications section headed "Concrete, Masonry, and Reinforcing Steel."

Cast-in-place base slabs for FRP manholes shall be cast in place on a level, compacted bottom.

2. **Watertight Bottom:** The FRP manhole shall have a resin fiber-reinforced bottom and a 3-inch-wide anti-floatation flange as a homogeneous part of the bottom section. The manhole bottom shall be a minimum 1/2-inch thick.

For FRP manhole depths greater than 10 feet, the manufacturer shall install a minimum of two 1 and 1/2-inch-deep by 3 and 1/2-inch-wide stiffening ribs. Stiffening ribs shall be completely enclosed with resin fiber-reinforcement.

3. **Anchors and Washers:** FRP manholes shall be anchored to the cast-in-place concrete base slab with 316 stainless steel Kwik Bolt II Wedge anchors and washers as manufactured by Hilti, or approved equal. The size, number of anchors, and embedment depth shall be as shown on the Plans. The anchors shall be installed a minimum of 1 and 1/2 inches from the outer edge of the anchoring flange and shall be equally spaced around the circumference of the manhole bottom.
4. **Manhole Height:** No fiberglass manhole shall have less than 4 feet clear inside height (measured from invert of bench to finished grade.)
5. **Inverts:** Inverts shall be as shown on the Plans.

A concrete invert may be formed in the field using poured-in-place concrete conforming to the Technical Specifications section headed "Concrete, Masonry, and Reinforcing Steel" and shall have a minimum strength of 2,500 psi.

6. **Stub Outs:** FRP stubouts shall be installed as shown on the Plans or directed by the Engineer, in accordance with approved shop drawings.

Pipe-to-manhole connectors for new manholes shall be installed by the FRP manhole manufacturer, unless specified otherwise. Connections for 4-inch through 15-inch pipe shall be made with an Inserta Tee boot as manufactured by Inserta Fittings, or Kor N Seal boot as manufactured by NPC Inc., or approved equal, and laminated sleeve, as shown in the details

on the Plans. Connections of PVC sewer pipe, and connections 18-inch and larger, shall be with a Link-Seal connector and laminated sleeve as manufactured by Thunderline Corp., or Kor N Seal II Connector, or approved equal. Installation of PVC sewer pipe must be performed by sanding, priming, and using resin fiber-reinforced hand layup, by a manufacturer's certified representative or a Contractor-certified person.

Laminated sleeves shall be formed using resin and fiberglass of same type and grade as used in the fabrication of the fiberglass manhole. Laminated sleeves may be factory installed or field installed. Field installation shall be by a manufacturer's certified representative or a Contractor-certified person.

All holes cut into the FRP manhole shall be by core methods recommended by the manhole manufacturer. A minimum of 12-inch clear wall between cutouts shall be maintained in all directions for each cored hole.

6.08 TESTING OF SEWER PIPELINES

A. Pressure Pipelines

Pressure sanitary sewer pipelines shall be tested in accordance with the applicable requirements of the Technical Specifications section headed "Pressure Pipe Construction." Pressure sanitary sewer pipelines shall not be disinfected.

B. Gravity Pipelines

1. Gravity pipelines shall be tested for infiltration, exfiltration, deflection, or low pressure air test, at the Engineer's direction. The Contractor shall provide a closed circuit television video camera inspection, in the presence of the City (or engineer) for all sanitary sewer pipe repairs and all new sanitary sewer construction. The video tape, CD, or DVD shall include time and date, footage, and audio describing any pipe abnormality; also, a CCTV inspection log shall be provided with each completed inspection. Any sewer pipeline found to be unacceptable by the Engineer shall be corrected, repaired, or replaced as directed by the Engineer, at no additional cost to the City.
2. **Infiltration Test:** Upon completion of a section of sewer line, a test for infiltration shall be conducted as directed by the City Inspector. Dewatering of the line to be tested shall terminate at least 2 days prior to the infiltration test. The maximum infiltration allowed in a 24-hour period shall not exceed 200 gallons per inch of diameter per mile of sewer from any section between successive manholes. If the infiltration exceeds the allowable limits, the line shall be further checked and repaired by the Contractor until the infiltration requirements have been met. If any particular location indicates concentrated infiltration, such location shall be investigated and corrected regardless of the overall infiltration requirement.

Groundwater level measuring pipes shall be installed at manholes. The groundwater level shall be measured prior to testing. If the groundwater level is at least 2 feet above the highest section of the work being tested, infiltration methods of measurement shall be used. If there is insufficient groundwater head to perform infiltration testing, exfiltration tests will be made.

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3. **Exfiltration Test:** If, in the opinion of the City Inspector, the position of a sewer line is above the normal groundwater table, the Engineer may direct the Contractor to perform an exfiltration test. The maximum allowable exfiltration during a 24-hour period shall not exceed 200 gallons per inch of diameter per mile of sewer from any section between successive manholes. An allowance of an additional 10 percent of gallonage shall be permitted for each additional 2 feet of head over a basic 2-foot minimum internal head.

The exfiltration test shall be performed by plugging the upstream and downstream manholes of the test section, filling the line with water, and maintaining a minimum of 2 feet head of water in the section of line being tested. The rate of exfiltration shall be calculated from the water level drop in the upstream manhole during the 24-hour test period.

4. **Low pressure air test:** At the direction of the City Inspector or Engineer, each pipeline reach may alternatively be tested with air pressure (minimum 3.5 psi, maximum 5 psi) in accordance with UNI-BELL UNI-B-6-98 "Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe." The system passes the test if the pressure drop due to leakage through the pipe or pipe joints is less than or equal to 0.5 psig over the time period described below.

Minimum time period for a 0.5 psig pressure drop

The time period for the test shall be calculated from UNI-B-6-98 as follows:

- T = 28.33 DK,
T = Shortest time, in seconds allowed for the air pressure to drop 0.5 psig,
K = .000419 DL, but not less than 1.0,
D = Nominal pipe diameter in inches, and
L = Length of pipe being tested in feet.

5. **Deflection Test:** Prior to final acceptance of the Project, all PVC pipelines shall be deflection tested. The Contractor or a City-approved test lab shall perform the deflection testing at the expense of the Contractor. The deflection test shall be performed a minimum of 7 days after the base has been compacted and sealed.

The PVC pipe/soil system has been designed so that the maximum installed deflection does not exceed 5 percent and 7.5 percent of the base inside diameter of the pipe as listed in the following table:

<u>Nominal Size</u> (inches)	<u>Base Inside Diameter</u> (inches)	<u>5% Deflection After 7 Days Mandrel</u> (inches)	<u>7.5% Deflection after 30 Days Mandrel</u> (inches)
ASTM D 3034 SDR-35			
8	7.665	7.28	7.09
10	9.563	9.08	8.85
12	11.361	10.79	10.51
15	13.898	13.20	12.86
ASTM F 679 TYPE T-1			
18	16.976	16.13	15.70
21	20.004	19.01	18.50
24	22.480	21.36	20.79
27	25.327	24.06	23.43

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ASTM D 3034 SDR-26

8	7.488	7.11	6.93
10	9.342	8.87	8.64
12	11.102	10.55	10.27
15	13.575	12.90	12.56

ASTM F 679 TYPE T-2

18	17.054	16.20	15.77
21	20.098	19.09	18.59
24	22.586	21.46	20.89
27	25.446	24.17	23.54

The Contractor shall have the option of testing for 5 percent deflection after the base has been compacted and sealed for 7 days; or for 7 and 1/2 percent deflection after the base has been compacted and sealed for 30 days.

If the pipe fails the 7-day, 5 percent deflection test, the Contractor shall immediately conduct a 7 and 1/2 percent deflection test. If the pipe passes the 7 and 1/2 percent deflection test, the Contractor has the option of repairing that section at that time or waiting until a minimum of 30 days after the base has been compacted and sealed and then re-testing for a maximum of 7 and 1/2 percent deflection.

If the pipe fails the 7 and 1/2 percent deflection test after 7 days or at 30 days, the Contractor shall repair that section immediately.

If the Contractor performs the deflection testing rather than employing a City-approved test lab, the following shall apply:

- a. The Contractor shall furnish the mandrel, labor, materials, and equipment necessary to perform the tests as approved by the Engineer. The mandrel shall be pulled through by hand or a hand operated reel in the presence of the Engineer. Prior to performing the deflection tests, the Contractor shall submit to the Engineer certification that the 9-arm mandrels are preset as stated above. Each mandrel shall be engraved with the following:
 - Serial Number
 - Nominal Pipe Diameter
 - Either "ASTM D 3034," year and either "SDR-35" or SDR-26" or "ASTM F 679," year and either "Type T-1" or Type T-2"
 - Percent deflection as stated above
- b. If the mandrel fails to pass any section of pipe, the Contractor shall excavate and make all repairs (section replacements) necessary to correct the excessive deflection. The Contractor shall then backfill, recompact, reseal the permanent pavement base, and retest the line. If the mandrel fails to pass a second time, the affected section shall be replaced. Re-rounding shall not be permitted.

END OF SECTION

SECTION 7 - PRESSURE PIPE CONSTRUCTION

7.01 GENERAL

The Work in this section includes construction of potable water mains, reclaimed water mains, sanitary force mains, and appurtenances.

Pressure pipelines are to be constructed at locations shown on the Plans. The City reserves the right to make minor changes in grade and/or alignments as the Work progresses.

Piping materials for pressure pipe installations shall be as follows:

Potable Water Main

PVC Pipe	2-inch	
DI Pipe	6-inch and larger	
HDPE Pipe	2-inch and larger	ASTM D3350 meeting PE 3408 code designation
Galvanized Pipe	2-inch blow-off assemblies, 2-inch connections, 2-inch short tunneling, and 2-inch short relocations	
Fittings	2-inch PVC pipe: 2-inch galvanized pipe: 6-inch and larger pipe:	PVC with gasketed joint Galvanized steel with threaded joint Ductile Iron (DI) with push-on or mechanical joint

Sanitary Force Main

PVC Pipe	4-inch through 12-inch: 14-inch through 36-inch:	ANSI/AWWA C900 ANSI/AWWA C905
DI Pipe	14-inch and larger pipe:	ANSI/AWWA C151
HDPE Pipe	2-inch and larger	ASTM D3350 meeting PE 3408 code designation
PVC Fittings	4-inch through 12-inch pipe: 14-inch through 36-inch pipe:	DI with push-on or mechanical joint DI with push-on or mechanical joint
DI Fittings	4-inch and larger pipe:	DI with push-on or mechanical joint
HDPE Fittings	2-inch and larger pipe:	ASTM D3350 meeting PE 3408 code designation or DI with HDPE mechanical joint adapter

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All existing water services shall be kept in service during the construction of water mains and the preparation of new service connections. Water meters requiring disconnection by the Contractor to accomplish the Work shall be promptly restored to service by the Contractor. The Contractor shall give a minimum of 24 hours prior written notice to all affected water customers of the intended service interruption.

All pipe, fittings, and appurtenances shall be furnished by the Contractor and be transported, delivered, and installed by the Contractor in accordance with the requirements of the subsection headed "Laying and Jointing Pipelines."

All pipelines shall be tested in accordance with the requirements of the subsection headed "Testing and Disinfection of Pressure Pipelines: Pressure Test."

All potable water and reclaimed water pipelines shall be disinfected before they are put into service as specified in the subsection headed "Testing and Disinfection of Pressure Pipelines: Disinfection."

As-built drawings shall be submitted to the Engineer prior to acceptance of the Work and prior to commencement of the warranty period.

Standards referenced in this Section are the latest revision of the following specifications:

ANSI/AWWA C105	"Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids"
ANSI/AWWA C110	"Ductile-Iron and Gray-Iron Fittings, 3-Inch through 48-Inch"
ANSI/AWWA C111	"Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings"
ANSI/AWWA C504	"Rubber-Seated Butterfly Valves"
ANSI/AWWA C509	"Resilient-Seated Gate Valves for Water and Sewerage Systems"
ANSI/AWWA C515	"Reduced Wall, Resilient-Seated Gate Valves for Water Supply Service"
ANSI/AWWA C550	"Protective Epoxy Interior Coating for Valves and Hydrants"
ANSI/AWWA C600	"Installation of Ductile-Iron Water Mains and Their Appurtenances"
ANSI/AWWA C605	"Underground Installation of PVC Pressure Pipe and Fittings for Water"
ANSI/AWWA C651	"Disinfecting Water Mains"
ANSI/AWWA C800	"Underground Service Line Valves and Fittings"
ANSI/AWWA C900	"Polyvinyl Chloride (PVC) Pressure Pipe, 4-Inch through 12-Inch, for Water Distribution"
ANSI/AWWA C901	"Polyethylene (PE) Pressure Pipe and Tubing, 1/2-Inch through 3-Inch"

	for Water Service"
ANSI/AWWA C905	"Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings 14-Inch through 48-Inch, for Water"
ANSI/AWWA C906	"Polyvinyl Chloride (PVC) Pressure Pipe and Fittings 4-Inch through 63-Inch, for Water Distribution and Transmission"
ANSI/AWWA C901	"Polyethylene (PE) Pressure Pipe and Tubing, 1/2-Inch through 3-Inch for Water Service"
ASTM A 126	"Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings"
ASTM D 429	"Test Methods for Rubber Property - Adhesion to Rigid Substrates"
ASTM D 3139	"Standard Specification for Joints for Plastic Pressure Pipes using Flexible Elastomeric Seals"

7.02 DATA TO BE SUBMITTED

The Contractor shall submit shop drawings in accordance with the *General Conditions* Article headed "Shop Drawings and Submittals."

- Pipe
- Valves
- Joints and joint accessories
- Fittings
- Specials and accessories
- Special linings and coatings
- Water service materials

7.03 MATERIALS

All pressure pipe materials shall be in accordance with the applicable requirements of the Technical Specifications sections headed:

DIP	"Piping Materials: Ductile Iron Pipe"
PVC	"Piping Materials: PVC Pressure Pipe"
HDPE	"Piping Materials: HDPE Pressure Pipe"

All pressure pipe materials (pipe, fittings, valves, valve boxes, tapping valves and sleeves, precast thrust blocks, blow-offs, house services, etc.) except fire hydrants, shall be furnished by the Contractor. All pressure pipe fittings and valves shall be cast and manufactured in the United States of America unless complete certification is furnished in accordance with ANSI/AWWA C110.

All materials furnished shall be new. Materials not specified herein or on the Plans shall conform to

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AWWA Standards and Industry Standards.

Piping, concrete, masonry, and all other materials shall conform to those materials as specified in the appropriate Technical Specifications sections for those materials. Specific pressure pipe and appurtenances materials shall conform to the following specifications:

A. 2-Inch Diameter Pipe

1. Steel pipe shall be standard galvanized steel, Schedule 40, furnished in 21-foot lengths with both ends threaded.
2. All 2-inch steel fittings shall have screw type joints.
3. Pipe thread compound shall not be used. Threads shall be wrapped with teflon joint tape, non-hardening, Mil. Spec. T27730A. Cutting oils shall be dark, non-toxic, and equal to cutting oil manufactured by the Rigid Tool Company. The Contractor shall take caution not to allow cutting oil inside the pipe, and shall remove all cuttings. Cutting oils shall be UL listed or NSF approved for use in potable water systems.
4. PVC pressure pipe to be used in the potable water system shall be Safety Blue in color or white with Safety Blue identification tape or color coded approved ink lettering as specified. PVC pressure pipe to be used in the reclaimed water system shall be Safety Purple in color or white with Safety Purple identification tape or approved color coded ink lettering as specified.

PVC pipe shall conform to the Technical Specifications section headed "Piping Materials - PVC Pressure Pipe."
5. HDPE pressure pipe shall conform to the Technical Specifications section headed, "Piping Materials – HDPE Pressure Pipe."

B. Valves - General

Valves shall be iron body, bronze mounted, and have joint ends as shown or specified. Valves shall have O-ring seals, unless otherwise specified.

A standard 2-inch square AWWA operating nut shall be provided on each valve. Valves shall have non-rising stems and shall open when the nut is turned counterclockwise. Each nut shall be marked with an arrow.

All valves of the same type shall be from the same manufacturer. Parts of valves of the same type and size shall be interchangeable. Unless otherwise specified, all valves shall be designed for a cold water working pressure of 150 psi.

All valves shall be furnished complete with gaskets, bolts, nuts, and glands necessary for installation.

All valves larger than 2-inch shall have restrained rubber gasketed compression joints, or mechanical joints with retainer glands, conforming to ANSI/AWWA C111, at the Contractor's option unless otherwise noted.

All valves shall be factory lined with an epoxy coating conforming to ANSI/AWWA C550.

Valves used for sanitary force mains shall be the same as those used in other pressure pipe applications, unless otherwise specified.

Upon request, the valve manufacturer shall provide an affidavit of compliance, proof of design testing, and proof of production testing.

C. Valves - Specific

1. **2-Inch Valves:** Valves shall be resilient seated gate valve, cast iron body. Joint ends shall have NPT pipe threads. The minimum stem diameter shall be 0.85 inch.

Valves used with PVC pipe shall be connected to the pipe using thread/push-on adapters with push-on joint conforming to ASTM D 3139, 200 psi pressure rating.

2. **Gate Valves:** 3-Inch gate valves shall be resilient seated, shall meet the requirements of ANSI/AWWA C509, and shall be U.S. Pipe Metro-Seal or approved equal. Gate valves 4-inch through 12-inch shall be resilient seated, shall meet the requirements of ANSI/AWWA C509 or ANSI/AWWA C515, and shall be U.S. Pipe Metro-Seal or approved equal. Valves shall be designed for buried service, with O-ring seals and mechanical joint ends, or push-on joints, at the Contractor's option.

3. **Butterfly Valves:** Valves shall be cast iron body, rubber seated, tight closure, direct burial, and shall conform to the applicable sections of ANSI/AWWA Standard C504, Class 150B. Valve disc shall rotate 90 degrees from full open position to tight shut position, and valve disc shall be of ductile iron or cast iron.

Valve shafts shall be constructed of Type 304 stainless steel; shaft seals shall be designed for standard V-type packing, O-ring seals, or approved equal. If stub shafts are furnished, the shafts shall extend a minimum of 1.5 diameters into the disk.

Valve seats shall be of synthetic or new natural rubber, and shall be either disc-mounted and clamped, or bonded to the valve body according to ASTM D 429, Method B. The mating seat surface shall be constructed of Type 316 stainless steel or approved equal.

Valve actuators shall be designed for buried service and shall be of the traveling nut, self-locking type. Actuators shall be designed to withstand a torque of 450 foot pounds.

4. **Tapping Valves:** Valves 4-inch through 12-inch shall be resilient seated gate valves meeting the applicable requirements of ANSI/AWWA C509 or ANSI/AWWA C515. The valves shall be specially designed for pressure tapping, and shall be U.S. Pipe Metro-Seal, or approved equal.

Tapping valves 16-inch and larger shall be horizontal gate valves with bypass valve, rollers, and scrapers as specified. Tapping valves shall conform to the applicable provisions of ANSI/AWWA C509 or ANSI/AWWA C515.

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Tapping valves shall be furnished with joint accessories and shall include rubber gasket for the tapping flange joint. Tapping valves shall have a full waterway opening capable of passing a full-sized shell cutter. The flange shall have a raised face designed to engage the corresponding recess in the tapping sleeve flange.

5. **Ballcentric Plug Valves:** Plug Valves shall be non-lubricated, eccentric type and designed for a working pressure of 175 psi for valves 12-inch and smaller, and 150 psi for valves 14-inch and larger. Valves 20-inch and smaller shall be round port design. Valves shall be manufactured by Henry Pratt Company.

End connections shall be mechanical joint.

The plug valve body shall be cast iron ASTM A126 Class B with a welded-in overlay of 90% nickel alloy content on all surfaces contacting the face of the plug. Sprayed, plated, nickel welded rings or seats screwed into the body are not acceptable.

The valve plug shall be cast iron ASTM A 126 Class B, with Buna N resilient seating surface to mate with the body seat.

Plug valves shall be furnished with permanently lubricated, sleeve type metallic bearings. Grit excluder seals shall be provided in the upper and lower journals to isolate the bearings.

Plug valves shaft seals shall be the self adjusting type, replaceable without removing the valve bonnet.

Manual gear actuators shall be totally enclosed worm and gear type permanently lubricated. Above ground valves 8-inch and larger shall be provided with gear actuators. Buried valves 6-inch and larger shall be provided with gear actuators.

D. Tapping Sleeves

Sleeves shall be cast iron, ductile iron, or fabricated steel. Iron body tapping sleeves shall have standard mechanical joint ends and shall be complete with necessary nuts, bolts, gaskets, and glands. Tapping sleeves shall be suitable for installation on centrifugally or pit cast iron pipe (Class A-B or C-D).

All iron body tapping sleeves shall be U.S. Pipe T-9 tapping sleeve or approved equal.

Steel fabricated tapping sleeves epoxy coated with stainless steel nuts and bolts may be used when the tapped line is larger than the tapping diameter (i.e., 12 x 8 allowed, 12 x 12 not allowed). Fabricated tapping sleeves for DI pipe and PVC pipe shall be Smith-Blair 622 or approved equal.

Tapping sleeves shall have a 3/4-inch NPT test plug for pressure testing.

Taps for 2-inch connections shall be installed using a service saddle clamp as described in these Specifications.

E. Valve Boxes

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Valves to be buried in the ground shall be provided with cast iron valve boxes. The valve boxes shall be of proper size to fit over the valve bonnets and extend slightly above the finished ground surface or flush with pavement or sidewalk. The tops shall be complete with stay-put cover.

Valve boxes for potable water system shall be adjustable slip type valve box and cover such as Series 6855 manufactured by Tyler Utilities, or Russco, Universal Part No. 461-A,, or approved equal, and the cover shall be marked "WATER."

Valve boxes for reclaimed water system shall be Russco, Bottom Part No. VB4612X and Top Part No. VB2503L (a slip type bottom with a screw type top, lid to be installed unlocked), or approved equal, with a square cover marked "RECLAIMED WATER."

The interior and exterior surfaces of valve boxes shall be coated with asphalt varnish in accordance with ANSI/AWWA C509.

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7.04 CONNECTIONS TO EXISTING MAINS

The Contractor shall connect the new pressure pipelines to the existing pressure pipelines at locations as shown on the Plans and as specified. The Engineer shall be notified at least 2 working days prior to making connections. The time at which the connections are to be made and the manner of making the connections shall be subject to approval by the Engineer.

The connections to the existing pressure pipeline shall be made so as to minimize the time during which the existing pressure pipeline will be out of service. The Contractor shall utilize the necessary number of crews and types of equipment, and shall work the necessary hours to ensure completion of the connections within the time specified.

7.05 CONSTRUCTION OPERATIONS

Pressure pipelines shall be installed in open trenches, except when another method, such as jacking, boring, or tunneling, is shown on the Plans, specified, or ordered. Jetting shall not be allowed under roadway, alley, or driveway.

Pipe and fittings shall not be strung in residential areas more than 3 weeks in advance of pipelaying, unless otherwise approved by the Engineer. The Contractor shall install pipelines, pressure test, disinfect, and restore the ground surface in pipeline segments of 3,500 linear feet or less, except as otherwise approved by the Engineer. The new segment of pipelaying shall not start until restoration has commenced on the previous segment, or as approved by the Engineer.

Pipeline segments shall be pressure tested and disinfected after pipelaying is complete, to minimize inconvenience to the Public, except as otherwise approved by the Engineer.

No excavation shall be left open over a weekend. All pavement openings shall be completely repaired as specified in the Technical Specifications section headed "Surface Restoration" within 7 days of opening, or a temporary asphaltic pavement patch placed and maintained daily.

Where shown on the Plans or where directed by the Engineer, the Contractor shall remove existing pipelines which are shown to be abandoned. Any such pipe, fitting, etc., shall be removed after the new pipeline (replacing the existing line) is accepted and put into service by the City. Removed pipe and appurtenances 6 inches or larger which are described elsewhere or deemed by the Engineer to be reusable shall be delivered to the City by the Contractor. All material not deemed reusable shall become the Contractor's property and shall be removed from the site by the Contractor. No additional payment will be made for salvaging pipe and fittings.

Short tunneling of pressure pipe shall be constructed as required to protect trees, shrubs, and existing surface or subsurface utilities and structures. Short tunnels shall be constructed to the lengths shown on the Plans, specified, or directed by the Engineer.

Existing fences shall be restored by the Contractor and shall be finished and installed so that the restoration is equal to or better than the original. Only those portions of original fencing or materials there from, that the Engineer approves for re-use, shall be used by the Contractor in fence restoration. All other materials, including lumber, paint, wood preservative, concrete, and metal products shall be furnished by the Contractor.

The cost of protecting, replacing, relocating, and maintaining (including using hay bales) storm and sanitary sewerage facilities shall be included in the various unit price Pay Items, and no separate payment will be made therefore unless otherwise specified in other Pay Items.

7.06 LAYING AND JOINTING PRESSURE PIPELINES

All pressure pipeline installation shall comply with applicable standards of ANSI/AWWA C600, C605, and C906, and with these Specifications.

Mechanical joint fittings and valves installed in sections of unrestrained pipe, and in blow-offs, shall be installed using ductile iron retainer glands, as set forth in the Technical Specifications section headed "Piping Materials: Ductile Iron Pipe."

PVC push-on fittings for pressure pipelines shall conform to the Technical Specifications section headed "Piping Materials: PVC Pressure Pipe."

Laying and jointing of HDPE pressure pipe shall conform to the Technical Specifications section headed "Piping Materials: HDPE Pressure Pipe."

Excavation and backfill shall conform to the Technical Specifications section headed "Excavation and Backfill."

In lieu of jacking and boring or pushing of pipe up to 4-inch in diameter, the Contractor may use a softbore directional drilling process as provided by Flow Mole Corporation or approved equal.

Cover for all pressure pipeline Work, if not shown on the Plans, shall be not less than:

	2-inch and 4-inch	6-inch and larger
Under roadways and alleys:	36 inches	36 inches
Under grass and sidewalks:	24 inches	30 inches

Unless otherwise noted on the Plans or in other sections of this Specification, the pressure pipeline shall be handled and installed in strict accordance with the manufacturer's instructions and with the applicable AWWA Standards. If a conflict exists between the manufacturer's instructions and the AWWA Standards, the manufacturer's instructions shall govern.

Any defective material shall be removed from the job site immediately. Should a defect be discovered after the item has been placed in the trench, the replacement will be at the Contractor's expense. Materials shall be stored along installation routes in a manner acceptable to the Engineer or as described elsewhere in the Specifications.

Polyethylene wrapping shall be installed on ductile iron pipe and appurtenances where shown on the Plans or where ordered by the Engineer.

Polyethylene encasement materials and installation shall meet the applicable requirements of ANSI/AWWA C105. Care shall be taken while backfilling to prevent puncturing, tearing, or otherwise damaging the polyethylene wrapping.

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The Contractor shall use every precaution during construction to protect the pressure pipeline against the entry of non-potable water, dirt, wood, small animals, and any other foreign material that would hinder or contaminate the operation of the pipeline. Where the groundwater elevation is above the bottom of the trench, the Contractor shall provide suitable dewatering equipment.

All dewatering shall meet the requirements set forth in the Technical Specifications section headed "Excavation and Backfill."

Watertight plugs of an approved type shall be installed in the ends of all pipe, fittings, and valves during 24-hour or longer periods when installation is not in progress, or as required to prevent ditch water, sand, etc. from entering the pipe.

Concrete thrust blocks of the proper size and type shall be furnished and installed at all locations where a change in the pipe alignment exceeds 7 degrees or dead ends, unless Plans show that adjacent pipe, in excess of 2 bells each direction, shall be restrained. Concrete thrust blocks used on 12-inch and larger mains shall be poured in place. Precast thrust blocks may be used on mains less than 12-inch in diameter. Thrust block concrete shall conform to the Technical Specifications section headed "Concrete, Masonry, and Reinforcing Steel."

Boring, soft boring, and jacking work other than new services shall strictly conform to all applicable stipulations of the State of Florida Department of Transportation Utility Accommodation Manual, unless otherwise specified. Softbore shall utilize a guided boring system, equal to FlowMole or DirectLine.

A. Expose Existing Pressure Pipeline and Record Elevation

The Contractor shall expose the existing pressure pipelines prior to the construction stake-out to determine the station, offset, and elevation, before actual construction begins. The Plans may be modified by the Engineer, as necessary, to accommodate the pressure pipelines which must remain.

B. Conflict Adjustment of Existing Pressure Pipelines

In some locations existing pressure pipelines intended to remain in service may need to be adjusted horizontally or vertically to avoid conflicts with the proposed storm drains, sanitary sewers, roadway base, manholes, inlets, or other proposed improvements. The conflict may not be shown on the Plans.

In the event that a conflict is encountered and confirmed by the Engineer, the adjustment to alleviate the conflict shall be constructed in accordance with the applicable "Obstruction Detail" or as ordered by the Engineer.

C. Pipe Joints

1. **Standard Mechanical Joints:** In making mechanical joints, the pipe shall be centered in the bells. The surfaces of ductile iron pipe with which the rubber gasket comes in contact shall be thoroughly brushed with a wire brush just prior to assembly of the joint. The surfaces of PVC pipe shall be wiped clean with a cloth and soapy water. A pipe lubricant shall be brushed over the gasket just prior to installation. The gasket and gland shall be

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placed in position, the bolts inserted, and the nuts tightened finger tight. The nuts shall be tightened by means of a torque wrench, or as approved by the City, in such a manner that the gland shall be brought up evenly into the joint. The following range of bolt torques shall be applied:

Bolt Size (inch dia.)	Range of Torque (foot lbs.)
5/8	45 - 60
3/4	75 - 90
1	70 - 100

If effective sealing is not obtained at a maximum torque listed above, the joint shall be disassembled and reassembled after thorough cleaning.

- DI Pipe Push-On Joints:** In making up the push-on rubber gasket joint, the gasket seat in the socket shall be thoroughly brushed with a wire brush and the gasket shall be wiped with a clean cloth. The gasket shall be placed in the socket with the large round end entering first so that the groove fits over the bend in the seat. A thin film of approved lubricant shall then be applied to the inside surface of the gasket that will come in contact with the entering pipe. The plain end of the pipe to be entered shall be thoroughly brushed with a wire brush and placed in alignment with the bell of the pipe to which it is to be joined. Ends of cut pipe shall be ground to a smooth bevel edge before inserting in bell. The joint shall be made up by exerting sufficient force on the entering pipe so that its plain end is moved past the gasket until it makes contact with the base of the socket.

Backhoe buckets or excavation equipment are not to be applied directly to the pipe.

- PVC Pipe Push-On Joints:** Procedures for the making of PVC pipe push-on joints shall be similar in nature to those set forth in the preceding paragraph (except the bell shall be wiped with a clean cloth). Procedures shall strictly follow the manufacturer's printed instruction for the making of joints. In a like manner, all other PVC pipeline Work shall be performed in accordance with the manufacturer's recommendations.
- Restrained Joints:** Ductile iron mechanical joint pipe, fittings, and valves 12-inch and smaller that require restraint shall be installed using ductile iron retainer glands, as specified. The glands shall be installed in accordance with the manufacturer's recommendations. Glands using a frangible bolt for setting the restraining devices shall be tightened with standard wrenches.

Glands using standard bolts for setting the restraining devices shall be tightened with a torque wrench. The assembly shall be given 2 heavy coats of a bituminous coating after installation.

Restrained push-on joint pipe, fittings, and valves, where shown on the Plans, shall be with a restraining gland or restraining gasket, as specified.

At locations where the restraining gasket type joint is used, the words "RESTRAINED JOINT" shall be painted near the top of the bell of each such joint, in brick red 1-inch letters.

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Pipe, fittings, and valve joints shall be restrained at locations shown on the Plans, or as specified. In addition, all other fittings and valves shall be installed using a ductile iron retainer gland.

The following shall apply to various restrained joint/pipe size type:

Pipe Size (Inches)	Restrained Joint Type
2	No restrained joint allowed.
4 through 12	Mechanical joint/retainer glands Tyton Pipe/Loc Fast Gasket, or equal
16 and larger	Mechanical joint/retainer glands TR Flex, or equal, pipe valves and fittingsD.

Color Coding

Prior to backfilling, all pressure pipelines shall be identified with color coding. The applicable color codes, with light color stabilant, are:

Pipe Use	Color Coding
Potable Water	Safety Blue
Sanitary Sewer	Safety Green
Reclaimed Water	Safety Purple

- Coding on the Pipe:** HDPE and PVC pipe shall be colored at the point of manufacture. If black or white pipe must be used, pipe shall have City approved color coded ink lettering stamped on the pipe, or shall be continuously taped with plastic adhesive tape using the color coding as stated above. Plastic adhesive tape shall be applied as follows:

Black and white 2-inch and 4-inch pipe -- continuously taped at top center.

Black and white 6-inch and larger pipe -- continuously taped at "10, 12, and 2 o'clock."

Ductile iron pipe shall be continuously painted along the top one-third of the pipe with a 2-part high build epoxy-polyamide paint or approved equal. The paint shall be dry prior to the pipe being installed.

Ductile iron pipe wrapped in color coded polyethylene wrapping is not required to be painted.

- Coding above the Pipe:** HDPE and PVC pipe shall also be color coded by installation of a metal tape, equal to Teratape, laid continuously 1 foot above all pipe. Tape shall be cut in 5-foot lengths and installed with no gaps, to facilitate future field location and pipe protection. Color coded tape shall be labeled "Water Main," "Reclaimed Water Main," or "Sanitary Force Main," as required.

Ductile iron pipe shall not require coded tape above the pipe, nor shall HDPE or PVC pipe installed by directional boring.

E. Valves and Valve Boxes

Valves shall be installed in a closed position, free from all distortion and strain, and left in satisfactory operating condition. Valves shall be tested in place by the Contractor, as far as practicable, and any defects in valves or connections shall be corrected to the satisfaction of the Engineer.

Tapping sleeves shall be pressure tested prior to making the tap.

Valve boxes with stay-put cover shall be vertical and concentric with the valve stem. Any valve box which is moved from its original position, preventing the operation of the valve stem, shall be satisfactorily reset by the Contractor at his expense.

F. Connections (Tie-ins) and Shutdowns

The Contractor shall furnish all labor and equipment necessary for the connection of approved pipelines to the existing system and the shutdown, removal or disconnection and plugging of existing pipelines as indicated on the Plans or as directed by the Engineer.

This may be required in instances where existing pipelines are to be abandoned or where a short segment of existing pipeline must be cut out and adjusted either vertically or horizontally to avoid a conflict with a proposed storm drain or storm drain structure, sanitary sewer, or other proposed improvement.

The Contractor shall make all taps and tie-ins required, under the direct observation of the Engineer.

7.07 TESTING AND DISINFECTION OF PRESSURE PIPELINES

All new pressure pipelines shall be subjected to a water pressure test between valves. In order to expedite the restoration of certain surface facilities, it may be required that individual sections between valves be tested as soon as the valves are installed. Disinfection shall be accomplished after the pressure test requirements have been met for the entire segment of pressure pipe.

The Contractor shall furnish all labor, materials, equipment, and chemicals to perform the required pressure tests and disinfection. All testing and disinfection will be subject to City inspection. All new valves shall be operated by the Contractor. However, all tie-in valves to the existing water system shall only be operated with the approval of, and in the presence of, the City, and shall be scheduled to be performed during the standard work hours of City staff, unless otherwise approved by the Engineer.

All existing valves shall be operated by the City or by the Contractor under the direct supervision of the City.

A. Blow-off Assemblies

Pressure pipelines shall be flushed through a blow-off assembly at those locations as shown on the Plans or as ordered by the Engineer.

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Potable and reclaimed water pipelines 2-inch through 12-inch shall have a permanent or temporary blow-off assembly at those locations as shown on the Plans or as ordered by the Engineer.

B. Pressure Test

All lines shall be subjected to a water pressure test as follows:

Water pipelines 2-inch through 12-inch	100 psi
Water pipelines 14-inch and larger	150 psi
Sewer force mains - all sizes	100 psi

Temporary plugs or caps shall be furnished by the Contractor for this purpose, and the Contractor shall furnish personnel and all other necessary equipment required to accomplish the test. The pipeline or force main shall be entirely free of air when subjected to the pressure test.

The test pressure shall be applied to the piping through a corporation tap in the main by means of a pump or other approved method and maintained for a minimum of 2 hours. Air shall not be used for testing. Potable water shall be used for testing potable water pipelines. Reclaimed water shall be used for testing reclaimed water pipelines. Potable water shall be used for testing sanitary force mains when reclaimed water is not available.

The allowable leakage is tabulated as follows, as the allowable leakage for pressure pipelines permitted by Section 5 of ANSI/AWWA C600 for ductile iron and Section 7 of ANSI/AWWA C605 for PVC:

**Allowable Leakage per 1,000 Feet of Pipeline
(gallons per hour)**

Test Pressure	Nominal Pipe Diameter (inches)												
	2	4	6	8	10	12	14	16	18	20	24	30	36
100 psi	0.2	0.3	0.5	0.6	0.8	0.9	1.1	1.2	1.4	1.5	1.8	2.3	2.7
150 psi	0.3	0.4	0.6	0.7	0.9	1.1	1.3	1.5	1.7	1.8	2.2	2.8	3.3

Valves in the section being tested shall be operated through several complete cycles of closing and opening. In addition, each valve shall be closed and the test pressure applied to one end of the valve only. Each end of the valve shall be tested in this manner. There shall be no visible leakage through the valve, and the valve shall not show any evidence of movement or structural distress.

All restrained pipe sections and thrust blocks shall be completely backfilled before testing.

All tests shall be under the observation of the Engineer. All tests and inspections shall be conducted in a manner to minimize as much as possible any interference with the Contractor's work or progress. All tests shall be made with water at the pressures specified herein.

The Contractor shall notify the City Inspector 48 hours in advance of when the work is ready for testing and inspection. Tests and inspection shall be made as soon thereafter as practicable.

7.08 SURFACE RESTORATION AND MISCELLANEOUS

- A. All surfaces disturbed by the Contractor shall be restored to their original condition in conformance to the Technical Specifications sections headed "Surface Restoration".
- B. Sanitary sewers and laterals which cross a new potable water pipeline with less than 18 inches clear vertical separation, shall be replaced with 20 linear feet of ductile iron pipe, PVC pressure pipe (ANSI/AWWA C900 or C905 depending on pipe size), or SDR26 gravity pipe centered on the new pipeline, or as ordered by the Engineer.

Sanitary sewers and/or laterals which conflict with the new pipeline or are damaged by pipeline construction shall be reconstructed with ductile iron pipe, PVC pressure pipe (ANSI/AWWA C900 or C905), or SDR26 gravity pipe, as ordered by the Engineer.

- C. Each valve box in an unpaved area shall have an 18-inch by 18-inch by 4-inch concrete pad. Pad shall be 1 inch above grade, and sod shall be so placed to maintain this 1 inch.

END OF SECTION

SECTION 8 - SURFACE RESTORATION

8.01 GENERAL

The Work in this section includes restoring and maintaining pavements and pavement bases, curbing, sidewalks, driveways, and grass surfaces that are disturbed, damaged, or destroyed during the course of the Work under this Contract.

The quality of workmanship and materials used in the restoration shall produce a surface equal to or better than the condition before the Work began.

Prior to restoration, the Contractor shall saw cut and remove all existing pavement within 2 feet of the edge of the excavation, or within such widths as may be ordered by the Engineer.

Compaction of soil and base materials shall be tested using the AASHTO T 180 method.

Surface restoration workmanship and materials shall conform to the applicable sections of the DOT-SSRBC.

All dirt areas disturbed shall be restored with sod, unless otherwise specified.

The City reserves the right to delete any or all of the restoration work.

8.02 ROADWAY RESTORATION

Where the installation of pipe or structures occurs within an existing roadway, the limits of excavation shall be saw cut leaving a straight and square edge. The upper portion of the trench backfill shall be replaced with a compacted shell, crushed (reclaimed) concrete, or limerock base as shown on the Plans, and paved to match the surrounding surface. Replacement base material shall be the same as the existing base. Roadway restoration shall conform to the detail for "Flexible Pavement Restoration."

8.03 TEMPORARY PAVEMENT

Immediately upon completion of backfilling, the pavement surfaces damaged or destroyed shall be temporarily restored by placing a shell (DOT-SSRBC Section 913), crushed (reclaimed) concrete (DOT-SSRBC Section 204 applicable sections), or limerock (DOT-SSRBC Section 911) base on the backfilled, compacted subgrade, and an adequate temporary asphaltic patch as shown or as approved by the Engineer. Shell, crushed (reclaimed) concrete, or limerock shall be used as a base for all bituminous pavements.

Temporary work shall be maintained in a suitable and safe condition for traffic until the permanent pavement is laid or until final acceptance of the Work.

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8.04 SHELL BASE

Shell base shall be constructed on the prepared subgrade to not less than 98 percent of maximum density, in accordance with the requirements of DOT-SSRBC Section 250. The minimum compacted thickness of shell base shall conform to the detail for "Flexible Pavement Restoration."

8.05 LIMEROCK BASE

Limerock base shall be constructed on the prepared subgrade to not less than 98 percent of maximum density, in accordance with the requirements of DOT-SSRBC Section 200. The minimum compacted thickness of limerock base shall conform to the detail for "Flexible Pavement Restoration."

8.06 CRUSHED (RECLAIMED) CONCRETE BASE

Crushed (reclaimed) concrete base shall be constructed on the prepared subgrade to not less than 98 percent of maximum density, in accordance with the requirements of DOT-SSRBC Section 204. The minimum compacted thickness of crushed (reclaimed) concrete base shall conform to the detail for "Flexible Pavement Restoration."

The minimum limerock bearing ratio (LBR) value shall be 150.

8.07 ASPHALTIC CONCRETE PAVEMENT

A prime coat shall be applied to the prepared base in accordance with DOT-SSRBC Section 300 prior to permanent asphaltic concrete pavement.

Unless specified elsewhere, all permanent asphaltic concrete pavement replacement shall be Type SP-1 and shall be constructed in accordance with the requirements of DOT-SSRBC Sections 320, 330, and 331. Compacted thickness shall conform to the detail for "Flexible Pavement Restoration."

8.08 BRICK PAVEMENT

Construction of brick pavement shall follow the details as shown on the Plans and City standard practice using City standard paving brick or red clay brick conforming to ASTM C 32, Grade SS with City standard dimensions.

Streets with exposed brick surface shall be restored with brick. Brick pavers removed from streets that are not to be restored with brick shall remain the property of the City of St. Petersburg. Bricks not required for restoration, even those that have been overlaid with asphalt, shall be delivered by the Contractor to the City of St. Petersburg Maintenance Storage Yard, 3rd Avenue North and 17th Street. Brick streets that are restored shall be restored to a condition of a new well-defined and contoured cross section with a surface appearance equal to or better than that which previously existed.

Bricks which are broken or damaged by the Contractor shall not be reused. Replacement bricks shall be purchased from the Maintenance Storage Yard. The Contractor shall obtain the current

brick charge from the Engineering, Stormwater and Traffic Operations Department, Pavement Maintenance, phone 893-7260.

Brick street abutting asphalt pavement shall have a minimum 6-inch-wide flush Type A Header Curb.

8.09 CURB AND GUTTER

All permanent restoration of street curb, or curb and gutter, shall be of the same type and thickness as the curb, or curb and gutter, which abuts. The grade of the restored curb, or curb and gutter, shall conform to the grade of the existing adjacent curb, or curb and gutter, so that positive drainage is maintained.

8.10 CONCRETE SIDEWALK

The restoration and construction of concrete sidewalks shall conform to applicable requirements of DOT-SSRBC Section 522 and the Plans, and shall be constructed where shown on the Plans and directed by the City. Sidewalk expansion joints with bituminous filler shall be installed at a maximum of 50-foot intervals on center, and struck joints shall be spaced equidistant with walk width (joints wider than 6 feet shall be spaced as directed by the City). Where new construction is to be tied into existing facilities, the old material is to be removed back to the nearest construction joint, or sawcut to a straight line as directed by the Engineer. The soil under sidewalks and driveways shall be compacted to 98 percent of the maximum density.

New sidewalks shall be 4 inches thick. Concrete pour for walk construction shall be made only on dampened subgrade. A soft broom finish shall be given the walk surface as directed by the Engineer.

Sidewalks crossing driveways shall be constructed according to the Specifications for concrete driveways.

Curb ramps for physically handicapped shall be constructed at all locations where sidewalks cross the curb or where directed by the Engineer. Those existing sidewalks which are removed to accomplish associated work as a part of this Project shall be replaced with a curb ramp when the sidewalk crosses the curb. The cost of curb ramps shall be included in the appropriate proposal item for sidewalk restoration.

Where sidewalks are replaced, the replacement shall be the full width of the walk and the minimum length shall be 60 inches. Restoration of adjacent lawn is incidental to sidewalk replacement and no separate payment will be made therefore.

8.11 HEXAGON BLOCK SIDEWALK

The restoration and construction of hexagon block sidewalks shall conform to the details shown on the Plans and City standard practice using City standard hexagon blocks.

The soil under sidewalks and driveways shall be compacted to 98 percent of the maximum density. New hexagon block sidewalks shall be 2 inches thick.

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Curb ramps for physically handicapped shall be constructed at all locations where sidewalks cross the curb, or where directed by the Engineer. Those existing sidewalks which are removed to accomplish associated work as a part of this Project shall be replaced with a curb ramp when the sidewalk crosses the curb. The cost of curb ramps shall be included in the appropriate Pay Item for sidewalk restoration.

Where sidewalks are replaced, the replacement shall be the full width of the walk. Restoration of adjacent grass is incidental to sidewalk replacement and no separate payment will be made therefore.

Hexagon block removed from a sidewalk that is not to be restored with hexagon block shall remain the property of the City of St. Petersburg. Hexagon block not required for restoration shall be delivered by the Contractor to the City of St. Petersburg Maintenance Storage Yard, 3rd Avenue North and 17th Street. Hexagon block that is broken or damaged by the Contractor shall not be reused. Replacement hexagon block may be purchased from the Maintenance Storage Yard. The Contractor shall obtain the current hexagon block charge from the Engineering, Stormwater and Traffic Operations Department, Pavement Maintenance, phone 893-7260.

8.12 DRIVEWAY AND PARKING LOT

Except as otherwise specified, all permanent restoration of base and surface of driveways, parking aprons, and sidewalks shall match the materials, thicknesses, elevations, lines, and grades of the existing construction, all to the Engineer's satisfaction. Patching of Portland cement driveway areas will not be allowed between joints or dummy joints.

For areas where streets are to be paved, or where more than 50 percent of the driveway apron is disturbed, concrete or brick driveways shall be replaced in kind. All other driveways, including shell and dirt, shall be restored with an asphalt concrete surface from the street to the property line or front of sidewalk, as directed by the Engineer.

All base compaction under driveways shall be to a minimum density of 98 percent of the maximum density.

8.13 DRIVEWAY - ASPHALT

Residential asphalt driveway restoration shall include 1-inch thick asphaltic concrete surface over 2 inches of compacted sand-asphalt hot mix base, or 5 inches of compacted limerock or shell base.

Commercial asphalt driveway restoration shall be constructed of 1-inch thick asphaltic concrete surface over 8 inches of limerock base compacted in 2 lifts.

8.14 DRIVEWAY - CONCRETE

The restoration and construction of concrete driveways shall conform to applicable requirements of DOT-SSRBC Section 522 and the Plans, and shall be constructed where shown on the Plans and directed by the Engineer.

Residential concrete driveway restoration shall be 5 inches thick and shall include placing a single layer of 6-inch by 6-inch wire mesh (WWF 6 x 6 - W1.4 x W1.4).

Commercial concrete driveways shall be 6 inches thick with a double layer of 6-inch by 6-inch wire mesh (WWF 6 x 6 - W1.4 x W1.4).

8.15 DRIVEWAY - PEAGRAVEL

Where less than 50 percent of the driveway apron is disturbed, peagravel driveways shall be restored to match the existing driveway. Peagravel driveway restoration shall include asphalt treated shell base 5 inches thick after compaction to a minimum density of 98 percent of the maximum.

8.16 DRIVEWAY - SHELL

Where less than 50 percent of the driveway apron is disturbed, shell driveways shall be restored to match the existing driveway. Shell driveway restoration shall be 5 inches thick after compaction to a minimum density of 98 percent.

8.17 GRASS

A. Sodding

Sod shall be planted as soon as practical after paving, pipeline, or other work has been completed. Sodding shall always be used over seeding.

All work and materials shall meet the applicable requirements DOT-SSRBC Section 575 (Sodding).

Sodding shall be done as directed by the Engineer, using only material which, in the opinion of the Engineer, is healthy and free of weeds, and (unless specified otherwise by the Engineer) of the same variety predominating at time of removal. Sod may be St. Augustine, Bahia, or other varieties as selected by the Engineer.

Sod shall be planted within 72 hours of being cut. Only moist, green sod having a virile root system may be planted. Sod shall be cut into adjacent sod to provide a smooth surface, and "top dressed" where necessary. Sod shall be rolled or tamped after planting to provide a uniform and consistent grade.

B. Grass Maintenance

The Contractor shall properly water and otherwise maintain all seeded and sodded areas for a minimum of 60 consecutive calendar days after completion of sodding operations. After the 60 days, and upon receipt of written request from the Contractor, the Engineer will inspect the areas for acceptance by the City. Any area that is washed or eroded, fails to show a uniform stand of healthy, vigorous grassing, or does not appear to be otherwise developing satisfactorily, shall be resodded and maintained until suitable for acceptance by the Engineer.

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In the event that the stand of grass is found to be contaminated by weeds or other undesirable growth, the Contractor will be required to effectively eliminate such undesirable growth at his own expense.

8.18 EXPANSION JOINT MATERIAL

Expansion joint material for concrete pavement surfaces, including sidewalks and driveways, shall be the bituminous strip type, 1/2-inch thick, and shall conform to applicable requirements of DOT-SSRBC Section 932.

END OF SECTION

SECTION 9 – SUBMERSIBLE SEWAGE PUMPS

9.01 GENERAL

The Contractor shall furnish and install, as described hereinafter and shown on the plans, three submersible non-clog wastewater pumps at Pump Station No. 2 following the demolition work and installation of the new wet well indicated by the Contract Documents. The principal items shall include explosion-proof submersible centrifugal sewage pumps, plus base elbows, discharge piping and valves, stainless steel guide rails, and all miscellaneous and associated equipment required for a complete operating installation.

Each pump shall be equipped with an 35 HP submersible electric motor, connected for operation on 460 volts, 3 phase, 60 hertz, with 100 feet of submersible cable (SUBCAB) suitable for submersible pump applications. The power cable shall be sized according to NEC and ICEA standards and also meet with P-MSHA Approval.

The Contractor also shall furnish and install, as described hereinafter and shown on the plans, two submersible non-clog wastewater pumps at Pump Station No. 1 following the demolition work indicated by the Contract Documents. The principal items shall include explosion-proof submersible centrifugal sewage pumps, plus base elbows, discharge piping, stainless steel guide rails, and all miscellaneous and associated equipment required for a complete operating installation.

Each pump shall be equipped with an 140 HP submersible electric motor, connected for operation on 460 volts, 3 phase, 60 hertz, with 100 feet of submersible cable (SUBCAB) suitable for submersible pump applications. The power cable shall be sized according to NEC and ICEA standards and also meet with P-MSHA Approval.

The Contractor shall also perform such start-up operations and tests as delineated.

Pumps shall be tested to Hydraulic Institute (HI) Standards; International Standards Organization (ISO) Standards are not acceptable. Certification must accompany pumps.

Each pump shall have a stainless steel nameplate indicating the design capacity in GPM, with one pump operating, the design TDH, with one pump operating, the RPM, Voltage, Full-Load Amperage, Date of Manufacture and Explosion-Proof Listing Organization. The nameplate GPM/TDH shall read the GPM and TDH noted in the approved shop drawing for the pump.

All metal components not specified otherwise shall be 316 stainless steel. The pumps, motors, control panel, and H2O load rated aluminum access frame and safety hatch from EJCO, shall be coordinated with the pump supplier to insure compatibility of all these components as a system.

All equipment shall be installed by skilled workmen in accordance with the instructions of the equipment supplier.

All equipment supplied shall have ample means of lubrication for all bearings and other metal surfaces in sliding contact. The Contractor shall provide all lubricants, fuel and power necessary to start-up, test, and place the pumping facility in operation.

9.02 DATA TO BE SUBMITTED

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The Contractor shall provide the following information and documents:

- A. Shop Drawings
 - 1. Make, model, weight and horsepower of each equipment assembly
 - 2. Complete catalog information, descriptive literature, specifications and identification of materials of construction.
 - 3. Performance data curves showing: head, capacity, horsepower demand and pump efficiency over the entire pump operating range, from shut-off to maximum capacity. Indicate separately the head, capacity, horsepower demand, overall efficiency and minimum submergence required at the guarantee point.
 - 4. Detailed structural, mechanical and electrical drawings, showing the equipment dimensions, size and locations of connections, and weights of associated equipment.
 - 5. Power and control wiring diagrams, including terminals and numbers.
 - 6. Complete motor nameplate data, as defined by the motor manufacturer, including any motor modifications.

- B. Quality Control Submittals
 - 1. Factory Functional, Performance Hydrostatic Test Reports and logs certified by pump manufacturer.
 - 2. Special shipping, storage and protection, and handling instructions.
 - 3. Manufacturer's printed installation instructions.
 - 4. Manufacturer's Certificate of Compliance that the factory finish system is identical to the requirements specified herein.
 - 5. Manufacturer's Certificate of Proper Installation.
 - 6. List of special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.
 - 7. Suggested spare parts list to maintain the equipment in service for a period through 5 years. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information.
 - 8. Operation and Maintenance Manuals.
 - 9. Service records for maintenance performed during construction.
 - 10. Field Test Reports.

9.03 PUMPS

Pumps to be furnished and installed at each pump station shall be non-clog, heavy-duty municipal-type explosion-proof submersible pumps. Each pump shall have an eight or ten-inch diameter discharge and shall be capable of passing any trash, stringy material or three-inch solid. Each pump/motor unit must be non-overloading across the complete head capacity range of the pump.

Pumps shall meet the following listed minimum operating conditions:

Pump Station No. 2

Operating Points	1	2	3	4
Number of Pumps in Operation	2	2	1	1
Speed (hz)	60	54	50	35
Capacity (gpm)	4,420	3780	2350	1110
TDH (ft)	46.2	37.9	23.8	17
Total HP	63.9	44.8	18.8	5.9

Other Design Data:

Number of Pumps	3
Propeller Diameter- Inches	13.15
Electric Motor Characteristics	460v/3 Phase/60 Hertz
Maximum Motor Speed- RPM	1170
Pump Suction Pipe Diameter-Inches	8
Pump Discharge Pipe Diameter-Inches	8
Maximum Allowable Solid Size-Inches	4

Pump Station No. 1

Operating Points	1	2	3	4
Number of Pumps in Operation	2	2	1	1
Speed (hz)	60	50	50	40
Capacity (gpm)	5300	4200	2800	1600
TDH (ft)	125	110	80	60

Other Design Data:

Number of Pumps	2
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Propeller Diameter- Inches	17.60
Electric Motor Characteristics	460v/3 Phase/60 Hertz
Maximum Motor Speed- RPM	1170
Pump Suction Pipe Diameter-Inches	10
Pump Discharge Pipe Diameter-Inches	10
Maximum Allowable Solid Size-Inches	4

Pump casing shall be of the volute-type and centerline discharge design to minimize clogging or flow interference. They shall be of one-piece construction made from cast iron, Class 30, in accordance with ASTM Specification A-48, latest revision.

Wet well pumps shall be easily removable for inspection/servicing without the necessity of personnel entering the wetwell and shall be equipped with a discharge connection having a 125-pound American Standard cast iron flange fitting. A 316 stainless steel wire rope of sufficient length shall be attached to each pump to permit withdrawal from the wetwell. The upper end of the wire rope shall be hung within the wetwell access from a stainless steel hook or hanger. The wire rope shall be 3/8-inch minimum diameter with three-inch opening (minimum) stainless steel lifting rings at the end and at the mid-point of the rope. Lifting rings shall be provided every ten feet on the rope if the rope is greater than 15 feet in total length. Pumps shall automatically connect to the discharge connections when lowered into place on the slide rail system. No part of the pump shall rest on the floor. The area under the pumps shall be free and clear of any support legs or pump guides.

Impellers shall be of the non-clog type, one-piece construction and mounted directly on a stainless steel pump motor shaft. Impellers shall be N-type impeller as manufactured by ITT-FLYGT.

For informational purposes, the design of these facilities and dimensional layouts are based on the pump model provided on the drawings.

FLYGT Pumps is the accepted pump manufacturer on this project. Base bids for the pumps shall be as manufactured by FLYGT Pumps. Pumps shall be as follows:

- Pump Station No. 2:
FLYGT Model NP-3202.185 MT (8-inch discharge w/ 13.15in impeller)
- Pump Station No. 1:
FLYGT Model NP-3315.095 MT (10-inch discharge w/ 17.60in impeller)

Contractors may provide a Deductive Alternate which must be a pre-approved deductive alternate manufacturer(s), as per 9.04 of this specification. The Base Bid equipment shall be FLYGT.

Pumps and motors shall be constructed as integral units and shall be the products of one manufacture/supplier. Each motor shall be UL listed, explosion-proof, hermetically sealed, submersible-type electric motors.

The pump system, including pump, motor and power cable, shall be approved for use in areas classified as hazardous locations in accordance with the NEC Class I, Division I, Group C and D service as determined and approved by a U.S. nationally recognized testing agency such as Factory Mutual.

9.04 ENGINEER’S PRE-APPROVAL OF DEDUCTIVE ALTERNATE EQUIPMENT

- A. Manufacturer of deductive alternate equipment shall submit a pre-approval submittal package to engineer at least fourteen (14) days prior to the bid date. Only approved deductive alternates listed by addendum will be acceptable. Deductive alternate manufacturer shall submit the following information and supporting documentation:
1. A complete set of drawings with dimensions specific to this project showing the individual pumps, their installation in the wetwell, specifications, catalog cut-sheets, and detailed descriptive material. Drawings shall show all relevant details of each unit. This information shall identify all technical and performance requirements stipulated on the drawings and in the specification. If the proposed equipment does not meet these specifications, any deviation from the specification must be expressly noted. All deviations shall be listed on a single document.
 2. Detailed installation drawings illustrating how the proposed pumps will fit in the wetwell and how it will mate to ancillary equipment. The drawings shall include dimensioned plan, and elevational and sectional views of each individual system as well as the overall installation.
 3. Hydraulic performance data showing the relationship of head loss (ft) versus discharge flow (gpm). See Section 9.04 – Basin of Design for Hydraulic performance data.
 4. Complete electrical and controls submittals including control schematics, PLC programming logic, detailed cut sheets on electrical components and a P&ID. Details of the control and instrumentation system including complete wiring diagrams per the wiring requirements shown on the drawings for this project.
 5. Motor characteristics and performance information.
 6. Complete reference list of all current and active installations of same and similar equipment including contact names and phone numbers, showing at least 5 installations.
 7. Complete bill of materials for all equipment, showing dimensions and materials of construction of all components.

The preapproval submittal shall be signed and sealed by a registered professional engineer in the State of Florida.

9.05 PUMP CONSTRUCTION

Major pump components shall be of grey cast iron, ASTM A-48, Class 35B, with smooth surfaces devoid of blow holes or other irregularities. The lifting handle shall be of stainless steel. All exposed nuts or bolts shall be of stainless steel construction. All metal surfaces coming into contact with the pumpage, other than stainless steel or brass, shall be protected by a factory applied spray coating of acrylic dispersion zinc phosphate primer with a polyester resin paint finish on the exterior of the pump.

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Sealing design shall incorporate **metal-to-metal contact** between machined surfaces. Critical mating surfaces where watertight sealing is required shall be machined and fitted with Nitrile rubber O-rings. Fittings will be the result of controlled compression of rubber O-rings in two planes and O-ring contact of four sides without the requirement of a specific torque limit.

Rectangular cross sectioned gaskets requiring specific torque limits to achieve compression shall not be considered as adequate or equal. No secondary sealing compounds, elliptical O-rings, grease or other devices shall be used.

9.06 COOLING SYSTEM

Each pump motor shall be sufficiently cooled by the surrounding environment or by submergence in the pumped media.

9.07 CABLE ENTRY SEAL

The cable entry seal design shall preclude specific torque requirements to insure a watertight and submersible seal. The cable entry shall consist of dual cylindrical elastomer grommets, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter. The grommets shall be compressed by the cable entry unit, thus providing a strain relief function. The assembly shall provide ease of changing the cable when necessary using the same entry seal. The cable entry junction chamber and motor shall be sealed from each other, which shall isolate the stator housing from foreign material gaining access through the pump top. Epoxies, silicones, or other secondary sealing systems shall not be considered equal.

9.08 MOTOR

The pump motor shall be a NEMA B design, induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber. The stator windings shall be insulated with moisture resistant Class H insulation rated for 180°C (356°F). The stator shall be insulated by the trickle impregnation method using Class H monomer-free polyester resin resulting in a winding fill factor of at least 95%. The motor shall be inverter duty rated in accordance with NEMA MG1, Part 31. The stator shall be heat-shrink fitted into the cast iron stator housing. The use of multiple step dip and bake-type stator insulation process is not acceptable. The use of pins, bolts, screws or other fastening devices used to locate or hold the stator and that penetrate the stator housing are not acceptable. The motor shall be designed for continuous duty while handling pumped media of up to 104°F. The motor shall be capable of no less than 30 evenly spaced starts per hour. The rotor bars and short circuit rings shall be made of aluminum. Three thermal switches shall be embedded in the stator end coils, one per phase winding, to monitor the stator temperature. These thermal switches shall be used in conjunction with and supplemental to external motor overload protection and shall be connected to the motor control panel.

The junction chamber shall be sealed off from the stator housing and shall contain a terminal board for connection of power and pilot sensor cables using threaded compression type terminals. The use of wire nuts or crimp-type connectors is not acceptable. The motor and the pump shall be produced by the same manufacturer.

The motor service factor (combined effect of voltage, frequency and specific gravity) shall be 1.15. The motor shall have a voltage tolerance of +/- 10%. The motor shall be designed for continuous operation in up to a 40°C. ambient and shall have a NEMA Class B maximum operating temperature rise of 80° C. A motor performance chart shall be provided upon request exhibiting curves for motor

torque, current, power factor, input/output kW and efficiency. The chart shall also include data on motor starting and no-load characteristics.

Motor horsepower shall be sufficient so that the pump is non-overloading throughout its entire performance curve, from shut-off to run-out. The motor and cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet or greater.

9.09 BEARINGS

The integral pump/motor shaft shall rotate on two bearings. The motor bearings shall be sealed and permanently grease lubricated with high temperature grease. The upper motor bearing shall be a two row angular contact ball bearing. The lower bearing shall be a two row angular contact ball bearing to handle the thrust and radial forces. The minimum L10 bearing life shall be 50,000 hours at any usable portion of the pump curve.

9.10 MECHANICAL SEALS

Each pump shall be provided with a positively driven dual, tandem mechanical shaft seal system consisting of two seal sets, each having an independent spring. The lower primary seal, located between the pump and seal chamber, shall contain one stationary and one positively driven rotating corrosion resistant tungsten-carbide ring. The upper secondary seal, located between the seal chamber and the seal inspection chamber, shall be a leakage-free seal. The upper seal shall contain one stationary and one positively driven rotating corrosion resistant tungsten-carbide seal ring. The rotating seal ring shall have small back-swept grooves laser inscribed upon its face to act as a pump as it rotates, returning any fluid that should enter the dry motor chamber back into the lubricant chamber. All seal rings shall be individual solid sintered rings. Each seal interface shall be held in place by its own spring system. The seals shall not depend upon direction of rotation for sealing. Mounting of the lower seal on the impeller hub is not acceptable. Shaft seals without positively driven rotating members or conventional double mechanical seals containing either a common single or double spring acting between the upper and lower seal faces are not acceptable. The seal springs shall be isolated from the pumped media to prevent materials from packing around them, limiting their performance.

Each pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and shall provide capacity for lubricant expansion. The seal lubricant chamber shall have one drain and one inspection plug that are accessible from the exterior of the motor unit. The seal system shall not rely upon the pumped media for lubrication.

The area about the exterior of the lower mechanical seal in the cast iron housing shall have cast in an integral concentric spiral groove. This groove shall protect the seals by causing abrasive particulate entering the seal cavity to be forced out away from the seal due to centrifugal action.

A separate seal leakage chamber shall be provided so that any leakage that may occur past the upper, secondary mechanical seal will be captured prior to entry into the motor stator housing. Such seal leakage shall not contaminate the motor lower bearing. The leakage chamber shall be equipped with a float type switch that will signal if the chamber should reach 50% capacity.

9.11 PUMP SHAFT

The pump and motor shaft shall be a single piece unit. The pump shaft is an extension of the motor shaft. Shafts using mechanical couplings shall not be acceptable. The shaft shall be stainless steel

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– ASTM A479 S43100-T. Shaft sleeves will not be acceptable.

9.12 IMPELLER

High-chrome iron - .185 and .095 versions

The impeller shall be of ASTM A 532 (Alloy III A) , 25% chrome cast iron, dynamically balanced, semi-open, multi-vane, back swept, screw-shaped, non-clog design. The impeller leading edges shall be mechanically self-cleaned automatically upon each rotation as they pass across a spiral groove located on the volute suction. The screw-shaped leading edges of the impeller shall be capable of handling solids, fibrous materials, heavy sludge and other matter normally found in wastewater. The screw shape of the impeller inlet shall provide an inducing effect for the handling of up to 6% sludge and rag-laden wastewater. The impeller to volute clearance shall be readily adjustable by the means of a single trim screw. The Impeller shall be locked to the shaft and held by an impeller bolt.

9.13 VOLUTE/SUCTION COVER

The pump volute shall be a single piece gray cast iron, ASTM A-48, Class 35B, non-concentric design with smooth passages of sufficient size to pass any solids that may enter the impeller. Minimum inlet and discharge size shall be as specified. The volute shall have a replaceable volute insert ring containing spiral-shaped, sharp-edged groove(s). The spiral groove(s) shall provide the relief path and sharp edge(s) across which each impeller vane leading edge shall cross during rotation so to remain unobstructed. The internal volute bottom shall provide effective sealing between the multi-vane semi-open impeller and the volute. The insert ring shall be cast of (ASTM A-48 Class 35B cast iron or ASTM A 532 (Alloy III A), 25% chrome cast iron).

9.14 PROTECTION

Each pump motor stator shall incorporate three thermal switches, one per stator phase winding and be connected in series, to monitor the temperature of the motor. Should the thermal switches open, the motor shall stop and activate an alarm. A float switch shall be installed in the seal leakage chamber and will activate if leakage into the chamber reaches 50% chamber capacity, signaling the need to schedule an inspection.

The thermal switches and float switch shall be connected to a Mini CAS control and status monitoring unit. The Mini CAS unit shall be designed to be mounted in the pump control panel.

9.15 TESTING

Upon completion of installation, the Contractor shall test the facilities to demonstrate that the station performs as specified. He shall perform the initial testing to assure himself that acceptance testing can be satisfactorily completed.

The Contractor shall then arrange for the equipment manufacturer to furnish a qualified representative to check the installation and conduct testing for final acceptance, and shall give the Engineer written notice as to the date and time of the test. An acceptance test shall demonstrate that all items are in compliance with the function as specified. Testing shall illustrate the following:

- A. That the quick-release lift-off feature functions properly and allows the pump to be raised and lowered without draining the pit.

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- B. That all units have been properly installed and are in correct alignment
- C. That all units operate without overheating or overloading any parts and without objectionable vibrations.
- D. That there are no mechanical defects in any of the parts.
- E. That all pumps can deliver that specified and certified pressure and quantity and have correct rotation, volts and amps as verified by a drawdown test and a closed discharge pressure test.
- F. That the pumps shall be capable of pumping raw, unscreened sewage.
- G. That all pumps, sensors, and controls perform satisfactory as to sequence control, correct start and stop elevations, and proper high level alarm functions.

In addition to furnishing, delivering, installing, and testing equipment, the Contractor shall provide the services or competent manufacturing representatives for the period indicated. Additional time, beyond that specified which is necessitated by installation or other non-City related requirements, shall be paid for by the Contractor. Such representatives shall assist the City's personnel on start-up, instructing operating personnel of the City in the maintenance and operation of the equipment, conducting tests, and making recommendations for producing the most efficient results. These services shall be made during the initial operation of the pumping station and shall be over and above any services necessary during construction and to correct defective materials or workmanship during the guarantee period. These representatives shall be specially trained and qualified for installation, adjustment, start-up and testing work and shall not be sales representatives only. The cost for such representation, including subsistence and travel, shall be included under this contract. The time required for instructing the City's personnel in the proper operation and maintenance of the stations, not to exceed one day.

9.16 WARRANTY

The pump manufacturer shall warrant pumps being supplied to the City against defects in workmanship for a period of five years under normal use, operation and service. In addition, the manufacturer shall replace certain parts which shall become defective through normal use and wear and on a progressive schedule of cost for a period of five years; parts included are the mechanical seal, impeller, pump housing, wear ring and ball bearings. The warranty shall be in published form and apply to all similar units.

9.17 SPARES

Contractor shall provide an additive optional price to the bid to furnish one spare pump for each station, delivered to the City's Public Services Yard at 7581 Boca Ciega Drive, St. Pete Beach, Florida.

END OF SECTION

SECTION 10 – CONTROL AND INSTRUMENTATION – GENERAL REQUIREMENTS

GENERAL

10.01 DESCRIPTION OF WORK

- A. The CONTRACTOR shall provide an approved professional SYSTEMS INTEGRATOR to have total systems responsibility for instrumentation, controls, services, and systems as indicated in the contract drawings and described herein.
- B. This section of the specifications shall be considered as a single unit and shall be included in the single source responsibility from the SYSTEMS INTEGRATOR.
- C. The SYSTEMS INTEGRATOR, working together with the CONTRACTOR, shall provide and install the total instrumentation requirements for System Controls and Instrumentation as described herein and shown in the contract drawings.
- D. The control systems will utilize standard industrial Allen Bradley 5/05 SLC Programmable Logic Controller (PLC), which shall be installed in the new PLC control cabinet. The system will also incorporate a Pump Watch cellular modem and Autodialer for alarm communications. A personal computer (PC) shall also be provided with Human-Machine-Interface (HMI) software to serve as an operator interface to the system.
- E. The System Integrator shall provide the PLC Control Cabinet, PLC hardware, PC, HMI software, Pump Watch cellular modem, autodialer, wiring, installation, and communications. The System Integrator shall also be responsible for the PLC programming, tag name dictionary, and control algorithms.
- FL. Work includes engineering, furnishing, installing, testing, documenting and placing in operation the complete Control System for the St. Pete Beach's Pump Station #2 Rehabilitation. The work is specified in this Section and further detailed in the following section:
 - 1. Section 09: Submersible Sewage Pumps
 - 2. Section 11: Pump Control System

10.02 INSTRUMENTATION RESPONSIBILITY

- A. It is the intent of these Contract Documents that a SYSTEM INTEGRATOR be retained by the CONTRACTOR to have overall responsibility for designing, furnishing, interfacing, adjusting, testing, documenting, and starting-up the various CONTROL SYSTEM equipment described in the Contract Documents. The specified intent is to have an experienced firm or entity on-site that will have overall responsibility for making sure the various systems, trades, suppliers, vendors, subcontractors, etc. come together as a complete coordinated system which will reliably perform the specified functions. The CONTRACTOR shall provide written notification of the intended SYSTEM INTEGRATOR at bid time.

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- A. The SYSTEM INTEGRATOR shall be subcontracted by and paid by the Contractor. The SYSTEM INTEGRATOR, listed in alphabetical order, shall be:
1. C2i Controls, Atlanta, Georgia
 2. Rocha Controls, Tampa, Florida
 3. Unitron Controls, Lakeland, Florida
- B. The SYSTEM INTEGRATOR shall provide all equipment, materials, programming, software, modifications to existing equipment, calibrations and services that are required to successfully interface and interconnect the system and any other control systems and associated equipment that are specified or designated in any drawings or provisions of these specifications for the purpose of providing a fully integrated and functional control system.
- C. Division of Work. It is the ultimate responsibility of the Contractor to furnish complete and fully operable Control System that reliably performs the specified functions. The Contractor is to assume full responsibility for additional costs, which may result from unauthorized deviations from the specifications. The Contractor is to establish the actual division of work with the minimum requirements as specified herein.
1. The SYSTEM INTEGRATOR shall be responsible for:
 - a. The integration of the system including the cabinet fabrication, panel layouts and wiring, Control System PLC programming, PC set-up, PC software installation, HMI screen development, autodialer setup and cellular modem setup.
 - b. All hardware and software submittals. The SYSTEM INTEGRATOR shall develop the panel shop drawings, wiring diagrams, PLC, PC, cellular modem and autodialer configuration drawings and layouts, software documentation, and all other submittals defined herein and in other specification sections. Coordination with the Contractor and other subcontractors shall be the responsibility of the SYSTEM INTEGRATOR.
 - c. The final system operation and reliability. The final demonstration tests and training shall be under the on-site supervision of the SYSTEM INTEGRATOR. The CONTROL SYSTEM warranty period shall be through the SYSTEM INTEGRATOR.
 - d. Ordering, fabrication, assembly, delivery and start-up of the CONTROL SYSTEM. All panel fabrication shall be performed at the SYSTEM INTEGRATOR's shop. The SYSTEM INTEGRATOR's personnel shall perform the system checkout tests for the Control System.

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- e. Obtaining from the Contractor, the required information on those field elements, flow meters, pressure transducers, variable frequency drives, and other control equipment or devices that are required to be interfaced with, but that are not provided with the Control System in order to provide full system coordination regarding interface, function, testing, and adjustment requirements.
 - f. Providing accessory devices including furnishing and installation of networking interface cards interposing relays, control switches and signal converters necessary to perform the intent as described by the control strategies and services necessary to achieve a fully integrated and operational system as shown on the Contract Drawings and defined in the Specifications.
 - g. In order to insure compatibility between all equipment, it shall be the responsibility of the SYSTEM INTEGRATOR to coordinate all interface requirements with mechanical and electrical system suppliers and furnish any signal isolation devices that might be required.
 - h. Providing any special manufacturer's cables as required.
 - i. Defining the final installation and connection requirements of the Control System at the jobsite through development of interconnection diagrams.
 - j. Coordinating all interface requirements with mechanical and electrical system suppliers and furnish any signal isolation devices that might be required in order to insure compatibility between all equipment.
 - k. Verifying correctness of all final power and signal connections to the Control System. The SYSTEM INTEGRATOR shall make final adjustments to and calibrate all field elements provided with the Control System. Ensuring that:
 - i) All components provided under this section are properly installed.
 - ii) The proper type, size and number of control wires with their conduits and junction boxes are provided and installed.
 - iii) Proper electric power circuits are provided for all components and systems.
2. The Electrical Contractor shall be responsible for:
- a. Included within the electrical subcontractor's scope:

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- i) Termination of field and power wiring to CONTROL SYSTEM supplied control panels and field elements. Termination shall be made in accordance with final accepted interconnection diagrams developed by the SYSTEM INTEGRATOR. The electrical subcontractor shall mark on the interconnect diagram the field wire numbers used for each termination point. The SYSTEM INTEGRATOR shall finalize the interconnect diagrams by including these field wire numbers in the final as built version.
 - ii) Installing all communication cables, (including telemetry coaxial cables), interconnecting CONTROL SYSTEM supplied equipment.
 - iii) Installing any special manufacturer's cables furnished by the SYSTEM INTEGRATOR.
 - iv) Physical installation of CONTROL SYSTEM supplied control panel.
3. Included within the mechanical subcontractor's scope installation of any in-line instrumentation. Installation shall be made in accordance with the manufacturer's recommendations and under the direction of the SYSTEM INTEGRATOR.
4. Equipment found to be defective prior to system acceptance shall be replaced and installed at no additional cost to the OWNER.
5. In the bid price, the SYSTEM INTEGRATOR shall provide, as a minimum, for obtaining the services of authorized field personnel from the manufacturer's of specialty instruments and from the suppliers of application software packages. These personnel shall be on site to supervise installation, start-up and checkout of the respective portions of the Control System.

E. RELATED WORK

1. Division 15 – Mechanical. Installation of all mechanical piping and fittings, as well as in-line instruments supplied with and/or for the Control System.
2. Division 16 - Electrical. All conduits are provided and installed under Division 16, Electrical. With the exception of certain specified networking and special manufacturer's cables, all wiring and cables are provided and installed under Division 16, Electrical. Division 16 also covers physical installation of the control panels supplied with and/or for the Control System.

10.03 SUBMITTALS

- A. Furnish, as prescribed under the General Requirements, all required submittals covering the items included under this section and its associated sections of the work.
- B. Submit complete, neat, orderly, and indexed submittal packages. Handwritten diagrams are not acceptable and all documentation submittals shall be made using CADD generated utilities as specified herein.
- C. Partial submittals or submittals that do not contain sufficient information for complete review or are unclear will not be reviewed and will be returned by the ENGINEER as not approved.
- D. Provide all shop-drawing submittals on disk in AutoCad format.
- A. The Project Plan defined below shall be submitted and approved before any further submittals will be reviewed by the ENGINEER.
- B. Project Plan: The project plan shall provide an overview of the proposed system including system architecture diagrams, the approach to work, the proposed work schedule indicating milestones and potential meetings, project personnel and organization, resumes of key project personnel, details of factory testing and field testing, details of training programs, and a paragraph by paragraph review of the specifications indicating any proposed deviations. Microsoft "Project" or similar software shall be used for data presentation. The schedule shall illustrate all major project milestones including the following:
 - 1. Schedule for all subsequent project submittals.
 - 2. Tentative dates for all project design review meetings.
 - 3. Schedule of manufacture and staging of all instrumentation and control system equipment.
 - 4. Schedule for shipment of all instrument and control system equipment all peripheral devices
 - 5. Schedule for equipment start up.
 - 6. Schedule for field acceptance test.
 - 7. Schedule for all training.
- C. Design Related Submittals: Provide individual shop drawing submittals as further defined in each specification section defining the Control System. Provide the following additional submittals covering the complete system:

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1. Loop diagrams, consisting of complete wiring and/or plumbing diagrams for each control loop showing all terminal numbers, the location of the dc power supply, the location of any booster relays or common dropping resistors, surge arrestors, etc. The loop diagrams shall meet the minimum requirements of ISA S5.4 plus divide each loop diagram into four areas for identification of element locations: Control System I/O point(s), panel face, back-of-panel, and field, respectively. On each diagram present a tabular summary of:
 - a. The output capability of the transmitting instruments
 - b. The input impedance of each receiving instrument
 - c. An estimate of the loop wiring impedance based on the wire sizes and lengths shown
 - d. The total loop impedance
 - e. Reserve output capacity.
 2. System interconnect diagram that shows all connections required between component parts of the items covered in this section and between the various other systems specified in this Contract. Number all electrical terminal blocks and field wiring. Identify each line at each termination point with the same number. Do not use this number again for any other purpose in the complete control scheme.
- D. Test Procedures: Submit the procedures proposed to be followed during all system testing. Procedures shall include test descriptions, forms, and check lists to be used to control and document the required tests.
1. Prior to the preparation of the detailed test procedures, submit outlines of the specific proposed tests. Submittals shall include examples of the proposed forms and check lists that will be used by the SYSTEM INTEGRATOR during the system testing.
 2. After the preliminary test procedure submittals have been reviewed by the ENGINEER and returned stamped either "approved" or "approved as noted, confirm", the SYSTEM INTEGRATOR shall submit the proposed detailed test procedures for ENGINEER approval. Following this, the system tests may be started.
 3. Upon completion of each required test, document the test by submitting a copy of the signed off test procedures to the ENGINEER.
- E. Third Party Operating and Maintenance Manuals: No later than four weeks after approval of the shop drawing submittal, provide a complete set of third party O&M manuals in hard copy and, where available, on Compact Disc.

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- J. Instrument Installation Details Submittal
1. The System Integrator shall develop and submit for review, complete installation details for each field mounted device and panel furnished prior to shipment and installation. Common details may be referenced by an index showing the complete instrument tag number, service, location, and device description. Installation details shall be provided as required to adequately define the installation of the components. Drawings may be included in the Control Panel Submittal when only a few are required.
 2. Power Requirement and Heat Dissipation Summary
 - i. Provide a summary of the power requirements and heat dissipation for all control panels furnished. Power requirements shall state required voltages, currents, and phase(s). Heat dissipations shall be maximums and shall be given in BTU/Hr. Summary shall be supplemented with calculations and show expected temperatures to be maintained for proper control equipment operation.
 3. System Calibration and Test Documentation Submittal
 - i. The System Integrator shall submit an example of each type of Instrument Calibration Report and Loop Functional Test Report that will be used to verify that all preliminary calibration and testing has been performed and the system is considered, by the supplier, to be ready for the Engineer's acceptance testing.
 - ii. After approval of the examples, the System Integrator shall prepare Loop Functional Test Report(s) for each loop and an Instrument Calibration Sheet for each active element (except simple hand switches, lights, etc.). These sheets shall be completed and submitted to the Engineer after completion of the operational availability field tests.
 - a. Instrument Calibration Reports
 1. An Instrument Calibration report shall be used to certify that each instrument requiring calibration has been calibrated to its published specified accuracy shall be submitted to the Engineer. This report shall include all applicable data as listed below plus an area to identify any defects noted, corrective action required, and corrections made.
 2. Facility identification (Name, location, etc.)
 3. Loop identification (Name or function)
 4. Scale ranges and units

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5. Actual readings at 0, 10, 25, 50, 75, 90 and 100 percent of span
 6. Tester's certification with name and signature
- b. Loop and Functional Test Reports
1. Loop Status Report - For each function that can be demonstrated on a loop-by-loop basis:
 - (1) Each form shall include:
 - a. Project name
 - b. Loop number
 - c. Loop description
 - d. Test procedure description, with a space after each specific test to facilitate sign off on completion of each test.
 - e. For each component: tag number, description, manufacturer, and data sheet number.
 - f. Space for sign off and date by the System Integrator
 2. Functional Acceptance Test Report - For those functions that cannot be demonstrated on a loop-by-loop basis :
 1. Each form shall include a listing of the specific tests to be conducted. With each test description the following information shall be included:
 - a. Specification page and paragraph of function to be demonstrated
 - b. Description of function
 - c. Test procedure description
 - d. Space after each specific test to facilitate sign off on completion of each test

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- c. System Integrator's Installation Certification Reports
 - 1. Upon completion of all preliminary calibration and functional testing, the System Integrator, shall submit a certified report for each control panel and its associated field instruments certifying that the equipment (1) had been properly installed under his or her supervision, (2) is in accurate calibration, (3) was placed in operation, (4) has been checked, inspected, calibrated, and adjusted as necessary, (5) has been operated under maximum power variation conditions and operated satisfactorily, and (6) is fully covered under the terms of the guarantee.
- 4. Functional Acceptance Test Procedures Submittal
 - i. Submit for approval not later than 30 days prior to the functional acceptance test demonstration, a written plan for demonstrating that each device and function of the equipment provided under these specifications meets the specified operational requirements.
 - ii. The plan shall detail procedures to be used in the functional acceptance testing of all systems. The plan shall include a description of test methods and materials that will be utilized for testing each system.
 - iii. Immediately correct defects and malfunctions with approved methods and materials in each case and repeat the testing.

10.04 FINAL SYSTEM DOCUMENTATION

- A. Reproducible Drawings
 - 1. The System Integrator shall submit one (1) set of full size reproducible of complete schematics, wiring diagrams and installation drawings to include all installed field and panel instruments, mounting details, point-to-point diagrams with cable, wire, and termination numbers. Drawings shall be a record of work as actually constructed and shall be labeled "As-Installed". One copy of applicable schematics and diagrams shall be placed in each control panel in a protective envelope or binder.
 - a. Loop Diagrams
 - b. Panel Construction Drawings and Wiring Diagrams
 - c. Interconnecting Wiring Diagrams
 - d. Instrument Installation Details

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B. Software

1. In addition to the reproducible hard copy of drawings and literature specifically generated for the project, two (2) sets of CD-ROM's shall be submitted to the Engineer which shall include a copy of all files specifically generated to create the drawings, data sheets, bill of materials, operating and test procedures, control logic, etc. Drawing format shall be compatible with "AutoCAD" Release 2005. Disks shall be clearly labeled with the following:
 - a. Project Name
 - b. Volume Number
 - c. Software Program Name and Version used to generate the files
 - d. Label "As-Installed"
2. Provide two (2) copies of all programming software, application programs, and source code (RSLogix 500 *.RSS program and full project report) and include HMI development files. Provide two (2) copies of any items used to generate, annotate, or debug any software provided. Programming software, detailed programming instructions, software keys, cables, and licenses shall be provided for all programmable devices, i.e., PLC, PC, HMI software and cellular modem. Special devices used in programming supplied hardware shall be provided. It is the intent that the Engineer and owner shall have the full capability to re-program and modify any application on-site without the need to purchase additional software or hardware. Information to be provided on two (2) appropriately sized USB thumb drives.

C. Operation and Maintenance Manuals

1. Furnish the balance of six (6) sets of Operation and Maintenance Manuals for equipment provided under these Specifications. Content shall be as described above for the submittals.

10.05 QUALITY CONTROL

- A. The SYSTEM INTEGRATOR shall be subcontracted by and paid by the CONTRACTOR. Acceptance of alternates shall be made based on price, location of the fabrication shop, accessibility of personnel, PLC programming knowledge, and OWNER confidence. SYSTEM INTEGRATOR seeking ENGINEER approval shall meet the following minimum requirements:
 1. Have extensive experience in systems of similar size and complexity. Provide references for a minimum of five completed water and/or wastewater projects furnished within the last four years. For each identify the following:

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- a. Project name
 - b. Project dollar value
 - c. General Contractor
 - d. Engineer, with contact name and phone number
 - e. Owner, with contact name and phone number
2. Panel fabrication shop shall be a UL listed panel shop. Submit evidence thereof.
3. Have specific experience with the controller hardware and software to be supplied hereunder. Submit resumes of personnel available to work on the project demonstrating said experience.
4. Have an established service facility from which qualified technical service personnel and parts may be dispatched upon call. Such a service facility shall be no more than six (6) hours travel time from the jobsite. Identify the location of said facility.
- B. The SYSTEM INTEGRATOR shall meet all of the requirements of these specifications, and, unless specifically stated otherwise, no prior acceptance of any subsystem, equipment, or materials has been made.
- C. Component equipment shall be as supplied by one of the manufacturers named in the individual specification sections or approved equal. The design of the Control System is based on the first- named manufacturer's equipment if there is a difference.
- D. All equipment furnished by the SYSTEM INTEGRATOR shall be of the latest and most recent design and shall have overall accuracy as guaranteed by the manufacturer.
- E. To facilitate the OWNER's operation and maintenance, products shall be of the same major instrumentation MANUFACTURER, with panel-mounted devices of the same type and model as far as possible.
- F. In order to insure the interchangeability of parts, the maintenance of quality, the ease of interfacing between the various subsystems, and the establishment of minimums with regard to ranges and accuracy, strict compliance with the above requirements shall be maintained.
- G. The SYSTEM INTEGRATOR shall designate a single point of contact for interface with the ENGINEER on this project. The ENGINEER reserves the sole right to approve or reject this point of contact.

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- H. The SYSTEM INTEGRATOR shall provide, on-site, an experienced project engineer to supervise and coordinate all of the on-site Control System activities. An experienced technician may be provided to assist the project engineer in field element installation, field calibration, and checkout tests. The SYSTEM INTEGRATOR 's project engineer shall be on- site during the period required to effect all of the critical on-site activities related to the Control System, particularly the software debugging, Control System training, and witnessed testing activities.
- I. The SYSTEM INTEGRATOR 's selected project personnel shall meet the following requirements:
 - 1. Project engineer shall have at least 10 years experience in installing similar systems and shall have a minimum of secondary education in the field of electronics or similar technical discipline.
 - 2. Project technician assisting the project engineer for field element calibration and check out shall have at least five years experience in installing similar systems.
 - 3. Key staff resumes shall be submitted for ENGINEER's approval with the Project Plan as further detailed under submittals.

10.06 STANDARDS

- A The design, testing, assembly, and methods of installation of the wiring materials, electrical equipment and accessories proposed under this Contract shall conform to the National Electrical Code and to applicable state and local requirements. UL listing and labeling shall be adhered to under this Contract.
- B Any equipment that does not have a UL, FM CSA, or other approved testing laboratory label shall be furnished with a notarized letter signed by the supplier stating that the equipment furnished has been manufactured in accordance with the National Electric Code and OSHA requirements.
- C Any additional work needed resulting from any deviation from codes or local requirements shall be at no additional cost to the OWNER.
- D Instrument Society of America (ISA) and National Electrical Manufacturers Association (NEMA) standards shall be used where applicable in the design of the Control System.
- E All equipment used on this project to test and calibrate the installed equipment shall be in calibration at the time of use. Calibration shall be traceable to National Institute of Standards (NIS - formally NBS) calibration standards.

10.07 WARRANTY AND GUARANTEES

- A. The SYSTEM INTEGRATOR shall furnish to the OWNER a written guarantee in accordance with 3.07.F.1.

- B. The SYSTEM INTEGRATOR shall guarantee all equipment whether or not of his own manufacture.

10.08 SPARES AND EXPENDABLES

- A Obtain from the manufacturer(s) and provide the recommended critical spare parts as part of the work. Refer to the individual requirements listed in the associated specification sections for the Control System for specific parts lists to be provided as a minimum. The spare parts are the property of the OWNER.
- B Obtain from the manufacturer(s) and furnish any special tools, calibration equipment and testing apparatus required for the proper adjustment and maintenance of the material provided.

PRODUCTS

10.09 GENERAL REQUIREMENTS

- A. All Control System equipment shall produce or be activated by signals, which are established standards for the water and wastewater industries. Outputs of equipment that are not of the standard signals as outlined, shall have the output immediately raised and/or converted to compatible standard signals for remote transmission. No zero based signals will be allowed.
- B. Equipment to be installed in a hazardous area shall meet Class, Group, and Division classification as shown on the Contract Electrical Drawings, or comply with the local or National Electrical Code, whichever is the most stringent requirement.
- C. Electronic equipment utilizing printed circuitry shall be suitably coated to prevent contamination by dust, moisture and fungus. Solid-state components shall be conservatively rated for their purpose, to assure optimum long-term performance and dependability over ambient atmosphere fluctuations and 0 to 100 percent relative humidity. Field mounted equipment and system components shall be designed for installation in dusty, humid, and slightly corrosive service conditions.
- D. All equipment and devices furnished hereunder shall be heavy-duty type, designed for continuous industrial service. The System shall contain products of a single MANUFACTURER, insofar as possible, and shall consist of equipment models that are the latest design currently in production.
- E. All equipment shall be designed to operate on a 60-Hertz alternating current power source at a normal 120 volts, plus or minus 10 percent, except where specifically noted. All regulators and power supplies required for compliance with the above shall be provided between power supply and interconnected instrument loop. Where equipment requires voltage regulation, constant voltage transformers shall be supplied.

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- F. Materials and equipment used shall be U.L. approved wherever such approved equipment and materials are available.
- G. All Control System equipment shall be designed and constructed so that in the event of a power interruption, the equipment shall resume normal operation without manual resetting when power is restored.
- H. Refer to contract documents and specification sections 11 for the hardware and software requirements of the pump station.

EXECUTION

10.10 SEQUENCE OF WORK

- A. Prerequisite Activities and Lead Times: Do not start the following key project activities until the listed prerequisite activities have been completed and lead times have been satisfied:
 - 1. Hardware Purchasing, Fabrication, and Assembly: Associated design related submittals completed (no exceptions, or approved as noted).
 - 2. Shipment: Completion and approval of all design related submittals.
 - 3. Startup: Operational Checkout Tests.
 - 4. OWNER Training: Owner Training Plan completed and O&M manuals delivered.
 - 5. Demonstration Tests: Operational Check-out Tests, Startup, OWNER Training, and Demonstration Test Procedures must be complete. Give 4 weeks' notice prior to the planned test start date.
- B. Material and Equipment Installation: Install the Control System in locations indicated on the Drawings and follow manufacturers' installation instructions explicitly, unless otherwise indicated. Wherever any conflict arises between manufacturers' instruction, and these Contract Documents, follow ENGINEER's decision, at no additional cost. Keep a copy of manufacturers' instructions on the jobsite available for review at all times
- C. Equipment Finish: Provide materials and equipment with manufacturer's standard finish system. Provide manufacturer's standard finish color, except where specific color is indicated. If manufacturer has no standard color, finish equipment with light gray color.
- D. Cleaning and Touch-up Painting: Keep the premises free from accumulation of waste material or rubbish. Upon completion of work, remove materials, scraps, and debris from premises and from interior and exterior of all devices and equipment. Touch-up scratches, scrapes, or chips in interior and exterior

surfaces of devices and equipment with finishes matching as nearly as possible the type, color, consistency, and type of surface of the original finish. Clean and polish the exterior of all panels and enclosures upon the completion of the demonstration tests.

- E. Consoles, Panels, and Panel Mounted Equipment: Consoles, panels, and panel-mounted equipment shall be assembled as far as possible at the SYSTEM INTEGRATOR 's shop. No work, other than correction of minor defects or minor transit damage, shall be done on the panels at the jobsite.
- F. Field instruments: Verify correctness of installation. Verify calibration and adjustment of all transducers and verify correct control action. Verify position switch settings. Verify opening and closing speeds and travel stops.

10.11 PRODUCT HANDLING

- A. Store and protect equipment until installation following the storage and handling instructions recommended by the equipment manufacturers. Place special emphasis on proper anti-static protection of sensitive equipment.
- B. Protection During Construction: Throughout this Contract, provide protection for materials and equipment against loss or damage and from the effects of weather. Prior to installation, store items in indoor, dry locations. Provide heating in storage areas for items subject to corrosion under damp conditions. Provide covers for panels and other elements that may be exposed to dusty construction environments. Specific storage requirements shall be in accordance with the SYSTEM INTEGRATOR 's recommendations.
- C. Corrosion Protection: Protect all consoles, panels, enclosures, and other equipment containing electrical or instrumentation and control devices, including spare parts, from corrosion through the use of corrosion-inhibiting vapor capsules. Prior to shipment, include capsules in the shipping containers, and equipment as recommended by the capsule manufacturer. During the construction period, periodically replace the capsules in accordance with the capsule manufacturer's recommendations. Replace all capsules just prior to Final Acceptance.
- D. ESD Protection: Provide for the proper handling, storage, and environmental conditions required for the CONTROL SYSTEM components deemed static sensitive by the equipment manufacturer. The components of the Control System shall be protected in particular. Utilize anti-stat wrist straps and matting during installation of these items to prevent component degradation. Flooring used in the control room shall be reviewed and approved by the SYSTEM INTEGRATOR.
- E. Adequately pack manufactured material to prevent damage during shipping, handling, storage and erection. Pack all material shipped to the project site in a container properly marked for identification. Use blocks and padding to prevent movement.

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- F. Ship materials that must be handled with the aid of mechanical tools in wood-framed crates.
- G. Ship all materials to the project site with at least one layer of plastic wrapping or other approved means to make it weatherproof. Anti-stat protection shall be provided for all sensitive equipment.
- H. Inspect the material prior to removing it from the carrier. Do not unwrap equipment until it is ready to be installed. If any damage is observed, immediately notify the carrier so that a claim can be made. If no such notice is given, the material shall be assumed to be in undamaged condition, and any subsequent damage that is discovered shall be repaired and replaced at no additional expense to the OWNER.
- I. The Contractor shall be responsible for any damage charges resulting from the handling of the materials.

10.12 INSTALLATION

- A. Install materials and equipment in a workmanlike manner utilizing craftsmen skilled in the particular trade. Provide work, which has a neat and finished appearance. Coordinate I&C work with the OWNER and work of other trades to avoid conflicts, errors, delays, and unnecessary interference with operation of the existing plant during construction.
- B. Provide finish on instruments and accessories that protects against corrosion by the elements in the environment in which they are to be installed. Finish both the interior and exterior of enclosures. Provide extra paint of each color used in the material from the manufacturer for touch-up purposes.
- C. Ground each analog signal shield on one end at the receiver end only. Properly ground all surge and transient protection devices. Coordinate grounding system with Division 16, Electrical.
- D. For the purposes of uniformity and conformance to industry standard, provide analog signal transmission modes of electronic 4-20 ma DC. No other signal characteristics are acceptable.
- E. Fully isolate outputs for transmitted electronic signals between transmitters and receivers, equipment of different manufacturers and between control panels to conform to ISA Standard S 50. 1.
- F. Discrete signal are two-state logic signals. Use 120V ac sources on all discrete signals unless otherwise noted or shown.
- G. Surge Protection: Provide appropriately sized electrical transient protection devices for all electrical elements of the system to protect the Control System equipment and equipment which interfaces with the Control System from transient surges in power and signal wiring (from lightning and other ground potential differences). Locate and properly ground surge suppressors at: any

connection between power sources and electrical equipment including panels, assemblies, and field devices; and at both ends of all analog signal circuits.

10.13 TESTING - GENERAL

- A. All elements of the Control System, both hardware and software, shall be tested to demonstrate that the total system satisfies all of the requirements of the Contract Documents
- B. As a minimum, the testing shall include shop tests, operational check-out tests, and Demonstration Tests.
- 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 producing the correct result (effect), the specific test requirements will have been satisfied.
- D. All tests shall be conducted in accordance with, and documented on, prior approved procedures, forms, and checklists. Each specific test to be performed shall be described and a space provided after it for signoff by the appropriate party after its satisfactory completion. Copies of these signoff test procedures, forms, and checklists will constitute the required test documentation.
- E. 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, provide suitable means of simulation. Define these simulation techniques in the test procedures.
- F. The SYSTEM INTEGRATOR shall coordinate all of their testing with the Contractor, the ENGINEER, all affected suppliers, and the OWNER.
- G. The ENGINEER reserves the right to test or retest any and all specified functions whether or not explicitly stated in the approved test procedures. The ENGINEER's decision shall be final regarding the acceptability and completeness of all testing.

10.14 FIELD ACCEPTANCE TEST DEMONSTRATION

- A. Test all systems under actual process conditions in the presence of the Engineer and the Owner's Operators. The intent of this test is to demonstrate and verify the operational interrelationship of all instrumentation systems to the Owner's Operators. This testing shall include, but not be limited to, verifying all alarms, sequences, operations communications, and making final adjustments. Notify the Engineer in writing a minimum of 48 hours prior to the proposed date for commencing the test. Upon successful completion of this test the System Integrator shall begin the 30 Day Site Acceptance Test.

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10.15 30-DAY SITE ACCEPTANCE TEST

- A. After completion of the Field Acceptance Test, the entire system shall operate for a period of 30 consecutive days, under conditions of full process operation, without a single non-field repairable malfunction.
- B. Provide complete O&M Manuals for the Control System at the jobsite at least two weeks prior to the SAT.
- C. During this test, maintenance and operations, as well as, SYSTEM INTEGRATOR personnel shall be present as required. The SYSTEM INTEGRATOR is expected to provide personnel for this test who have an intimate knowledge of the hardware and software of the system.
- D. While this test is proceeding, the OWNER shall have full use of the system. Only operating personnel shall be allowed to operate equipment associated with the processes.
- E. Any malfunction during the tests shall be analyzed and corrections made by the SYSTEM INTEGRATOR. The ENGINEER and/or OWNER will determine whether any such malfunctions are sufficiently serious to warrant a repeat of this test.
- F. Any malfunction, during this 30 consecutive day test period, which cannot be corrected within 24 hours of occurrence by the SYSTEM INTEGRATOR 's personnel, or more than two similar failures of any duration, will be considered as a non-field-repairable malfunction.
- G. Upon completion of repairs, by the SYSTEM INTEGRATOR, the test shall be repeated as specified herein.
- H. In the event of rejection of any part or function, the SYSTEM INTEGRATOR shall perform repairs or replacement within 90 days.
- I. All data base errors must be corrected prior to the start of each test period. The 30-day test will not be considered successful until all databases are correct.
- J. The total availability of the system shall be greater than 99.5 percent during this test period.
 - 1. Availability is given by
$$\frac{\text{Total Time-Down Time}}{\text{Total Time}} \times 100$$
.
 - 2. Down times due to power outages or other factors outside the normal protection devices or back-up power supplies provided, shall not contribute to the availability test total or down times above.
- K. Upon successful completion of the 30-day Site Acceptance Test and subsequent review and approval of complete system final documentation, the system shall be considered substantially complete and the warranty period shall commence.

10.16 TRAINING REQUIREMENTS

A. General

1. Provide the services of a factory trained and field experienced control systems engineer to conduct group training of Engineer's designated personnel in the operation of all Instrumentation, Control and Monitoring equipment furnished. Include instruction covering basic system theory, operating principles and adjustments, routine maintenance and repair, and "hands-on" operation. The text for this training shall be the P&IDs, panel wiring diagrams, layouts, ladder listings, and the operation and maintenance manuals furnished under these Specifications.

B. Duration

1. Training specific to the system hardware shall be provided for a minimum of three operating shifts with a time period necessary to cover complete Operator and Maintenance Training.

C. Operator Training

1. Operator training shall include instruction in the use of all control system hardware and software furnished. A detailed written description of the system furnished and all equipment start-up, shut-down, troubleshooting, and maintenance procedures shall be provided to each Operator attending the training sessions. Training material shall be organized and bound in appropriate binders. One copy of the training manual shall be submitted to the Engineer prior to scheduling any training sessions. As a minimum, the format for the training material shall be as follows:
 - a. General system description and overview
 - b. Process and Instrumentation Diagrams
 - c. Sequence of Operation
 - d. General Troubleshooting Techniques
 - e. Recommended Maintenance Procedures
 - f. Recommended Spare Parts

D. Maintenance Training

1. Maintenance training shall include instruction in the calibration, maintenance, programming, and repair for all systems furnished.
2. Maintenance training shall include instruction in the maintenance of all control system hardware and software furnished. A detailed written description of the system furnished and all equipment start-up, shut-down, troubleshooting, and maintenance procedures shall be provided to

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each person attending the training sessions. Training material shall be organized and bound in appropriate binders. One copy of the training manual shall be submitted to the Engineer prior to scheduling any training sessions. As a minimum, the format for the training material shall be as follows:

- a. General system description and overview
 - b. Process and Instrumentation Diagrams
 - c. Sequence of Operation
 - d. Detailed review of all schematic diagrams
 - e. Detailed review of all software functions using actual software listings
 - f. Detailed programming instruction of hardware furnished unless otherwise noted
 - g. Detailed calibration procedures for all furnished instruments
 - h. Recommended Maintenance Procedures
 - i. Recommended Spare Parts
- E. Final Acceptance
1. Final Engineer acceptance is defined as a point in time when (1) all training has been performed, (2) final "As Installed" documentation and software have been received and approved, (3) the system has successfully passed the availability test period, and (4) all punch list items have been resolved.
- F. Guarantee and Warrantees
1. Guarantee all work of these Specifications for a period of one (1) year from the date of final acceptance by the Engineer. With respect to instruments and equipment, guarantee shall cover (a) faulty or inadequate design; (b) improper assembly or erection; (c) defective workmanship or materials; and (d) leakage, breakage, or other failure not caused by Engineer misuse. For equipment bearing a manufacturer's warranty in excess of one year, furnish a copy of the warranty to Engineer with Engineer named as beneficiary

END OF SECTION

SECTION 11 – PUMP CONTROL SYSTEM

GENERAL

SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required for a control system at St. Pete Beach's Pump Station #2 as specified and shown on the Drawings.

PRODUCTS

11.01 GENERAL

- A. The materials used in all systems shall be new, unused and as hereinafter specified. All materials where not specified shall be of the very best of their respective kinds. Samples of materials or Manufacturer's specifications shall be submitted for approval as required by the Engineer.
- B. Materials and equipment used shall be Underwriters Laboratories, Inc. listed and conform with applicable standards of NEMA and ANSI.
- C. Electrical equipment shall, at all times during construction, be adequately protected against mechanical injury or damage by water. Electrical equipment shall not be stored out-of-doors. Electrical equipment shall be stored in dry permanent shelters. If any apparatus has been damaged, such damage shall be repaired by the CONTRACTOR at his expense. If any apparatus has been subject to possible injury by water, it shall be thoroughly dried out and put through such special tests as directed by the Engineer, at the cost and expense of the CONTRACTOR, or shall be replaced by the CONTRACTOR at his own expense.

11.02 PUMP CONTROL SYSTEM

- A. PANEL CONSTRUCTION:
 - 1. The electrical control equipment shall be mounted within a NEMA Type 4X, dead front enclosure, constructed of not less than #14 gauge stainless steel (316 gauge). The enclosure shall be equipped with an inner aluminum door and shall incorporate a removable back panel on which control components shall be mounted. Back panel shall be secured to enclosure with collar studs. Outer panel door shall be equipped with door stop. Panel shall have 3-point latching system.
- B. PLC CONTROL CABINET COMPONENTS
 - 1. Enclosure: Enclosure shall be NEMA 4X by Hoffman or approved equivalent with a heavy-duty padlock hasp. Enclosure shall be 316 Stainless Steel.
 - 2. Inner Safety Door: Panel shall include one aluminum inner safety door, 12 gauge nominal thickness (minimum) with 3/4-inch, 90 degree break bend on all edges for rigidity; full length aluminum hinge; positive twist lock handle; safety latch to keep door open during maintenance.

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3. Provide 120V, 8 Watt cabinet light. Prescolite UCS12-1-08-PH-120-WSW with integral switch. Provide F8T5/CW Lamp and bracket to mount fixture to backpanel.

C. PLC HARDWARE

1. The programmable controller shall be an Allen Bradley SLC 5/05 (1747-L5553), with 16-point, 120V discrete input modules (1746-IA16); analog input modules (1746-NI8); analog output modules (1746-NO8I); relay output module; (1746-OX8) and Prosoft MVI46-MCM modbus communications module as required to fulfill the I/O requirements of this project. There shall be no approved equals.
2. The memory required for program storage and execution is a function of the program development, therefore, the supplier of the pump control cabinet will provide a processor with the quantity of memory required to execute the program developed. If the developed program exceeds the user program or user data size, the contractor shall provide a SLC product to support their developed program.

D. ETHERNET NETWORK

1. An unmanaged switch shall be provided to connect the PLC to the PC via a Cat 5e cable. The switch shall be Hirschmann Spider 5TX or equal.

E. LIGHTNING/SURGE PROTECTION

2. Surge suppressors and arrestors meeting the requirements of ANSI Standard C-62.41 (latest revision) shall be provided on all wiring entering all panels and enclosures.
3. DC signals. Lightning and surge protection shall be provided on all 4-20 mA signal wires. The protectors shall meet the following criteria:
 - a. DIN rail mounted.
 - b. Response time of less than five nanoseconds.
 - c. Automatic reset.
 - d. Operating signal voltage: up to 30 Volts DC
 - e. Operating signal current: up to 250 mA
4. 10kA maximum surge current.
5. Internal 250mA fuse.
6. Manufacturer/model:
 - a. MTL Surge Technologies Cat# SD32

- b. EDCO DRS-036 (with additional fusing)
 - c. Approved equal.
7. Single phase AC Power (to 15 Amps). Lightning and surge protectors for AC power supply lines up to 15 Amps service shall meet the following criteria:
- a. Serial protection with replaceable fuse.
 - b. Failure indicator
 - c. Response time of less than five nanoseconds.
 - d. Capable of withstanding up to 10,000 Amps at IEEE/ANSI C-62.41 8 x 20 microseconds combination wave.
8. Manufacturer/model:
- a. MTL Surge Technologies Cat# MA15
 - b. EDCO HSP121BT
 - c. Approved equal.
9. Single phase AC Power (over 15 Amps). Lightning and surge protectors for AC power supply lines over 15 Amps service shall meet the following criteria:
- a. Parallel protection using MOVs and thermal fusing technology.
 - b. Failure indicator
 - c. Response time of less than five nanoseconds.
 - d. Capable of withstanding up to 6,500 Amps at IEEE/ANSI C-62.41 8 x 20 microseconds combination wave.
10. Manufacturer/model:
- a. EDCO FAS-120AC
 - b. Transtector Slimline
 - c. Approved equal.
11. Discrete Signals.

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- a. All discrete input signals from outside the building shall be equipped with interposing relays to electrically isolate them from the control system I/O.
12. All discrete outputs regardless of their destination shall be equipped with surge protection devices. The protectors shall meet the following criteria:
- a. DIN rail mounted.
 - b. Response time of less than five nanoseconds.
 - c. Automatic reset.
 - d. 10kA maximum surge current.
13. Manufacturer/model:
- a. MTL Surge Technologies Cat# SD150X
 - b. Approved equal.

F. POWER SUPPLIES

1. Uninterruptible Power Supply (UPS) shall be provided in PLC enclosure as follows:
- a. Size the supplies for all internal equipment and all external equipment/devices powered from within the enclosure plus an additional 20% spare capacity.
 - b. Provide 15 minutes battery back-up capability at full load.
 - c. Provide Eaton Powerware model number PW9120-700 or equal.
2. 24 Volt DC Power Supplies
- a. Provide isolated 24 Volt DC power supplies as follows:
 - i. Redundant supplies with separately fused connections to power the PLC and miscellaneous field instruments as shown in the Contract Drawings.
 - ii. A wetting supply for interposing relay contacts that provide discrete inputs to the PLC, separately fused for each input group. An additional, separately fused connection, from this supply shall also power the discrete output isolation relay coils.
 - iii. 24Volt DC power supplies shall be Mean Well model DR-75-24 as required. There shall be no approved equals.

G. ANALOG SIGNAL ISOLATION/LOOP POWER

1. Provision shall be made for providing loop power and signal isolation of the two-wire transmitters as indicated on the drawings.
2. Signal Isolators shall be Moore Industries ECT model with two-wire transmitter excitation option. There shall be no approved equals.

H. ELECTRICAL WIRING

1. Panel (or site) lighting, receptacles, heaters, controls, telemetry and fans on separate branch circuits.
2. Branch circuit breakers shall be Square-D QOU110 and QOU115 as applicable.
3. Thermal circuit breakers shall be 120V and shall be Type TCP as manufactured by Phoenix Contact.
3. Power wiring shall be 600 volt, type THWN stranded copper, No. 14 AWG size, for 120V service.
4. Discrete wiring shall be 600-volt type THWN stranded copper, sized for the current carried, but not smaller than No. 16 AWG.
5. Analog signal wiring shall be 300 volt, stranded copper in twisted shield pairs, no smaller than No. 16 AWG.
6. Panel wiring shall be routed within 2" x 2" panduit.
7. Hinge wiring shall be secured at each end with the bend portion protected by a plastic sleeve.
8. Analog or DC wiring shall be separated from any AC power or control wiring by at least six inches.
9. Each wire shall be uniquely identified using plastic, snap-on numbered tags.
10. Terminal blocks shall be provided for all field wiring entering the panel. The greater of 4 or 15% spare terminal blocks shall be provided. Terminal blocks shall be Square-D, Class 9080 type G.
11. No more than one wire per screw and yoke termination.
12. Duplex receptacles shall be Ground Fault Interrupting (GFI) type, Hubbell model number GFR5352IA or equal.

I. PANEL MOUNTED DEVICES

1. Control/Interposing Relays: All relays shall meet the following:

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- a. Compact, general-purpose, plug-in type.
 - b. Socket mounted.
 - c. Contacts rated for not less than 10 amperes at 120V.
 - d. Square-D Class 8501, Type R, miniature plug-in with relay base. Poles and coil voltages vary, refer to contract drawings.
2. Seal Failure/Thermal Sensors:
 - a. Seal failure/thermal sensors shall be MiniCAS II as provided by Xylem and installed by the SYSTEMS INTEGRATOR. There will be no acceptable equals.
 3. Terminal Blocks. Terminal blocks shall meet the following requirements:
 - a. Screw terminals capable of accepting 10-26 AWG wire.
 - b. Fused disconnect style, Automation Direct Part # DN-F6L110 (when applicable).
 - c. DIN-rail mounting.
 - b. Square-D, Class 9080 type G as applicable.
 - c. Provide end barriers and end anchors as required.
- J. SPARES AND EXPENDABLES
1. Provide the following spare parts:
 - a. One (1) spare SLC 5/05 PLC (1747-L5553).
 - b. One (1) spare analog input module (1746-NI8).
 - c. One (1) spare analog output module (1746-NO8I).
 - d. One (1) spare discrete input module (1746-IA16).
 - e. One (1) spare relay output module (1746-OX8).
 - f. One (1) spare 24V D.C. power supply.
 - g. Five (5) spare relays of each type provided.
 - h. Two (2) spare surge suppressors of each type provided
 - i. Provide the following expendables:
 - i. Two year supply of corrosion inhibitor capsules

- ii. Ten percent (rounded up) spare fuses (minimum of 10) of each type and rating supplied.

11.03 SUBMERSIBLE PRESSURE TRANSDUCERS

- A. The level sensor for controlling the sewage level in wet wells shall consist of a submersible bonded strain gauge inconel pressure-sensing element, encased in a watertight case with a 316 stainless steel FM approved explosion resistant body. It shall be supplied with 40 feet of shielded and vented cable, able to withstand 200 pounds of tensile strength, allowing the transducer to be suspended directly by it's own cable. The cable shall be connected directly to the signal input terminals on the main control panel with no intervening junction box or calibration device required. The device shall require a 10-30 VDC low voltage power supply. The output shall be a standard 4-20 MADC control signal, factory set proportional to the selected fixed range of the transducer, and shall have an accuracy of <0.5% across the temperature band, with a one year stability of <0.2% FSO.
- B. The transducer shall be an FM approved Explosion Proof* Unit and when used with a vented cable, shall be FM approved intrinsically safe when used with an approved barrier (supplied by the customer). The transducer shall meet DO 160 for lightning and surge protection for FAA and MILSTD test and launch standard electrical surge requirements.
- C. The transducer shall be provided with a sealed airbag for compensating for atmospheric changes and to insure that no external moisture reaches the internal electronics. The nose of the transducer shall be threaded onto a protective device consisting of the top half of a 316 stainless steel chemical seal with a welded 316s/s diaphragm. The fill fluid shall be glycerin or silicone depending on the extremes of the temperatures expected to be encountered. Eight 304 stainless steel spacers and bolts and nuts hold a stand-off ring in position so as to fully protect the diaphragm from the debris frequently encountered in lift stations.
- D. Analog signals shall be communicated using shielded stranded signal cable with braided shield and water proof jacket, suitable for the service intended. The transducer supplier shall provide the signal cable of a length required for the installation, coordinate the installation of the signal wiring, and provide appropriate installation procedures.
- E. This device shall be the Birdcage® Lift Station Sensor as assembled and fabricated by Blue Ribbon Industrial Components Corp. Winter Park, FL., incorporating the GP50 model 311Z submersible transducer, or equal.

*Class I, II, III, Div I, Group A, B, C, D, E, F, G.

11.04 FLOAT SWITCHES

- A. High and low level shall be sensed by a polypropylene weighted floats. The floats shall be heavy-duty type, with hermitically sealed non-mercury switch inside the float. Weights shall be 20 ounces minimum. The floats shall be secured at the top of the wetwell via a stainless steel wall mount bracket designed specifically for float

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installation. The float shall be B/W 7000 Series or approved equal. Float shall be used to provide backup high level alarm to PCU.

11.05 ANALOG LOOP SUPPLY AND SURGE PROTECTION

- A. Provision shall be made for providing loop power and signal isolation of the two-wire transmitters as indicated on the drawings.
- B. Signal Isolators shall be Moore Industries ECT model with two-wire transmitter excitation option. There shall be no approved equals.
- C. All analog signal wiring shall be installed in metallic conduit which is physically separated from power conduits. Shields shall be wired to drain only at one end, and terminated to a proper ground connection. Signal loops shall be provided with signal line surge protection at panel. Surge protection shall be MTL catalog # SD32.

11.06 SCADA COMPUTER

- A. Windows-based computer (workstation) shall provide access to all The SCADA SOFTWARE functions.
- B. OS support for SCADA computer shall include Windows 7 and Windows XP.
- C. SCADA computer shall not require customized hardware or specialized software. All required software shall be readily available off-the-shelf products.
 - 1. SCADA computer shall access the PLC controller via an Ethernet TCP/IP local area network (LAN)
- D. Minimum Requirements for a Workstation Computer:
 - 1. Windows 7 operating system
 - 2. Internet Explorer 8
 - 3. Any other specifics as required by the SCADA Software
- E. The dedicated Primary Workstation shall be a Dell XPS 8500 system to be provided, installed and configured by the SYSTEMS INTEGRATOR and shall meet the following requirements:
 - 1. Windows 7 Professional Operating system
 - 2. 3rd generation Intel Core i7 processor
 - 3. 8 GB of memory
 - 4. 1T Hard Drive
 - 5. Provide 24" Widescreen Monitor with 1920 x 1080 resolution
 - 6. Standard keyboard.
 - 7. Optical mouse
 - 8. DVD/CD-RW drive
 - 9. 10/100/1000 Ethernet network card

- F. Provide a separate/individual Uninterruptible Power Supply (UPS) for the SCADA computer.
 - 1. Provide Eaton Powerware model number PW9120-1000 or equal.

11.07 SCADA SOFTWARE

- A. In order to maintain continuity within the City of St. Pete Beach, the SCADA Software to be provided by the SYSTEMS INTEGRATOR shall be General Electric (GE) Intellution based product.
- B. The SCADA Software shall be Proficy HMI/SCADA iFIX 5.5.
- C. SCADA Software shall be configured as a stand-alone node.
- D. The SCADA Software shall be provided with the required I/O driver for the PLC specified.
- E. The SYSTEMS INTEGRATOR shall provide the City of St. Pete Beach with licenses for all software products provided.

11.08 PUMP WATCH RADIO MODEM

- A. The City of St. Pete Beach has standardized their pump station cellular communications based on a Pump Watch Remote Terminal Unit as manufactured by Primex. The SYSTEMS INTEGRATOR shall coordinate the cellular data service plan to be utilized with the City of St. Pete Beach. Antenna requirements and all other system requirements shall coordinated with the unit manufacturer.
- B. The SYSTEMS INTEGRATOR shall be responsible for configuring the Prosoft MVI46-MCM module to allow for alarm/system information to be transferred between the Pump Control PLC and the Pump Watch Unit.
 - 1. The PLC shall act as a Modbus slave unit.
 - 2. Communications shall be via RS485. The SYSTEMS INTEGRATOR shall coordinate the cable pinout requirements and shall provide/install the RS485 communication cable. Port number, baud rate, parity, dta bits, etc. for Modbus communications shall be coordinated with the Pump Watch supplier.
 - 3. The SYSTEMS INTEGRATOR shall coordinate with the Pump Watch supplier to allow the cellular modem to provide as much system information as possible (modem to transmit as much information as it may accommodate).
 - 4. Primex shall supply the Pump Watch RTU in a NEMA 4X enclosure with integral circuit breaker and battery back-up unit.
 - 5. Primex shall provide cellular antenna (3dB - panel mounted).

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6. Primex shall provide Pump Watch web portal customization for displaying, trending and alarming additional bits and registers from the PLC
7. All programming of the Prosoft MVI46-MCM modbus module shall be performed by the SYSTEMS INTEGRATOR.
8. Primex shall provide 2 year of cellular data service (Verizon CDMA)

11.09 AUTODIALER

- A. The autodialer shall be a Sensaphone Model 800.
- B. The SYSTEMS integrator shall coordinate all emergency callout phone numbers required with the City of St. Pete Beach.

EXECUTION

11.10 PLC PROGRAM DEVELOPMENT

- A. The SYSTEMS INTEGRATOR shall program the PLC in order for the Pump Station to function per Specification Section 10.

11.11 SCADA COMPUTER (HMI) SCREEN DEVELOPMENT

- A. Custom screens shall be capable of displaying the status of points and shall allow users to initiate controls.
- B. Custom Screens for new Control System
 1. The Custom screens allow the user to fully control the Pump Station. As a minimum, the HMI screen(s) shall display :

Overall System Screen to include :

- a. Wet Well Water Level
- b. Pump 1 VFD Running
- c. Pump 1 RVSS Running
- d. Pump 1 in Auto Mode
- e. Pump 1 in Hand Mode
- f. Pump 1 Bypassed
- g. Pump 2 VFD Running
- h. Pump 2 RVSS Running
- i. Pump 2 in Auto Mode
- j. Pump 2 in Hand Mode
- k. Pump 2 Bypassed
- l. Pump 3 VFD Running
- m. Pump 3 RVSS Running
- n. Pump 3 in Auto Mode
- o. Pump 3 in Hand Mode
- p. Pump 3 Bypassed
- q. Pump 1 Speed

- r. Pump 2 Speed
- s. Pump 3 Speed
- t. System on Generator Indication
- u. VFD #1 Manual Speed Control
- v. VFD #2 Manual Speed Control
- w. VFD #3 Manual Speed Control

Overall Alarm Screen to include :

- a. VFD #1 Fault
- b. VFD #2 Fault
- c. VFD #3 Fault
- d. RVSS #1 Fault
- e. RVSS #2 Fault
- f. RVSS #3 Fault
- g. Loss of normal power
- h. Loss of DC power
- i. Loss of UPS power
- j. Generator Fault
- k. High Water Level Alarm
- l. Low Water Level Alarm

Maintenance Screen to include :

- a. VFD #1 Run Time
- b. VFD #2 Run Time
- c. VFD #3 Run Time
- d. RVSS #1 Run Time
- e. RVSS #2 Run Time
- f. RVSS #3 Run Time
- g. Generator Run Time
- h. Totalized Flow for Day, Week and Month
- i. Average Wet Well Level for Day, Week and Month

- 2. The operator shall be able to control all system components, adjust setpoints, acknowledge alarms, etc. from the new SCADA computer.
- 3. The SYSTEMS INTEGRATOR shall generate shop drawing submittals for the Custom Screens for approval by the City. At a minimum the submittals shall be :
 - a. Full color
 - b. Have minimum dimension of 11" x 17"
 - c. Shall be annotated to fully describe the function of each element
- 4. The SYSTEMS INTEGRATOR shall resubmit any HMI screen(s) rejected by the City and shall resubmit the shop drawings until they obtain the approval of the City.

11.12 HISTORY AND ALARM DATABASE

- A. The HMI software shall be configured with an alarm and history database to allow for historical trending of motor VFD runtimes, RVSS runtimes, generator runtimes, wet

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well levels and flow rates. Alarms shall be stored in a database to include date and time of alarm, type of alarm, and date and time of alarm acknowledgement by operator. The SYSTEMS INTEGRATOR shall also include any database information as directed by the City of St. Pete Beach.

11.13 TESTING

- A. Testing shall be as per Specification Section 11.

11.14 WARRANTY

- A. Warranty - The SYSTEM INTEGRATOR shall warrant all hardware and software provided under this contract against all defects in material and workmanship for a period of one year. The system supplier shall warrant the telemetry software to be free of defects for as long as it is operational in the county. The SYSTEM INTEGRATOR shall also provide free updates to this software for the life of the system. The function modules utilized in the remote terminal units shall carry an additional two year return-to-factory warranty. The two year return-to-factory warranty shall also cover damage due to lightning.

END OF SECTION

SECTION 12 - ELECTRICAL

GENERAL

12.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required for complete electrical system for St. Pete Beach's Pump Station #2 Renovation, as well as, the installation of two (2) new variable Frequency Drives (VFD's) at St. Pete Beach's Pump Station #1 as hereinafter specified and shown on the Drawings.
- B. The work, apparatus and materials, which shall be furnished under these Specifications and accompanying Drawings, shall include all items listed hereinafter and/or shown on the Drawings. Certain equipment, which will require wiring thereto and/or complete installation, is indicated. All materials necessary for the complete installation shall be furnished and installed by the CONTRACTOR to provide complete power, lighting, instrumentation, wiring and control systems as indicated on the Drawings and/or as specified herein.
- C. The CONTRACTOR shall furnish and install the necessary cables, protective devices, conductors, supports, raceways, exterior electrical system, etc., to serve lighting loads and miscellaneous electrical loads as indicated on the Drawings and/or as specified. The CONTRACTOR shall install any control panel provided under this or any other sections on the specifications.
- D. The work shall include complete testing of all equipment and wiring at the completion of the work and making any minor connection changes or adjustments necessary for the proper functioning of the system and equipment. All workmanship shall be of the highest quality; sub-standard work will be rejected.
- E. For process instrumentation furnish and install all conduit, wire and interconnections between primary elements, transmitters, local indicators and receivers.
- F. It is the intent of these Specifications that the electrical system shall be suitable in every way for the service required. All material and all work, which may be reasonably implied as being incidental to the work of this Section, shall be furnished at no extra cost.

12.02 CODES, INSPECTION AND FEES

- A. All material and installation shall be in accordance with the latest edition of the National Electrical Code and all applicable national, local and state codes, laws and ordinances.
- B. Pay all fees required for permits and inspections.

12.03 TESTS

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- A. Test all systems and repair or replace all defective work. Make all necessary adjustments to the systems and instruct OWNER's personnel in the proper operation of the systems.
- B. The following minimum tests and checks shall be made prior to the energizing of electrical equipment. Test shall be by the CONTRACTOR and a certified test report shall be submitted providing all test results and stating that the equipment meets and operates in accordance with the Manufacturer's and job specifications, and that equipment and installation conforms to all applicable Standards and Specifications:
 - 1. Test all 600-volt wire insulation with a megohm meter after installation. Make tests at not less than 1000 volts. Submit a written test report of the results to the engineer.
 - 2. Mechanical inspection of all circuit breakers to assure proper operation.
- C. The Engineer shall be notified forty-eight (48) hours before tests are made to enable the Owner to have designated personnel present.

12.04 CUTTING AND PATCHING

- A. All cutting and patching shall be done in a thoroughly workmanlike manner.

12.05 INTERPRETATION OF DRAWINGS

- A. The Drawings are not intended to show exact locations of conduit runs.
- B. All three-phase circuits shall be run in separate conduits unless otherwise shown on the Drawings.
- C. Unless otherwise approved by the Engineer, conduit shown exposed shall be installed exposed; conduit shown concealed shall be installed concealed.
- D. Where circuits are shown as "home-runs," all necessary fittings and boxes shall be provided for a complete raceway installation.
- E. The CONTRACTOR shall harmonize the work of the different trades so that interferences between conduits, piping, equipment, architectural and structural work will be avoided. All necessary offsets shall be furnished so as to take up a minimum space and all such offsets, fittings, etc., required to accomplish this shall be furnished and installed by the CONTRACTOR without additional expense to the Owner. In case interference develops, the Owner's authorized representative is to decide which equipment, piping, etc., must be relocated, regardless of which was installed first.
- F. The locations of equipment, fixtures, outlets, and similar devices shown on the Drawings are approximate only. Exact locations shall be as approved by the Engineer during construction. Obtain in the field all information relevant to the placing of electrical work and in case of any interference with other work, proceed as

directed by the Engineer and furnish all labor and materials necessary to complete the work in an approved manner.

- G. Circuit layouts shown are not intended to show the number of fittings, or other installation details. Furnish all labor and materials necessary to install and place in satisfactory operation all power, lighting, and other electrical systems shown. Additional circuits shall be installed wherever needed to conform to the specific requirements of the equipment.
- H. The ratings of motors and other electrically operated devices together with the size shown for their branch circuit conductors and conduits are approximate only and are indicative of the probable power requirements insofar as they can be determined in advance of the purchase of equipment.
- I. All connections to equipment shall be made as shown, specified and directed and in accordance with the approved shop drawings, regardless of the number of conductors shown on the Electrical Drawings.

12.06 RECORD DRAWINGS

- A. As the work progresses, legibly record all field changes on a set of project Contract Drawings. When the project is complete, furnish a complete set of reproducible "As-built" drawings for the Project Record Documents.

12.07 COMPONENT INTERCONNECTIONS

- A. Component equipment furnished under this Specification will not be furnished as integrated systems.
- B. Analyze all systems components and their shop drawings; identify all terminals and prepare drawings or wiring tables necessary for component interconnection.

12.08 SHOP DRAWINGS

- A. As specified under other Sections, shop drawings shall be submitted for approval for all materials, equipment, apparatus, and other items as required by the Engineer.
- B. Shop drawings shall be submitted for the following equipment:
 - 1. PLC Control Cabinet
 - 2. Motor Control Center (MCC)
 - 3. Variable Frequency Drives (VFD's)
 - 4. Reduced Voltage Softstarters (RVSS's)
 - 5. Transfer Switch
 - 6. Natural Gas Generator and sound attenuated enclosure
 - 7. Pump Watch Unit
 - 8. Autodialer
 - 9. Circuit Breakers
 - 10. Surge Protection Devices
 - 11. Lighting Fixtures

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12. Junction Boxes
 13. Wire & cable
 14. Conduit
- C. The Manufacturer's name and product designation and catalog cutsheets shall be submitted for the following material:
1. Conduit
 2. Receptacles
 3. Boxes and fittings
 4. Lamps
- D. Prior to submittal by the CONTRACTOR, all shop drawings shall be checked for accuracy and contract requirements. Shop drawings shall bear the date checked and shall be accompanied by a statement that the shop drawings have been examined for conformity to Specifications and Drawings. This statement shall also list all discrepancies with the Specifications and Drawings. Shop drawings not so checked and noted shall be returned.
- E. The Engineer's check shall be only for conformance with the design concept of the project and compliance with the Specifications and Drawings. The responsibility of, or the necessity of, furnishing materials and workmanship required by the Specifications and Drawings, which may not be indicated on the shop drawings, is included under the work of this Section.
- F. The responsibility for all dimensions to be confirmed and correlated at the job site and for coordination of this work with the work of all other trades is also included under the work of this Section.
- G. No material shall be ordered or shop work started until the Engineer's approval of shop drawings has been given.

12.09 WARRANTY

- A. Provide a warranty for all the electrical equipment in accordance with the requirements of other Sections. Under no circumstances shall the warranty be for less than one year starting from substantial completion.

12.10 ELECTRICAL IDENTIFICATION

SUMMARY

- A. Section Includes:
1. Nameplates.
 2. Labels.
 3. Wire markers.
 4. Conduit markers.

5. Stencils.
6. Underground Warning Tape.
7. Lockout Devices.

CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of tagged devices; include tag numbers.

DELIVERY, STORAGE, AND HANDLING

- A. Division 1 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept identification products on site in original containers. Inspect for damage.
- C. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- D. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

ENVIRONMENTAL REQUIREMENTS

- A. Division 1 - Product Requirements: Environmental conditions affecting products on site.
- B. Install labels and nameplates only when ambient temperature and humidity conditions for adhesive are within range recommended by manufacturer.

NAMEPLATES

- C. Product Description: Laminated three-layer plastic with engraved white letters on black background color.
- D. Letter Size:
 1. 1/8 inch high letters for identifying individual equipment and loads.
 2. 1/4 inch high letters for identifying grouped equipment and loads.
- E. Minimum nameplate thickness: 1/8 inch.

LABELS

- F. Labels: Embossed adhesive tape, with 3/16 inch white letters on black background.

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WIRE MARKERS

- G. Description: Cloth tape, split sleeve, or tubing type wire markers.
- H. Legend:
 - 1. Power and Lighting Circuits: Branch circuit or feeder number.
 - 2. Control Circuits: Control wire number as indicated on shop drawings.

CONDUIT AND RACEWAY MARKERS

- I. Description: Stencils.
- J. Color:
 - 1. Medium Voltage System: Black lettering on white background.
- K. Legend:
 - 1. Medium Voltage System: HIGH VOLTAGE.

STENCILS

- L. Stencils: With clean cut symbols and letters of following size:
 - 1. Up to 2 inches Outside Diameter of Raceway: 1/2 inch high letters.
 - 2. 2-1/2 to 6 inches Outside Diameter of Raceway: 1 inch high letters.
- M. Stencil Paint: As specified in other sections of specifications, semi-gloss enamel, colors.

UNDERGROUND WARNING TAPE

- N. Description: 6 inch wide plastic tape, colored red with suitable warning legend describing buried electrical lines.

LOCKOUT DEVICES

- O. Lockout Hasps:
 - 1. Anodized aluminum hasp with erasable label surface; size minimum 7-1/4 x 3 inches.

PREPARATION

- P. Degrease and clean surfaces to receive adhesive for identification materials.
- Q. Prepare surfaces in accordance with Division 9 for stencil painting.

INSTALLATION

- R. Install identifying devices after completion of painting.
- S. Nameplate Installation:
 - 1. Install nameplate parallel to equipment lines.
 - 2. Install nameplate for each electrical distribution and control equipment enclosure with corrosive-resistant mechanical fasteners, or adhesive.
 - 3. Install nameplates for each control panel and major control components located outside panel with corrosive-resistant mechanical fasteners, or adhesive.
 - 4. Secure nameplate to equipment front using screws or adhesive.
 - 5. Secure nameplate to inside surface of door on recessed panelboard in finished locations.
 - 6. Install nameplates for the following:
 - a. Motor Control Center.
 - b. Panelboard.
 - c. Transfer Switch.
 - d. Disconnect Switches.

Label Installation:

- 7. Install label parallel to equipment lines.
- 8. Install label for identification of individual control device stations, and wall switches where their purpose is not readily obvious.
- 9. Install labels for permanent adhesion and seal with clear lacquer.

Wire Marker Installation:

- 10. Install wire marker for each conductor at panelboard gutters, pull boxes, outlet and junction boxes, and each load connection.

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11. Mark data cabling at each end. Install additional marking at accessible locations along the cable run.
12. Install labels at data outlets identifying patch panel and port designation.

Raceway Marker Installation:

13. Install raceway marker for each raceway longer than 6 feet.
14. Raceway Marker Spacing: 20 feet on center.
15. Raceway Painting: Identify conduit using field painting in accordance with Division 9.

Stencil Installation:

16. Apply stencil painting in accordance with Division 9.

Underground Warning Tape Installation:

17. Install underground warning tape along length of each underground conduit, raceway, or cable 12 inches below finished grade, directly above buried conduit, raceway, or cable.

12.11 RACEWAYS AND FITTINGS

GENERAL

SCOPE OF WORK

- A. All aboveground, exterior conduit shall be rigid aluminum. All conduit installed in slabs, ductbank or below grade shall be rigid non-metallic heavy wall conduit. Minimum conduit size in floor slabs, walls, or below grade shall be ¾-inch. Electrical Metallic Tubing (EMT) shall be permitted to be used in the interior of the Pump Station #2 Control Building (above grade only) for trade sizes 2” and smaller.

PRODUCTS

MATERIALS

- A. Rigid Non-metallic Conduit and Fittings : Rigid non-metallic conduit and fittings of heavy wall polyvinyl chloride (PVC) meeting ASTM Specification D 1785, approved by UL for the specific purpose, may be used in locations not prohibited by the NEC Section 347-3. When equipment grounding is required by Article 250 of the NEC, a separate grounding conductor shall be installed in the conduit. Installation methods of

rigid non-metallic conduit shall conform to Section 347-5 through 347-15 of the NEC. Supports shall be in accordance with Table 347-8.

- B. Rigid Aluminum Conduit and Fittings : All electric aluminum conduit and fittings shall conform ANSI C80.5. Rigid aluminum conduit shall not be used for concealed work. The use of dissimilar metals shall be avoided throughout the system. Installation methods of metallic conduit shall be in accordance with Sections 348-4 through 348-13 of the NEC.
- C. Flexible Metallic Conduit: All motors and all other indicated or necessary equipment shall be connected with liquid-tight flexible metallic conduit of the size required for the conductors to the equipment. Liquid-tight flexible metallic conduit shall be UL, type UA. It shall be installed in such a manner that liquids tend to run off the surface and not drain toward the fittings. Sufficient slack shall be provided to reduce the effects of vibration. Where the fittings are brought into an enclosure with a knock-out, a gasket assembly consisting of an O-ring and retainer shall be installed. These fittings shall be nylon insulated-throat type. Conduit shall be galvanized, PVC covered and shall be constructed to provide a continuous metallic bond. It shall be equal to that manufactured by Appleton "Sealtite".
- D. Electrical Metallic Tubing (EMT) : Steel tubing, zinc coated. Comply with ANSI-C80.3, UL 797

EXECUTION

INSTALLATION:

- A. Conduit shall be concealed unless otherwise shown. Exposed conduit shall run parallel or perpendicular to building planes. Concealed conduits shall be run in a direct line with long sweep bends and offsets. Conduit shall be continuous and installed in such a manner that the system shall be electrically continuous throughout. Conduit ends shall be capped during construction. The ends of all conduits shall be carefully reamed free from burrs after threading and before installation. All cuts shall be made square. All joints shall be made up tight. Care shall be taken to see that all light and power conduit runs form a permanent and continuous ground connection point.
- B. The Contractor shall permanently and effectively ground service neutral and all raceways, devices, and utilized equipment in accordance with the requirements of the NEC, and as shown or required. All grounding electrodes shall have rigid clamp jaws and be UL listed for the application. A separate ground wire shall be provided in all lighting and power raceways.
- C. Conduit stubs shall be located to conform to location of connection boxes on motors and/or other equipment served. Traps in conduit runs shall be avoided. Device boxes in concrete shall be set true and packed as necessary to exclude concrete during placement.
- D. Final connections from the end of the conduit run to equipment or controls for both interior and exterior work shall be made by means of liquid-tight flexible conduit. The length of these sections of flexible conduit shall not exceed 36 inches in length.

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- E. Conductors shall be installed in a workmanlike manner. Damage to insulation or a reduction of the wire size when pulled into the conduit shall be avoided.
- F. All areas of the project are considered to be wet locations and construction within these areas shall be moisture and weather resistant. Work below grade, on grade, or beneath slabs shall be waterproof.
- G. Electrical work shall not rest upon, be supported by or hung from ductwork, piping or equipment. Adequate supports shall be provided to assure that this is achieved.
- H. Boxes, conduit, hangers, panels, etc., shall be fastened to steel by machine bolts and nuts, and by expansion bolts in concrete. Wood or composition plugs shall not be used.
- I. Buried conduit shall be installed so as to assure a watertight system. Turns and bends shall be made using watertight fittings or field-made bends. Trenchwork for installation of conduits and equipment underground shall conform to applicable sections of these specifications. Locations for buried conduit shall be carefully plotted to avoid conflict with other installations. Unless otherwise noted, all buried electrical installations shall be installed at least 24-inches below finished grade.
- J. Where installations pass through walls, slabs, or other structures, all cutting shall be accomplished without damage to the structure. Boring and cutting shall be done with proper equipment and without delivering excessive vibration or shock to the structure.

12.12 WIRES AND CABLES

GENERAL

SCOPE

- A. This section includes the furnishing, installation, and connection of all low voltage and power wiring. This shall include all wires and cables utilized for controls. Conductors specified for low voltage controls shall be coordinated with and approved by equipment manufacturers.
- B. Control wiring specified herein shall be installed and connected by the Electrical Contractor to perform the functions specified in other sections of these specifications.
- C. **REFERENCE STANDARDS:** The following specifications and standards, except as hereinafter modified, are incorporated herein by reference and form a part of this specification to the extent indicated by the references thereto. Except where a specific date is given, the issue in effect (including amendments, addenda, revisions, supplements, and errata) on the date of Invitation for Bids shall be applicable. In text such specifications and standards are referred to by basic designation only.
 - 1) Federal Specifications (Fed. Spec.)
 - J-C-30A(1) - Cable and Wire Electrical (Power, Fixed Installation)
 - HH-I-595C - Insulation Tape, Electrical, Pressure Sensitive Adhesive, Plastic

- 2) National Fire Protection Association (NFPA) Publications:
No. 70 - National Electrical Code (NEC) WIRES AND CABLES

- 3) Underwriter's Laboratories, Inc (UL) Publications:
No. 83 - Thermoplastic – Insulated Wires
No. 493 - Thermoplastic – Insulated Underground Feeder and
Branch Circuit Cables
No. 486 - Wire Connectors and Soldering Lugs

PRODUCTS

MATERIALS

- A. Conductors for 4-20mA signals and where twisted, shielded conductors are shown on the drawings shall have :
 - 1. 2 conductor, #18 tinned copper conductors.
 - 2. Polyethylene insulation material.
 - 3. Aluminum foil-polyester tape with shorting fold
 - 4. Shall be Belden Part Number 8760 or equal as determined by the engineer.

- B. Conductors for MiniCAS II sensor signals and where twisted, shielded conductors are shown on the drawings shall have :
 - 1. 2 conductor, #16 tinned copper conductors.
 - 2. Polyethylene insulation material.
 - 3. Aluminum foil-polyester tape with shorting fold
 - 5. Shall be Belden Part Number 8719 or equal as determined by the engineer.

- C. Power Conductors shall consist of annealed copper wire having a minimum of 98% conductivity and shall be sized and insulated or isolated in accordance with the NEC for the current and voltage of the individual circuit. All conductors, unless specifically noted, shall have type "THWN", 75 degrees f, 600 Volt insulation.

- D. Joints shall be made with mechanical connectors and insulated with two layers of Scotch No. 33 or Slipnot No. 3201 tape.

- E. All splices for conductors #12 through #6 AWG solid or stranded shall be made with "Scotchlock" spring connectors or the pressure wire type. For wire sizes larger than #6, splices shall be made with "OZ" type "XW" or "XTP" as appropriate to the splice being installed. Equal fittings of Burndy and Penn Union may be used. Tape shall be equal to Scotch No. 33 or Slipnot NO. 3201 over splice and filler tape on splices shall be equal to "Scotchfill".

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- F. Flexible cords and cables shall be of the size and number of conductors as indicated on drawings. Cords shall comply with the requirements of Article 400 of the NEC.
- G. Contractor shall coordinate the requirements for flow meter signal converter cable with the respective equipment manufacturers.

EXECUTION

INSTALLATION

- A. All conductors shall be coded throughout, using different colors for phases, white for neutral (white with other color stripe for neutral of a different voltage system) and green for ground. The same color code for a particular phase or part of a circuit shall be run with the same conductor throughout the job. Colors used for each voltage system shall be different. Conductors No. 8 AWG and larger may be black in color but shall be identified with colored tape in all outlet, junction or pull boxes and at the terminals of the equipment.

<u>Phase</u>	<u>120/208V, 3PH, System</u>	<u>480V, 3PH, WYE System</u>
A	Black	Brown
B	Red	Orange
C	Blue	Yellow
Neutral	White	Gray
Ground	Green	Green

- B. All wires in cabinets, boxes, panels, pull and junction boxes shall be trained neatly and tied.
- C. All wires and cables, larger than No. 12 AWG, shall be continuous from origin to destination without splices unless written permission is given by the ENGINEER.
- D. Conductors shall be sized in accordance with NEC requirements. No conductor shall be smaller than No. 12 AWG, except control and signal circuit conductors which may be No. 14 AWG, unless otherwise specified on the drawings.

TERMINATIONS AND SPLICES

- A. Power Conductors: Terminations shall be die type or set screw type pressure connectors as specified. Splices (where allowed) shall be die type compression connector and waterproof with heat shrink boot or epoxy filling.
- B. Control Conductors: Termination on saddle-type terminals shall be wired directly with a maximum of two conductors per termination. Termination on screw type terminals shall be made with a maximum of two spade connectors. Splices (where allowed) shall be made with insulated compression type connectors. Heat shrink boots shall be utilized for all outdoor splices.
- C. Instrumentation Signal Conductors: Terminations permitted shall be typical of control conductors. Splices are allowed at instrumentation terminal boxes only.
- D. Except where otherwise approved by the Engineer no splices will be allowed in manholes,

handholes or other below grade located boxes.

- E. Splices shall not be made in control devices (i.e., pressure switches, flow switches, etc.), conduit bodies, etc.

12.13 BOXES

GENERAL

SCOPE

- A. Boxes shall be provided where required by the NEC and other portions of this division of Specifications.

DESIGN REQUIREMENTS

- A. Where more than one feeder passes through a junction box or pull box, the conductors shall be identified with electrical characteristics, system designation, source and destination. Barriers shall be provided where required by Code.

PRODUCTS

MANUFACTURED UNITS

- A. Boxes shall conform to Federal Specification W-5-800 and sized in accordance with Section 370 of the NEC.
- B. All device outlet boxes and fittings used in the Chlorine and Fluoride Equipment Rooms shall be corrosion resistant, equal to Bell #5322. All other device outlet boxes and fittings including all lighting fixture outlet boxes shall be constructed of galvanized metal and shall be as manufactured by Steel City or equal.
- C. Outlet boxes at a minimum shall be 4-inch square not less than 1 ½- inch deep. Extra large boxes shall be used in accordance with the NEC where necessary to prevent undue crowding of wires. Gang boxes shall be used for gang switches.
- D. Pullboxes shall be constructed of code gauge metal and shall be galvanized. Any box that is tack or spot welded shall be galvanized after fabrication. All boxes shall bear the UL label. Flush boxes shall be equal to Columbia, Type “FC”, surface type shall be Type “SC” or equal.
- E. Cast metal boxes shall be equal to those manufactured by Crouse-Hinds or Pyle National.

EXECUTION

INSTALLATION

- A. Junction and pull boxes shall be installed where required by the NEC and where necessary to facilitate pulling of wire or cable. Consideration shall be given for all sizes of wire and cable, number of bends in raceways and conductor support requirements in vertical raceways. Maximum distance between terminations at

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junction or pull boxes, cabinets or other points of termination shall not exceed 100 feet for straight horizontal runs. This length shall be decreased by 50 feet for each 90 degree bend.

- B. Minimum size of junction and pullboxes shall be determined by the NEC, and by minimum raceway spacing requirements. The minimum raceway spacing shall be such as to allow ¼ inch space between knockouts.
- C. When splices and taps are to be made in junction or pull boxes, the minimum dimensions for straight through pull shall be 12 times the diameter of largest raceway. For angle pulls, the distance between raceway entry and opposite wall shall be 10 times the diameter of largest raceway, plus the sum of diameters of all other raceways entering the same wall. Additionally for angle pulls, the distance between the raceway entries enclosing the same conductor shall be 10 times the diameter of the largest raceway. Wires in junction or pull boxes that are spliced shall be covered with fire-proofing as specified below.
- D. Entries for raceways enclosing the same conductors shall provide the longest sweep or radius for the conductors.
- E. Junction and pull boxes shall be securely supported to the structure, or to a structural member. Raceways shall carry no weight of the box. Boxes embedded in concrete or masonry need not be additionally supported

12.14 WIRING DEVICES

GENERAL

SCOPE

- A. Provision of switches and receptacles.

PRODUCTS

COMPONENTS

- A. Devices in each category shall be the product of a single manufacturer. Shop drawings submittal shall include manufacturer's name and catalog number for each type of device and device plate. Unless noted, all devices shall be ivory in color.
- B. Light switches shall be rated 20 Ampere AC and mounted 4 feet above the floor elevation, unless otherwise noted.
- C. Receptacle Outlets: Convenience outlets shall be duplex grounding, 20-ampere (NEMA type 5-20R) ivory for nominal 120 Volt service, unless otherwise noted.
- D. G.F.I. Outlets: Outlets shall be duplex grounding, G.F.I. type, 20-ampere (NEMA type 5-20R) ivory for nominal 120 Volt service, unless otherwise noted.
- E. Device Plate: Device plates and screws for switches shall be stainless steel or aluminum. Device plates shall be of gang sizes and configurations required by

application. Plates and screws shall be the product of manufacturer of installed devices, made of stainless steel 302 satin, unless specified otherwise.

EXECUTION

INSTALLATION

- A. Contractor to provide testing equipment to test each ground fault interrupter for proper operation. Submit test results to Engineer for approval.
- B. Prior to installation, the wiring devices shall be stored on the job site in the original labeled cartons. The devices shall be installed in the outlets as soon as possible after the wire is pulled. The devices shall then be temporarily covered using the device packaging material, until finishing and painting operations re completed. Devices and service plates that are stained, paint splashed, or scratched shall be replaced.

12.15 DISCONNECTS AND OVERCURRENT PROTECTIVE DEVICES

GENERAL

SYSTEM DESCRIPTION

- A. All disconnecting means shall meet the requirements of the NEC.

PRODUCTS

ACCESSORIES

- A. **Circuit Breakers:** Circuit breakers for all branch circuits shall be molded-case unit breakers with thermal-magnetic trips designed to open all phases simultaneously under overload and/or fault conditions. Breakers shall be of adequate rating for the actual duty required. The breaker shall have quick-make, quick-break, toggle mechanism, inverse-time trip characteristics, and shall be trip-free on overload or short-circuit. Automatic release is to be secured by a bimetallic thermal element releasing the mechanism latch. In addition, a magnetic armature shall be provided to trip the breaker instantaneously for short circuit currents above the overload range. Automatic tripping shall be indicated by a handle position between the manual OFF and ON position. The trip mechanism shall be a combination thermal-magnetic type. Thermal elements shall inverse time characteristics for overload conditions and magnetic trip element shall protect against short circuits by providing instantaneous trip.
- B. **Safety Switches:** All safety switches shall be heavy-duty type "HD". The blades of switches shall be quick-make, quick-break operating type. All lugs on all switches shall be equal to Burdy's solderless quick lugs or shall be compression type. Switches shall have the number of poles and be of the size indicated. Enclosures shall be of the NEMA type indicated on the drawings. The switch shall conform to NEMA Standards and shall be UL listed. Switches shall be equal to General Electric, Square-D, or Cutler-Hammer.

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INSTALLATION

- A. Install disconnects as recommended by the manufacturer, required by Code, and as shown on the drawings.

12.16 SUPPORTING DEVICES

GENERAL

WORK INCLUDED

- A. Conduit supports.
- B. Channel supports for equipment.

REFERENCE STANDARDS

- A. National Electrical Code

PRODUCTS

CONDUIT SUPPORTS

- A. Single Runs: Galvanized conduit straps or ring bolt type hangers with specialty spring clips. Plumbers perforated straps or wire will not be acceptable.
- B. Multiple Runs: Conduit rack with 25 percent spare capacity.
- C. Vertical Runs: Channel support with conduit fittings.

CHANNEL SUPPORTS

- A. Stainless steel channel sections shall be rolled from AISI 1008 commercial grade steel and be in conformance with ASTM A 240.
- B. The cross sectional width dimension of the channel shall be a minimum of 1-5/8-inch. The depth will be as required to satisfy the load requirements. Channel with 1-5/8-inch depth or greater shall be rolled from manufacturer's standard 12 gauge steel. Channel smaller than 1½-inch may be manufacturer's standard 14 gauge steel.
- C. Attachment holes, when required, shall be factory punched on hole centers equal to the channel cross sectional width dimension and shall be a maximum of 9/16-inch in diameter.
- D. Channel attachment nuts shall be designed to prelocate in the channel and provide a bearing surface on the turned down lips while making positive contact with the side walls of the channel.

- E. Straps for the support of conduit shall be designed such that the attachment nut is captivated on the shoulder of the strap when tightened, and the attachment bolt shall allow tightening by either a screwdriver or wrench.
- F. All nuts, bolts, straps, threaded rod and miscellaneous hardware shall be stainless steel.
- G. When tested in accordance with ASTM B117-73 procedure, there shall be no sign of red rust after 1,000 hours of testing. Certified test results to support this must be submitted upon request.

ANCHOR METHODS

- A. Hollow Masonary: Toggle bolts, spider type expansion anchors, or tapcons.
- B. Solid Masonary: Lead expansion anchors, preset inserts, or tapcons.
- C. Metal Surfaces: machine screws, bolts, welded studs, or beam type clamps on steel joints.
- D. Wood Surfaces: Wood Screws
- E. Concrete Surfaces: Self-drilling anchors, power-driven studs, expansion bolts, or tapcons.
- F. See drawings for special mounting and installation.

EXECUTION

INSTALLATION

- A. Layout to maintain headroom, neat mechanical appearance, and to support equipment loads required.
- B. Verify exact mounting and installation requirements with the Owner's representative prior to installation.

12.17 GROUNDING

GENERAL

SCOPE OF WORK

- A. Furnish and install a complete grounding system in strict accordance with Article 250 of the National Electrical Code and as hereinafter specified and shown on the Drawings.

PRODUCTS

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MATERIALS

- A. Ground rods: Ground rods shall be Copperclad steel 3/4-inch x 20 foot. Ground rods shall be Copperweld or be an approved equal product.

EXECUTION

GENERAL

- A. Grounding electrodes shall be driven as required. Where rock is encountered, grounding plates may be used in lieu of grounding rods.
- B. All equipment enclosures, motor and transformer frames, conduits systems, cable armor, exposed structural steel and similar items shall be grounded.
- C. Exposed connections shall be made by means of approved grounding clamps. Exposed connections between different metals shall be sealed with No-Oxide Paint Grade A or approved equal. All buried connections shall be made by welding process equal to Cadweld.
- D. All underground conductors shall be laid slack and where exposed to mechanical injury shall be protected by pipes or other substantial guards. If guards are iron pipe or other magnetic material, conductors shall be electrically connected to both ends of the guard.
- E. The Contractor shall exercise care to insure good ground continuity, in particular between the conduit system and equipment frames and enclosures. Where necessary, jumper wires shall be installed.
- F. Provide grounding test wells where indicated on the drawings.

TESTS

- A. The Contractor shall test the ground resistance of the system. All test equipment shall be provided by the Contractor and approved by the Engineer. Dry season resistance of the system shall not exceed 2 ohms. If such resistance cannot be obtained with the system as shown, the Contractor shall provide additional grounding as directed by the Engineer, without additional payment. The Contractor shall submit all grounding system test results to the Engineer for review.

12.18 LIGHTING FIXTURES

GENERAL

SCOPE OF WORK

- A. The work included under this section of the specifications consists of furnishing all materials and equipment and performing all labor and services necessary for the complete installation of lighting fixtures, including all related systems and accessories, as shown on the drawing or hereinafter specified.

PRODUCTS

LIGHTING FIXTURES

- A. Materials.
 - 1. Lighting Fixtures shall be as specified in the lighting fixture schedule on the drawings and as specified herein.
 - 2. All high intensity discharge lamp ballasts shall be constant wattage or auto-regulator, high power factor type and internally fused.
 - 3. All fluorescent ballasts shall be magnetic energy saving, high power factor (H.P.F.) Class "P", C.B.M. certified by E.T.L., internally protected with an automatic reset thermal protector, with Class "A" sound rating unless otherwise noted. Fluorescent ballasts shall be manufactured by Advance, Jefferson Electric Company, or Universal Manufacturing Corporation.
 - 4. All fixtures shall bear the U.L. label.

EXECUTION

INSTALLATION

- A. Lighting fixture shall be installed as indicated on drawings.
- B. Fasten fixtures securely to provide adequate support.
- C. Ensure that lighting fixtures are plumb.

12.19 TESTS AND INSPECTIONS

GENERAL

SCOPE OF WORK

- A. The CONTRACTOR shall arrange for all inspections required by the local authority having jurisdiction. Approval of the installation by any such local authority shall not relieve the CONTRACTOR of any portion of his responsibility for adequate performance of the completed installation.

SUBMITTALS

- A. The CONTRACTOR shall furnish at least two copies of test records to the ENGINEER. At the completion of all tests specified herein and any others required to make operational all equipment, all records shall be viewed by the CONTRACTOR, then transmitted directly to the ENGINEER. All prints shall be corrected and verified for corrections of in-field changes by the CONTRACTOR prior to submittal.

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PRODUCTS (Not Used)

EXECUTION

PREPARATION

- A. After completion and prior to being energized, the electrical installation shall be tested to the extent necessary to demonstrate that all systems are complete and ready for operation. The CONTRACTOR shall notify the ENGINEER and the OWNER for the final inspection prior to energizing the system.
- B. The CONTRACTOR shall furnish all necessary test equipment to satisfactorily perform all tests specified herein or required by applicable codes and standards.

TESTING

- A. The CONTRACTOR shall test all wire, cable, equipment, and systems installed or connected under the Agreement to assure proper installation, settings, connection, and functioning in accordance with the Drawings, Specifications and the manufacturer's recommendations.
- B. When conducting tests the CONTRACTOR shall:
 - 1. Include all tests and inspections recommended by the equipment manufacturer and applicable Codes and Standards.
 - 2. Include any additional tests required by the ENGINEER that he deems necessary because of field conditions to determine that equipment, material, and systems meet the requirements of the Specifications.
 - 3. Maintain in quadruplicate a written record of all tests showing date, personnel conducting tests, equipment or material tested, tests performed, manufacturer and serial number of testing equipment and results.
- C. Tests to be accomplished as a minimum are as follows:
 - 1. Control Panels/Panelboards : provide temporary power source to all control circuits and check for proper operation prior to energizing equipment served.
 - 2. Wires and Cables:
 - a. High-potential test shall be conducted on all service entrance conductors. The insulation resistance between conductors and also between conductors and ground shall be measured.
 - b. All other cables and wires shall be checked for continuity and shall be determined to be free of grounds prior to energizing.
 - 3. Motor Test: Motor rotation will be checked by momentary energizing of motor. Correction of rotation shall be made by changing leads on the motor. Motors shall only be energized in the presence of a representative of the OWNER.

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- 4. Check phase rotation on all bussing. Phasing shall be A-B-C, left to right, top to bottom, front to rear, as viewed from the front.

- D. CONTRACTOR shall be responsible for any damage to equipment or material due to improper test procedures or test apparatus handling, and shall replace or restore to original condition any damaged equipment or material.

- E. CONTRACTOR shall furnish and use safety devices such as rubber gloves and blankets, protective screens, barriers, and danger signs to adequately protect and warn all personnel in the vicinity of the tests.

DEMONSTRATION OF COMPLETED ELECTRICAL SYSTEMS

- A. Upon the completion of the installation and testing, the CONTRACTOR shall demonstrate and familiarize representatives of the OWNER with the system.

END OF SECTION

SECTION 13 – NATURAL GAS ENGINE DRIVEN GENERATOR WITH WEATHERPROOF ENCLOSURE

GENERAL

13.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required to install, put into operation, and field test the weatherproof natural gas engine driven generator unit at the City of St. Pete Beach's Pump Station #2 as shown on the Drawings and specified herein.
- B. These Specifications are intended to give a general description of what is required, but do not cover all details which will vary in accordance with the requirements of the equipment as offered. It is, however, intended to cover the furnishing, the shop testing, and delivery and complete installation and field testing, of all materials, equipment and appurtenances for the complete unit as herein specified, whether specifically mentioned in these Specifications or not.
- C. For the unit there shall be furnished and installed all necessary and desirable accessory equipment and auxiliaries whether specifically mentioned in these Specifications or not. This installation shall incorporate the highest standards for the type of service shown on the Drawings. The CONTRACTOR is responsible for field testing of the entire installation and instruction of the regular operating personnel in the care, operation and maintenance of all equipment.

13.02 DESCRIPTION OF SYSTEM

- A. The engine-generator set shall be mounted as shown on the Drawings and shall be arranged for automatic starting and stopping, and load transfer upon failure of the normal source of power. The unit controls shall provide for automatic exercising on a weekly basis.

13.03 QUALIFICATIONS

- A. The engine-generator set shall be the standard product, as modified by these specifications, of a MANUFACTURER regularly engaged in the production of this type of equipment. The unit to be furnished shall be of proven ability and shall be designed, constructed, and installed in accordance with best practices and methods. To qualify as a MANUFACTURER, the engine must be the principal item manufactured and the completed engine generator set shall be supplied by the MANUFACTURER's authorized dealer only. The dealer shall have a minimum of ten (10) years experience in the field of power generation.
- B. It is the intent of this specification to secure a generator system that has been prototype tested, factory built, production tested, site tested and of the latest commercial design, together with all accessories necessary for a complete installation as shown on the plans and drawings, and specifications herein. The equipment supplied and installed shall meet the requirements of the NEC, along

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with all applicable local codes and regulations. All equipment shall be new, of current production of a national firm which manufactures the engine/generator and controls, and assembles the generator system as a matched unit so that there is one-source responsibility for warranty, parts, and service through a local representative with factory-trained servicemen.

- C. The unit must be of such physical dimensions as to make a good installation in the opinion of the ENGINEER, in the space provided as indicated on the Drawings.
- D. The unit shall be assembled in the U.S. with over 50% of the components such as the engine, generator, auxiliary equipment, etc., manufactured in the U.S. by a MANUFACTURER currently engaged in the production of such equipment.
- E. The unit shall be shipped to the jobsite by an authorized engine dealer having a parts and service facility within a 250 mile radius of the jobsite. In addition, and in order not to penalize the OWNER for unnecessary or prolonged periods of time for service or repairs to the emergency system, the bidding generator set supplier must have no less than eighty percent (80%) of all engine replacement parts locally available at all times. Certified proof of this requirement shall be furnished to the ENGINEER upon request.
- F. All materials and parts comprising the unit shall be new and unused, of current manufacture, and of the highest grade, free from all defects or imperfections. Workmanship shall conform to the best modern practices. Only new and current models will be considered. The unit offered under these Specifications shall be the product of a firm regularly engaged in the production of engine-generator equipment and shall meet the requirements of the Specifications set forth herein. Major exceptions to Specifications will be considered sufficient cause for rejection of the machines.
- G. The generator set shall be listed to UL 2200.
- H. The Engine/Generator Unit for Pump Station #2 shall be a Kohler model 100REZGD with a 4R9X alternator. The alternator starting capability of the unit shall be 165.0 SKVA at 15% maximum voltage dip. The unit shall operate at 480V, 0.8 power factor. Units meeting this specification, as manufactured by Caterpillar or Cummins, shall be considered as acceptable.

13.04 SUBMITTALS

- A. Submittals shall include prototype test certification and specification sheets showing all standard and optional accessories to be supplied, schematic wiring diagrams, dimension drawings, and interconnection diagrams identifying by terminal number each required for interconnection between the generator set and the transfer switch included elsewhere in these specifications.
- B. The successful bidder shall submit to the ENGINEER for review in accordance with other sections, complete sets of installation drawings, schematics, and wiring diagrams which shall show details of installation and connections to the

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work of other Sections, including foundation drawings showing location and size of foundation bolts for the spring type vibration isolators and brochures covering each item of equipment.

- C. In the event that it is impossible to conform with certain details of the Specifications due to different manufacturing techniques, describe completely all nonconforming aspects.
- D. The submittal data for each engine/generator set and sound attenuated, weatherproof enclosure shall include, but not necessarily be limited to, the following:
 - 1. Installation drawings showing plan and elevations of the complete generator unit; foundation plan; exhaust silencer; starting battery; battery charger; and sound attenuated, weatherproof enclosure.
 - 2. Engine Data:
 - a. Manufacturer
 - b. Model
 - c. Number of cylinders
 - d. RPM
 - e. Bore x stroke
 - f. BMEP at full rated load
 - g. Make and model and descriptive literature of electric governor
 - h. Fuel consumption rate curves at various loads
 - i. Engine continuous pump drive duty rating (without fan) HP
 - j. Gross engine horsepower to produce generator standby rating (including fan and all parasitic loads) HP
 - 3. Generator Data :
 - a. Manufacturer
 - b. Model
 - c. Rated KVA
 - d. Rated SKVA
 - e. Rated KW
 - f. Voltage
 - g. Temperature rise above 40° C ambient
 - i) Stator by thermometer
 - ii) Field by resistance
 - iii) Class of insulation
 - h. Generator efficiency, including excitation losses, at 80% power factor
 - i) Full load
 - ii) $\frac{3}{4}$ load
 - iii) $\frac{1}{2}$ load
 - 4. Generator Unit Control Data :

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- a. Actual electrical diagrams including schematic diagrams, and interconnection wiring diagrams for all equipment to be provided. Standard preprinted sheets are not acceptable.
 - b. Legends for all devices on all diagrams.
 - c. Sequence of operation explanations for all portions of all schematic wiring diagrams.
5. Engine/Generator Unit and Sound Attenuated, Weatherproof Enclosure: Dimensional data shall be given for the Engine/Generator set and for the weatherproof enclosures.
- a. Weight of skid mounted unit
 - b. Overall length
 - c. Overall width
 - d. Overall height
 - e. Exhaust pipe size
 - f. CFM of air required for combustion and ventilation
 - g. Heat rejected to jacket water and lubricating oil - BTU/hr.
 - h. Heat rejected to room by engine and generator - BTU/hr.
 - i. Weatherproof enclosure details and certification of manufacturing method per specifications.
 - j. Data on all miscellaneous items supplied.
6. Furnish the number of copies required of the MANUFACTURER'S certified shop test record of the complete engine driven generator unit.
7. Warranty information.
8. Submit to the ENGINEER operating and maintenance data.
9. Submit to the ENGINEER the equipment MANUFACTURER'S Certificate of Installation, Testing, and Instruction.
10. Submit to the ENGINEER the written warranty as required below.

13.05 TESTING:

- A. To assure that the equipment has been designed and built to the highest reliability and quality standards, the manufacturer and local representative shall be responsible for three separate tests: design prototype tests, final production tests, and site tests.
- B. Design Prototype Tests: Components of the system such as the engine/generator set and accessories shall not be subjected to prototype tests since the tests are potentially damaging. Rather, similar design prototypes and preproduction models, which will not be sold, shall have been used for the following tests. Prototype test programs shall include the requirements of NFPA

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110 and the following:

1. Maximum power (KW).
 2. Maximum motor starting (KVA) instantaneous voltage dip.
 3. Alternator temperature rise by embedded thermocouple and by resistance method per NEMA MG1-2240 and 16.40.
 4. Governor speed regulation under steady-state and transient conditions.
 5. Voltage regulation and generator transient response.
 6. Fuel consumption at 1/4, 1/2, 3/4, and full load.
 7. Harmonic analysis, voltage waveform deviation, and telephone influence factor.
 8. Three-phase short circuit tests.
 9. Alternator cooling air flow.
 10. Torsional analysis testing to verify that the generator set is free of harmful torsional stresses.
 11. Endurance testing.
- C. Final Production Tests: Each generator set shall be tested under varying loads with guards and exhaust system in place. Tests shall include:
1. Single-step load pickup.
 2. Transient and steady-state governing.
 3. Safety shutdown device testing.
 4. Voltage regulation.
 5. Rated power.
 6. Maximum power.
 7. Upon request, arrangements to either witness this test will be made, or a certified test record will be sent prior to shipment.
- D. Site Tests: An installation check, start-up and load test shall be performed by the manufacturer's local representative. The Engineer, regular operators, and the maintenance staff shall be notified of the time and date of the site test. The tests shall include:

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1. Fuel, lubricating oil, an antifreeze shall be checked for conformity to the manufacturer's recommendations, under the environmental conditions present and expected.
2. Accessories that normally function while the set is standing by shall be checked prior to cranking the engine. These shall include: block heaters, battery charger, generator strip heaters, annunciator, etc.
3. Start-up under test mode to check for exhaust leaks, path of exhaust gases outside the building, cooling air flow, movement during starting and stopping, vibration during running, normal and emergency line-to-line voltage, and phase rotation.
4. Automatic start-up by means of simulated power outage to test remote-automatic starting, transfer of the load, and automatic shutdown. Prior to this test, all transfer switch timers shall be adjusted for proper system coordination. Engine coolant temperature, oil pressure, and battery charge level along with generator voltage, amperes, and frequency shall be monitored throughout the test. An external load bank shall be connected to the system if sufficient load is unavailable to load the generator to the nameplate KW rating.

13.06 SPECIAL TOOLS AND SPARE PARTS

- A. Furnish one (1) set of all special tools required for normal operation and maintenance of the equipment being furnished. Furnish suitable steel tool chests complete with locks and duplicate keys.
- B. The MANUFACTURER shall furnish two (2) complete spare replacement sets of all filter elements required for the generator unit.

PRODUCTS

13.07 RATINGS

- A. The generator set shall be a Kohler model 100REZGD with a 4R9X alternator. It shall provide 98kW/122.5 kVA when operating at 277/480 volts, 60 Hz, .8 power factor. The generator set shall be capable of a Standby 130°C rating while operating in an ambient condition of less than or equal to 77° F and a maximum elevation of 656 feet above sea level.
- B. Motor starting performance and voltage dip determinations shall be based on the complete generator set. The generator set shall be capable of supplying 385 LRKVA for starting motor loads with a maximum instantaneous voltage dip of 35%, as measured by a digital RMS transient recorder in accordance with IEEE standard 115. Motor starting performance and voltage dip determination that does not account for all components affecting total voltage dip i.e. engine, alternator, voltage regulator and governor will not be acceptable. As such, the generator set shall be prototype tested to optimize

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and determine performance as a generator set system.

- C. Vibration isolators shall be provided between the engine-alternator and heavy-duty steel base.
- D. The Natural gas Engine/Generator Units shall have the KW ratings as indicated on the drawings at 0.8 power factor with fan.

13.08 ENGINE

- A. The minimum 350-cubic-inch displacement engine shall deliver a minimum of 162 HP at a governed engine speed of 1800 rpm, and shall be equipped with the following:
 - 1. Electronic isochronous governor capable of 0.5% steady-state frequency regulation.
 - 2. 12-volt positive-engagement solenoid shift-starting motor.
 - 3. 70-ampere automatic battery charging alternator with a solid-state voltage regulation.
 - 4. Positive displacement, full-pressure lubrication oil pump, cartridge oil filters, dipstick, and oil drain.
 - 5. Dry-type replaceable air cleaner elements for normal applications.
 - 6. Engine-driven or electric fuel-transfer pump including fuel filter and electric solenoid fuel shutoff valve capable of lifting fuel.
- B. The turbocharged engine shall be fueled by natural gas.
- C. The engine shall have a minimum of 8 cylinders and be liquid-cooled by Unit Mounted Radiator 122°F/50°C.
- D. The engine shall be EPA certified from the factory, and shall not require a site performance test.
- E. Natural Gas fuel supply pressure, measured at the generator set fuel inlet downstream of any fuel system equipment accessories shall be within the operating range of 1.74-2.74 kPa (7.0-11.0 in. H²O).

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13.09 ALTERNATOR

- A. The alternator shall be salient-pole, brushless, 2/3-pitch, 12 lead, self-ventilated with drip-proof construction and amortisseur rotor windings and skewed for smooth voltage waveform. The ratings shall meet the NEMA standard (MG1-32.40) temperature rise limits. The insulation shall be class H per UL1446 and the varnish shall be a fungus resistant epoxy. Temperature rise of the rotor and stator shall be limited to Standby 130°C. The excitation system shall be of brushless construction controlled by a solid- state voltage regulator capable of maintaining voltage within $\pm 2.0\%$ at any constant load from 0% to 100% of rating. The AVR shall be capable of proper operation under severe nonlinear loads and provide individual adjustments for voltage range, stability and volts-per-hertz operations. The AVR shall be protected from the environment by conformal coating. The waveform harmonic distortion shall not exceed 5% total RMS measured line-to-line at full rated load. The TIF factor shall not exceed 50.
- B. The alternator shall have a single maintenance-free bearing, designed for 40000 hour B10 life. The alternator shall be directly connected to the flywheel housing with a semi-flexible coupling between the rotor and the flywheel.
- C. The generator shall be inherently capable of sustaining at least 250% of rated current for at least 10 seconds under a 3-phase symmetrical short circuit without the addition of separate current-support devices.

13.10 GENERATOR, EXCITER AND ACCESSORIES

- A. Rating: The generator's KW ratings shall be as indicated in these specifications, 0.8 p.f., 1800 RPM, 3 phase, 60 Hertz, with a maximum temperature rise of 130 degrees C (both armature and field) by resistance at full rated load in ambient air of 40 degrees C. The generator shall conform to NEMA Standard MG-1.
- B. Performance: The instantaneous voltage dip shall not exceed 15 percent of rated voltage when any load is applied. Recovery of stable operation shall occur within 5 seconds. Steady state modulation shall not exceed + ½ percent.
- C. Construction:
 - 1. The generator and exciter shall be dripproof, with split sleeve, or ball race bearings. A shaft-mounted brushless exciter shall be a part of the assembly. The stator core shall be built up of high grade silicon steel laminations precision punched, and individually insulated. Armature lamination followers and frame ribs shall be welded integral with the frames for support of the stator core. A directional blower shall be mounted on the unit to draw cooling air from the exciter and over the rotor poles and through louvered openings on the opposite end.

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2. The exciters shall be a fast response type, with a rotating 3-phase full-wave bridge. The exciters shall have a low time constant and large capacity to minimize voltage transients under severe load changes.
3. The alternator shall be salient-pole, brushless, 12-lead reconnectable, self-ventilated of drip-proof construction with amortisseur rotor windings and skewed stator for smooth voltage waveform. The insulation shall meet the NEMA standard (MG1-33.40) for Class H and be insulated with epoxy varnish to be fungus resistant per MIL 1-24092. Temperature rise of the rotor and stator shall be limited to 130° C. The excitation system shall be of brushless construction controlled by a solid-state voltage regulator capable of maintaining voltage within +/- 0.25% at any constant load from 0% to 100% of rating. The regulator must be isolated to prevent tracking when connected to SCR loads, and provide individual adjustments for voltage range, stability and volts-per-hertz operations; and be protected from the environment by conformal coating.
4. Generator rotor poles shall be built up of individually insulated silicon steel punchings. Poles shall be wound and bonded with high strength epoxy resin. Cage connections to the amortisseur rings shall be brazed for strong construction and permanent electrical characteristics. Each pole shall be securely bolted to the rotor shaft with bolts sized for the centrifugal forces on the rotor. Generator windings shall be braced for full line to ground fault currents, with solidly grounded neutral system.

D. Accessories and Attachments

1. Low Voltage Terminal Boxes: The generator shall have separate AC and DC low voltage terminal boxes with suitably numbered terminal strip for required connections.
2. Engine Block Heater: Thermostatically controlled and sized to maintain the manufacturer's recommended engine coolant temperature to meet start-up requirements of NFPA-99 and NFPA-110, Level 1. Power supply shall be 120 volts single phase.

E. Generator Associated Controls:

1. Voltage Regulator:
 - i) The generator MANUFACTURER shall furnish a hermetically sealed, silicon controlled rectifier type voltage regulator employing a zener reference with a +1 percent regulation for the generator. The regulator shall include 3-phase voltage sensing, automatic short circuit protection and shall include automatic underfrequency protection to allow the generator to operate at no load at less than synchronous speed for engine start-up and shutdown procedures. Switches and/or fuses shall not be used to provide this protection. An over-voltage sensing module with manual reset shall be furnished with the regulator. A volts per Hz., sensing module shall

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be provided as part of the regulation system.

- ii) A voltage adjustment rheostat for 5 percent voltage adjustment on the unit shall be provided.
 - iii) High voltage step-down potential transformers shall be provided for the voltage regulator power input and sensing circuits if required.
2. Sustained Short Circuit: A permanent magnetic exciter shall be provided on the unit for sustaining a current of 300 percent during a short circuit, permitting the generator breaker to trip on overload. To prevent possible overheating of the armature windings, appropriate relaying shall be supplied to limit the fault to ten seconds. All current transformers required shall be supplied by the switchgear MANUFACTURER.

13.11 SOUND ATTENUATED, WEATHER-PROTECTIVE ENCLOSURE

- A. The intent of this Specification is to provide the OWNER with sound attenuated, weatherproof type generator set enclosures complete in every detail and requiring no additional in-field modifications or assembly, except where specifically allows by these Specifications. The enclosure is to be accurately dimensioned so as to be in compliance with the National Electrical Code (NEC), and the National Fire Protection Association (NFPA) for clearance of all specified items included therein, and all applicable fire codes for a structure and application of this type.
- B. The enclosure shall be of steel construction. The design and construction shall be modular in that the side panels, doors, and louvers shall be a minimum thickness of 14 gauge for all component parts. The roof of the enclosure shall meet or exceed the minimum gauge requirements specified but, in addition, shall be strengthened in such a manner as to support the largest commercially available exhaust silencer recommended by the MANUFACTURER for the applications.
- 1. Construction - All steel used in the construction of the enclosure shall be galvanized with painted finish. This sequence of metal forming, and final assembly of the enclosure must be noted on the drawings submitted for approval and a factory certification of this manufacturing process shall accompany the "as-built" drawings provided to the OWNER. Walls shall be minimum 14 gauge and the roof shall be minimum 12 gauge.
 - 2. Doors - All doors on the enclosure shall be strategically located in areas as to allow ease of maintenance on the generator set and allow good access to and visibility of instruments, controls, engine gauges, etc. The doors shall be fitted with bolt-on, stainless steel hinges constructed with stainless steel hinge pins of a diameter not less than 0.25-inch (1/4-inch). Each door shall be fitted with flush-mounted, adjustable, key-lock latches.

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Enclosure shall be rated for 140 MPH constant wind. Certified calculations shall be provided.

3. Louvers - All louvers fixed and drainable with bird screen and shall be designed to prevent the entrance of driving rainwater, but shall have sufficient free area to allow for 120% of the total engine/generator cooling air requirements used in this application. Maximum air velocity shall be 700 CFM. MANUFACTURER shall submit air flow calculations to engineer for review.
4. Components - All components of the enclosures shall be assembled utilizing 0.375-inch minimum stainless steel bolts, nuts, and lock washers. In addition, watertight neoprene flat washers shall be used on all roof bolts.
5. The MANUFACTURER of the enclosures shall provide mounting brackets for the exhaust silencer specified. In addition, a tail pipe extension shall be provided, terminating in a horizontal plane and cut at a 45° angle to prevent the entrance of water. Stainless steel, seamless flexible exhaust tube and all necessary bolts, flanges, and gaskets to mate with the engine and the exhaust silencer shall be provided. The length of the flexible tubing shall be such that additional solid metal nipples or sections shall not be required to be provided as spacers between the engine exhaust port or the exhaust silencer.
6. Oil and Water Drains - All necessary fittings, hoses, shut-off valves, etc., shall be provided by the MANUFACTURER of the enclosure to facilitate lube oil and water drain at the exterior of the enclosures. In addition, engines equipped with crank-case breather tubes shall have this tube terminate at the exterior of the enclosure directly under the radiator air discharge louver.
7. Enclosure - The enclosures shall be rigidly mounted to generator support rails.
8. Under no circumstances shall the floor area or any of its parts be considered for cooling air intake or discharge requirements of the generator set or their associated equipment, nor shall its properties as a "heat-sink" or heat dissipating medium be utilized in any manner whatsoever in this application.
9. All items specified herein shall be supplied and prewired and/or preinstalled including, but not limited to the following:
 - i) Rain dress for exhaust pipe and tail pipe extensions. Rain dress shall prevent the entrance of rain and allow for the expansion and vibration of the exhaust piping without stress to the exhaust system. Rain dress shall be stainless steel and provided by the enclosure supplier.

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- ii) Coordination between CONTRACTOR and Supplier is mandatory and the equipment Supplier's instructions will be adhered to without exception.
- 10. The enclosure shall have acoustic installation that shall meet UL94 HF1 flame resistance standards.
- 11. The enclosure shall offer a -25 dB(A) sound reduction at 7 meters (23 ft.) using acoustic insulation. (Level II).
- 12. Emergency Stop Pushbutton : Provide a NEMA 4X SS, Red, Mushroom-head emergency pushbutton that will immediately stop the generator upon activation. Provide a placard above the pushbutton to read "Generator Emergency Shut Down". Refer to drawings for pushbutton and placard location and details.

13.12 EXHAUST SYSTEM

- A. Exhaust Silencer - A critical type, side inlet, end outlet, Maxim M-51, or Silex JB silencer and a flexible stainless steel exhaust fitting properly sized shall be furnished and installed according to the MANUFACTURER's recommendation. Mounting shall be provided by the CONTRACTOR as required. The silencers shall be mounted so that its weight is not supported by the engine nor will exhaust system growth due to thermal expansion be imposed on the engine. Exhaust pipe size shall be sufficient to ensure that exhaust back pressure does not exceed the maximum limitations specified by the engine MANUFACTURER. So called "spiral" or truck mufflers are disallowed and will not be considered as equal to the industrial quality silencers specified above.
- B. The silencers shall be fitted with a tail pipe extension terminating at a 45° angle to prevent the entrance of rainwater. It shall also be fitted with an expanded metal bird screen.
- C. Rain Skirt - At the point where the exhaust pipe flexible tubing penetrates the roof of the enclosure, a suitable "rain skirt" and collar shall be provided by the MANUFACTURER. It shall be designed to prevent the entrance of rain and allow for expansion and vibration of the exhaust piping without chafing or stress to the exhaust system. This detail must appear on the drawings submitted for approval.

13.13 AUTOMATIC STARTING SYSTEM

- A. Starting Motors - A DC electric starting system with positive engagement shall be furnished. The motor voltage shall be 24 volts.
- B. Automatic Control - Fully automatic engine start-stop controls in the generator control panels shall be provided. Controls shall provide shutdown for low oil pressure, high water temperature, overspeed, overcrank, and loss of engine coolant. Alarms for approaching high water temperature and impending low oil pressure shall also be included. Controls shall include a 45-second single cranking cycle limit with lockout or a cyclic crank system with lockout and

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overcrank protection.

- C. Batteries - A lead-acid storage battery set of the heavy duty natural gas starting type shall be provided. Battery voltage shall be 24 volts, and the battery set shall be rated no less than 225 ampere hours. Necessary cables and clamps shall be provided.
- D. Battery Trays - battery trays shall be provided for the batteries and shall conform to NEC 480-7(b). It shall be constructed of fiberglass and so treated as to be resistant to deterioration by battery electrolyte. Further, construction shall be such that any spillage or boil-over of battery electrolyte shall be contained within the tray to prevent a direct path to ground.
- E. Battery Charger - A current-limiting, automatic 24 volt DC charger shall be furnished to automatically recharge batteries. Charger shall float at 2.17 volts per cell and equalize at 2.33 volts per cell. It shall include overload protection, silicon diode full wave rectifiers, voltage surge suppressor, DC ammeter, DC voltmeter, and fused AC input. AC input voltage shall be 120 volts, single phase. Amperage output shall be no less than ten (10) amperes. Charger shall be wall mounting type in NEMA 1 enclosure, and U.L. listed as an industrial control panel. The charger shall be as manufactured by LaMarche per NFPA 110 and U.L. 508. The charger shall be mounted and wired within the enclosure for the generator set by enclosure manufacturer.

13.14 MAIN LINE CIRCUIT BREAKER

- A. Type - Main line, 200 ampere frame, 150 ampere trip, 600 volt, 3-pole, 100% rated, molded case circuit breaker.
- B. Circuit breakers shall mounted upon and sized to the output of the generator shall be installed as a load circuit interrupting and protection device. It shall operate both manually for normal switching functions and automatically during overload and short circuit conditions.

Note : The manufacturer may size the main line circuit breaker based on the controller's protective scheme (when said controller meets UL requirements). However, in all cases, the breaker shall operate in a manner to protect both the output conductors and the transfer switch. For this application, the maximum current allowed is 200 amperes.

- B. The trip unit for each pole shall have elements providing inverse time delay during overload conditions and instantaneous magnetic tripping for short circuit protection. The circuit breaker shall meet standards established by Underwriters Laboratories, National Electric Manufacturers Association, and National Electrical Code.
- C. Generator exciter field circuit breakers do not meet the above electrical standards and are unacceptable for line protection.
- D. Circuit breaker shall have battery voltage operated shunt trip wired to safety

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shutdowns to open the breaker in the event of engine failure.

- E. The circuit breaker shall be equipped with an auxiliary contact for remote annunciation of breaker position.
- F. The rating of the circuit breaker shall allow the starting of full generator SKVA.
- G. The circuit breaker enclosure, together with all specified circuit breakers, shall be designed for the specific generator set specified and be equipped with an isolated neutral conductor bus, rear copper stabs, or load cable lugs and be finish painted to match the generator set.

13.15 GENERATOR CONTROL PANELS

- A. Type - A generator-mounted, NEMA 1 type, vibration isolated, 14-gauge steel control panel shall be provided for the generator set. The panel must be capable of facing any direction when mounted upon the generator set. Panel shall contain, but not be limited to, the following equipment:
 - 1. Frequency meter, 4-1/2", dial type, 55-65 hertz.
 - 2. Voltmeter, 4-1/2", 2% accuracy.
 - 3. Ammeter, 4-1/2", 2% accuracy.
 - 4. Ammeter (4 position) and voltmeter phase selector switches (individual).
 - 5. Automatic starting controls as previously specified.
 - 6. Voltage level adjustment rheostat with locking knob.
 - 7. Dry contacts for remote alarms wired to terminal strips.\
 - 8. Five (5) individual fault indicator lights for low oil pressure, over temperature, overspeed, battery charger low, and low coolant level. All lights to be pressed-to-test type, 1" diameter.
 - 9. Four (4) position function switch marked "auto", "manual", "off/reset", and "stop".
 - 10. Battery charging voltmeter, running time meter, electric oil pressure gauge, and electric water temperature gauge, all 2" size (nominal).
 - 11. Auxiliary relay, 3PDT, operating each time generator runs, 10 amp contacts brought out to terminal strip.
 - 12. Two (2) alarms and indicators for approaching low oil pressure and high water temperature. Each light to be press-to-test type, 1" diameter.
 - 13. Alarm horn and silence switch with cleared-fault resound circuitry. Alarm

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shall sound on impending shutdown.

14. Governor motor control switch with cleared-fault resound circuitry.
 15. Panel illumination lights and switch.
 16. An engraved, identification plate listing dealer's name, address, phone number, etc., as well as unit model and serial number shall be mounted on the panel face in a prominent location and be of a size easily read by maintenance personnel.
- B. Digital or solid state meters or metering devices shall be acceptable as a substitute for the electromechanical devices specified.
- C. Engraved, screw-on type nameplates will identify each function indicated without abbreviation of function description. So-called international symbols will not be acceptable substitutes for this mandatory requirement.
- D. Timing Functions - All control panel timing functions shall be accomplished by metal encased, solid-state, plug-in timing relays with 2PDT output contacts rated for ten (10) amperes. All solid-state time delay relays shall be reverse polarity protected and shall not function or be damaged by the application of improper polarity. Open printed circuit board type time delay circuits will not be accepted.
- E. Control Relays - All control relays shall be the 3PDT plug-in type with .187QC blade terminals rated for (10) amperes. Each relay shall be equipped with a manual push to operate check button, L.E.D. or neon visual indicator, and see-thru dust cover for contact inspection and protection. Exposed contact and octal base plug-in relays are not acceptable.
- F. Relay Sockets - All relay sockets shall be of the molded thermoplastic type, suitable for snap mounting on standard D.I.N. rail. Relay sockets will have wire clamp type terminals for secure wire connections, and one (1) piece bus bar connectors between the actual relay blade and wire clamp terminal. Relay sockets shall be rated for fifteen (15) amperes at 300V. Printed circuit board type relay sockets and relay sockets with push-on quick connect terminals are not acceptable.
- G. It shall be possible to adjust alternator output voltage at the control panel.
- H. Outputs :
- 1) There shall be two (2) dry-contact outputs available for interfacing to Pump Control Cabinet PLC system.
 - i) One (1) output shall indicate any generator fault conditions.
 - ii) One (1) operator programmable.

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EXECUTION

13.16 SERVICES

- A. Furnish the services of a competent and experienced MANUFACTURER'S field service technician who has complete knowledge of proper operation and maintenance of the equipment for a period of not less than two (2) days in two separate visits to inspect the installed equipment, supervise the initial test run, and to provide instructions to the plant personnel. The first visit will be for checking and inspecting the equipment after it is installed.
- B. At least one (1) of the two (2) days shall be allocated solely to the instruction of plant personnel in operation and maintenance of the equipment. This instruction period shall be scheduled at least ten days in advance with the OWNER and shall take place during plant start-up and acceptance by the OWNER.
- C. Three final copies of operation and maintenance manuals specified must be delivered to the ENGINEER prior to scheduling the instruction period with the OWNER.

13.17 PAINTING

- A. The engine generator set and associated equipment shall be shop primed and finish coated in accordance with the MANUFACTURER's standard practice prior to shipment. An adequate supply of touch-up paint shall be supplied by the MANUFACTURER.

13.18 TESTING

- A. The engine-generator set shall be given the MANUFACTURER'S standard factory load test prior to shipment.
- B. Prior to final acceptance of the generator set, all equipment furnished under this Section shall be field tested per NFPA 110 to show it is free of any defects and the generator set can operate satisfactorily under full load test using resistance type load banks (brine tanks not acceptable). Test shall be for four (4) continuous hours. Any defects which become evident at this time shall be corrected before acceptance.
- C. An all-in-place static alignment check of all rotating components shall be made prior to first start-up, after unit is secured in place and all final connections are made.
- D. A final alignment check and/or adjustment shall be made after the machines have run four (4) to six (6) hours with its normal connected load.

13.19 SYSTEM SERVICE CONTRACT

- A. The supplier of the standby power system must provide a copy of and make

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available to the OWNER his standard service contract which, at the OWNER'S option, may be accepted or refused. This contract will accompany documents, drawings, catalog cuts, specification sheets, wiring or outline drawings, etc., submitted for approval to the designing ENGINEER. The contract shall be for the complete services rendered over a period of one (1) year. The first year's service shall be included in the contract price.

13.20 WARRANTY

- A. Equipment furnished under this Section shall be guaranteed against defective parts and workmanship under terms of the MANUFACTURER'S and dealer's warranty. But, in no event, shall it be for a period of less than five (5) years (comprehensive) from date of initial start-up of the system and shall include labor, parts and travel time for necessary repairs at the job site. Running hours shall not be a limiting factor for the system warranty either by the MANUFACTURER or the supplying dealer. Submittal data received without written warranties as specified will be rejected in their entirety.

END OF SECTION

SECTION 14 – MOTOR CONTROL CENTER

GENERAL

14.01 SUMMARY:

Section Includes: This section includes, but shall not be limited to, requirements for a motor control center (MCC) and required control devices as shown on the Drawings and specified to be part of the MCC equipment. The MCC shall be 480 volt, 3-phase, 4-wire, 60 hertz.

14.02 REFERENCES:

- A. Codes and standards referred to in this Section are:
1. IEEE C37.90 - IEEE Standard for Relay and Relay Systems Associated with Electrical Power Apparatus
 2. IEEE C62.41 - IEEE Recommended Practice on Surge Voltages in Low Voltage AC Power Circuits
 3. IEEE C62.45 - IEEE Guide on Surge Testing for Equipment Connected to Low Voltage AC Power Circuits
 4. MIL-STD-220A - Method of Insertion-loss Measurement 12/1/59; with N1 and N2 (Fed/mil H-q)
 5. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Not More than 2000 Volts AC or 750 Volts DC.
 6. NEMA ICS 3 - Industrial Control and Systems Factory Built Assemblies
 7. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum)
 8. UL 486A - Wire Connectors and Soldering Lugs for Use With Copper Conductors
 9. UL 845 - Motor Control Centers
 10. UL 1283 - Electromagnetic Interference Filters
 11. UL 1449 - Transient Voltage Surge Suppressors

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14.03 SYSTEM DESCRIPTION:

- A. Design Requirements: Provide equipment capable of operating in an ambient temperature range of 0 to 40 degrees C and humidity of up to 90 percent noncondensing.
 - 1. Provide motor control centers designed for 480-volt, three-phase, 4-wire, 60-hertz operation.
 - 2. Provide all control devices in the center suitable for operation at 120-volts, 60-hertz, unless specifically noted otherwise.
 - 3. Provide all control equipment and devices that meet the requirements of the 600-volt insulation class.
 - 4. Provide motor control centers to include the indicated number of 20-inch deep sections and the components arranged as shown.
 - 5. Arrange the equipment for convenient and ready accessibility from the front for inspection and maintenance of devices, terminals and wiring.

14.04 SUBMITTALS:

- A. General: Furnish all submittals, including the following, as specified in the Specific/General Provisions.
- B. Product Data and Information: Provide catalog data for all associated equipment and devices.
- C. Shop Drawings: Furnish shop drawings customized to the project for motor control centers to include the following:
 - 1. Outline drawings showing dimensions, weights, arrangement, elevations, identification of components and a nameplate schedule for all units.
 - 2. Bill of materials including manufacturers' name and catalog number.
 - 3. Interconnecting wiring diagrams, where required.
 - 4. Individual schematic and wiring diagrams for each compartment.
 - 5. Furnish details showing electrical connections between main and tie circuit breakers and corresponding main buses.
 - 6. Furnish instruction booklets and time-current curves for each circuit breaker supplied.
 - 8. Furnish the following information on surge protection devices (SPDs):
 - a. Verification that surge protection devices comply with UL 1449.

- b. Actual let through voltage test data in the form of oscillograph results for both the ANSI/IEEE C62.41 Category C3 (combination wave) and B3 (ringwave) tests in accordance with ANSI/IEEE C62.45.
 - c. Spectrum analysis of each unit based on MIL-STD-220A test procedures between 50 kHz and 200 kHz verifying that the device's noise attenuation exceeds 50 dB at 100 kHz.
 - d. Test reports from a recognized independent testing laboratory verifying the suppressor components can survive published surge current ratings on both a per mode and per phase basis using the IEEE C62.41, 8 x 20 microsecond current wave. Test data on individual modules are not acceptable. Obtain and enter full performance details on all motors and other equipment being served on the above drawings.
- D. Quality Control: Furnish the following test reports and certificates as specified below:
- 1. Certified Shop Test Reports for motor control centers and related components. Provide a minimum of 15 days written notice prior to shop tests.
 - 2. Detailed field test reports of all tests indicating test performed as specified, discrepancies found, and corrective action taken.
- E. Operation and Maintenance Manuals: Furnish operation and maintenance manuals.

14.05 QUALITY ASSURANCE:

- A. Standards: Provide motor control centers in accordance with NEMA ICS 2, ICS 3, and UL Standard No. 845.
- B. Codes: Provide motor control centers in accordance with the NEC and local codes.
- C. UL Label: Provide a UL Label on each vertical section of each motor control center.

14.06 DELIVERY, STORAGE AND HANDLING:

- A. General: Deliver, store, and handle all products and materials as specified in the Specific/General Provisions.

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- B. Shipping and Packing: Provide all structures, equipment and materials rigidly braced and protected against weather, damage, and undue strain during shipment.
- C. Storage and Protection: Store all equipment and materials in a dry, covered, heated and ventilated location. Provide any additional measures in accordance with manufacturer's instructions.

14.07 SPARE PARTS

- A. General: Furnish the following spare parts:
 - 1. One set of contact tips, control power transformers and operating coils for each six or less of each size of motor starter.
 - 2. One auxiliary contact unit or one set of auxiliary contact tips for each six or less motor control units.
 - 3. Ten percent but not less than two complete control, latching and timing relays of each type used in motor control centers.
 - 4. Two complete replacements of overload heater units for each catalog number installed in motor control centers and motor starters.
 - 5. Two complete replacements of all LED indicating lamps and fuses used in the installation.
 - 6. One complete magnetic starter with motor circuit protector for each size required.
 - 7. Two sets of replacement indicating light color lenses of each color furnished.
 - 8. One circuit breaker test unit.
 - 9. Three 12-ounce spray cans of the final finish for touch-up
- B. Packaging: Pack spare parts in containers bearing labels clearly designating contents and related pieces of equipment. Deliver spare parts in original factory packages. Identify all spare parts with information needed for reordering.

PRODUCTS

14.08 MANUFACTURERS:

- A. Acceptable Manufacturers: Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted for review.
 - 1. Motor Control Centers:
 - a. Square-D Model 6 Series

- b. Cutler-Hammer 2100 Series
- 2. Surge Protection Devices (SPDs):
 - a. Advanced Protection Technology

14.09 MOTOR CONTROL CENTER:

- A. Basic Structural Components: Provide totally enclosed, dead-front, rigid, NEMA 1, Motor Control Center, as a self-supporting and freestanding structure.
 - 1. Construct the various sections from channels not less than 12 gauge, formed into proper shape, suitably reinforced and welded. Grind all internal welds smooth and round off all corners to give a neat and pleasing appearance. Construct doors and covers from a minimum of 14-gauge steel sheets.
 - 2. Provide steel bottom plates in each compartment section.
 - 3. Cover the rear of each structure with easily removable steel panels for rear access.
 - 4. Provide hinges, screws, bolts, circuit breaker operating mechanisms, nameplate mounting screws and other metallic appurtenances with a noncorrodible metal covering.
 - 6. Install full height steel barriers on each side of the tie breaker structure to prevent the passage of flames and ionized gases.
 - 7. Provide each motor control center with a three-phase bus compartment at the top and a conduit and cable compartment at the top and bottom.
 - 8. Provide the cable compartments that run the full length of the motor control center.
 - 9. Provide access to cable compartments by means of removable hinged doors.
 - 10. Provide each structure with a vertical wiring space between the starter cells and side sheet for unit wiring.
 - 11. Equip the vertical wiring space with cable supports to hold the cables and wiring in place.
 - 12. Motor Control Center physical dimensions shall be compatible with pre-fabricated building to be provided for Pump Station #2.

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- B. Bus Requirements: Provide main buses of tin plated copper bars across each structure, sized in accordance with UL temperature rise of 50 degrees C based on a 40-degree C ambient temperature.
1. Provide a 600-ampere minimum, main horizontal bus, unless otherwise shown.
 2. Support all bus bars in each structure by means of bus supports fabricated from an insulating material.
 3. Connect the horizontal bus to the incoming line circuit breakers and from both sides of the tie breaker with copper bars securely fastened in place.
 4. Provide tin-plated vertical three-phase copper bus of sufficient size to carry loads served.
 5. Insulate main and vertical buses over their entire length. Provide insulated covers over all bolted connections.
 6. Separate the bus bar compartments from breaker and controller cubicles by insulated barriers or steel plates.
 7. Provide a 300-ampere uninsulated copper grounding bus with lugs for connections to the plant grounding system in the bottom of each motor control center.
 8. Brace all bus work suitably to withstand a minimum of 42,000 rms amperes symmetrical short circuit current. Substantiate construction by a certified laboratory test covering units of similar construction.
- C. Individual Units: Provide motor control or circuit breaker units in combinations of not less than 12-inch modular heights.
1. Provide units of the plug-in or nonremovable type in accordance with the manufacturer's standard for type and size of controller.
 2. Provide plug-in units within-plated, pressure-type line disconnecting stabs of high strength copper alloy. Hold each plug-in unit in place and arrange the units such that they can be removed or remounted readily without access to the rear of the structure.
 3. Construct doors to be drip-proof and dust-tight. Provide all doors with hinges and screw fasteners for holding the doors closed. Fabricate each door as a part of the structure and not part of the unit.
 7. Equip the doors for motor control compartments with a motor circuit protector operating mechanism, thermal overload relay reset mechanism, controls and indicating lights and other required devices as shown.

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8. Equip the doors for branch feeder equipment with a circuit breaker operating mechanism.
 9. Provide mechanical interlocks between the compartment door and circuit breaker operating mechanism to prevent opening of the door unless the breaker is in the OFF position, and to prevent closing the breaker unless the door is fully closed.
 10. Provide circuit breaker operating mechanisms or handles that are padlockable in the OFF position with room for a minimum of three padlocks.
 11. Provide units having devices that are serviceable from the front, without provisions for rear access.
 12. Provide control power transformers, relays, timers, space heaters and accessories for each unit as shown or specified.
- D. Wiring:
1. Provide NEMA Class II Type B wiring for the motor control centers, including internal interlock and internal wiring between controller units and devices.
 2. Provide internal wiring runs for interconnecting units with stranded switchboard wire having 600-volt rated, flame-resistant, type SIS insulation. Provide No. 14 AWG wire for control interconnections. Provide power connections as required for the service.
 3. Provide wire markers at each end of all wires.
 4. Where wiring connections are made to equipment mounted on hinged doors, provide connections with extra flexible wires suitably cabled together and cleated.
 5. Provide the wiring of all control connections to individual terminal blocks at each motor starter. Locate terminal blocks for front access.
 6. Provide interlocking wiring between units of a motor control center or between units of grouped centers as internal wiring with terminals provided for external connections.
 7. Provide sufficient pull apart terminal blocks for all devices external to the motor control center.
- E. Variable Frequency Drives (VFD's) and Reduced Voltage Soft-Starters (RVSS).

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1. Refer to specification Section 16 for the VFD's and RVSS's required at Pump Station #2.
- F. Feeder Circuit Breakers: Provide molded-case type, two- or three-pole feeder circuit breakers as shown, with a minimum voltage rating of 600-volt ac.
1. Interrupting Ratings: Provide an interrupting capacity of 65,000 rms symmetrical amperes at 480 volts. Base interrupting rating on the IEEE and NEMA Standard duty cycle for this class of equipment.
 2. Provide circuit breakers trip units as follows:
 - a. Provide individual, thermal-magnetic trip units for all frame sizes smaller than 400 amperes.
 - b. Provide trip units that actuate a common tripping bar to open all poles when an overload or short circuit occurs on any one.
 - c. Provide trip elements with inverse time tripping and instantaneous tripping at about ten times the normal trip device rating.
 - d. Provide circuit breakers with trip-free handles.
- G. Main Circuit Breaker: Provide molded-case type, three-pole feeder circuit breakers as shown, with a minimum voltage rating of 600-volt ac.
1. Interrupting Ratings: Provide an interrupting capacity of 35,000 rms symmetrical amperes at 480 volts. Base interrupting rating on the IEEE and NEMA Standard duty cycle for this class of equipment.
 2. Provide circuit breaker trip unit as follows:
 - a. Provide individual, thermal-magnetic trip unit for 200 amperes.
 - b. Provide trip unit that actuates a common tripping bar to open all poles when an overload or short circuit occurs on any one.
 - c. Provide trip element with inverse time tripping and instantaneous tripping at about ten times the normal trip device rating.
 - d. Provide circuit breaker with trip-free handle.
- H. Surge Protection Devices (SPDs):
1. Provide surge protection devices (SPDs) that complies with UL 1449.
 2. Provide units with a maximum, continuous-operating voltage that exceeds 115 percent of the nominal system operating voltage.
 3. Provide surge protection devices suitable for delta configured systems.

4. Provide surge protection devices that distribute the surge current to all MOV components to ensure equal stressing and maximum performance and provides equal impedance paths to each matched MOV.
6. Provide high-performance EMI/RFI noise rejection filters that attenuate the electric line noise at least 50 dB at 100 kHz using the MIL-STD-220A insertion loss test method.
7. Wire internal components with connections utilizing low impedance conductors and compression fittings.
8. Provide a monitoring panel for each system that incorporates the following features:
 - a. Green/red solid state indicator light to indicate which phase(s) have been damaged.
9. Provide SPDs suitable for service entrance or branch location application with a minimum total surge current capable of withstanding 160kA per phase respectively.
10. Provide SPD with circuit breaker sized per manufacturer's recommendations. Circuit breaker handle for SPD shall extend through SPD door.
- I. Integral Panelboard and Distribution Transformer: Provide integral 120/208V, 100 ampere main circuit breaker, 3-phase, 4-wire distribution panelboard with a minimum of 24 single-pole spaces. Provide a 480V to 120/208V, 3-phase, 30 KVA transformer with a 40 ampere primary circuit breaker to feed the distribution panelboard. Provide Panelboard with equipment ground bus and isolated signal ground bus.
- J. Feeder Cable Terminals: Provide closed-end, compression-type, solderless connectors and terminals, suitable for copper conductors for terminating cables.
- K. Wiring Schematic: Provide a schematic wiring diagram of each unit and affix it to the inside of the door of that unit.
- L. Identification: Provide nameplates having the same type, appearance and shape throughout each motor control center.
- M. Automatic Transfer Switch: The rating of the automatic load transfer switch (ATS) shall be as indicated on the drawings. The ATS shall be 3-pole with a solid neutral. The ATS shall be installed within the MCC line-up. The withstand and closing ratings with any overcurrent device shall be 35,000 RMS symmetrical amperes minimum.

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- N. The automatic transfer switch shall be mechanically held on both the emergency and the normal side, and rated for continuous duty in the above described enclosure. The switch shall be solid-state, electronically controlled, double throw with the main contacts rigidly and mechanically interlocked to ensure positive positioning of power switches. A manual operator must be provided to enable one (1) hand manual operation which, when utilized, can provide a neutral position for servicing operations.
- O. The automatic transfer switch shall be a single motor operated circuit breaker type with interpole barriers and arc chutes. All elements of the drive system must be replaceable from the front of the switch, and the power switching devices must be replaceable without removal of the connecting cables.
- P. The transfer switch shall be listed under U.L. 1008 and CSA certified to CSA 22.2 No. 178-1978.
- Q. Accessories - The automatic load transfer switches specified shall include the following accessories:
1. Full phase protection. Solid-state phase monitor shall be field adjustable, close differential type, with 85-100% pick-up and 75-98% drop-out. A single adjustment shall set all phases.
 2. Phase failure or unbalanced phase detection.
 3. Solid-state voltage and frequency monitor on generator output to prevent transfer prior to proper output parameters, adjustable 85-100% of generator rated voltage and frequency, with adjustable drop-out of 75-85% of pick-up setting.
 4. Adjustable, solid-state, 0.5 to 6 seconds time delay on engine starting to override momentary outages and nuisance voltage dips.
 5. Adjustable, solid-state, 2 to 30 minutes time delay on retransfer of load to normal.
 6. Adjustable, solid-state, 2 to 30 minutes cool-down timer wherein the generator set runs unloaded after retransfer to line.
 7. Motor load decay time delay, adjustable for 1.5 to 15 seconds and operating on transfer to either source.
 8. Adjustable, solid-state, 0.5 seconds to 5 minutes time delay on transfer to emergency source after verification of emergency source voltage and frequency.
 9. Test switch to simulate normal power failure, heavy duty, oil tight, pushbutton type with momentary contacts and override circuitry to revert to normal power if emergency source should fail during test.

10. Three (3) pilot lights, to indicate the normal and emergency position of the transfer switch, and mode selector switch in "off" position. Lights shall be 'Push-to-Test' type.
11. Engine starting contacts to provide for generator starting.
12. Two (2) auxiliary S.P.D.T. contacts that close when connected to normal source and two (2) S.P.D.T. auxiliary contacts that close when connected to emergency source.
13. Plant exerciser to start and run the generator set with or without load (in-field switchable) each 168 hours for a 30 minute interval.
14. Four (4) position mode selector switch marked "test", "auto", "off", and "engine start".
15. Equipment grounding lug.
16. 3-phase differential voltage sensing of alternate source.
17. 3-phase overvoltage sensing of normal source.
18. Reset switch to manually bypass time delay on retransfer to normal.
19. Reset switch to manually retransfer to normal source after time delay.
20. Normal/alternate source available pilot lights.
21. Push-to-test pilot lights for connected-to-normal and connected-to-emergency source.
22. Engine generator exercise timer with switch to select with load or without load.
23. In-phase monitor for motor loads; monitors sources and retransfers to normal when both sources are phase; prevents excess transients on transfer.

14.10 SOURCE QUALITY CONTROL:

- A. Tests: Shop test each motor control center in accordance with IEEE and NEMA standards.

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1. Operational Tests: After the equipment has been completely assembled, perform operational tests to determine the general operating conditions and circuit continuity. Also, perform high potential tests and other standard tests for that particular class of equipment.

EXECUTION

14.11 INSTALLATION:

- A. General: Install all equipment in accordance with the manufacturer's recommendations and approved shop drawings and as specified in the Specific/General Provisions.
- B. Overloads: Adjust the thermal overloads on each phase of the starter units to the actual motor installed.
- C. Cable Connections: Terminate and label all field wiring per the approved diagrams.
- D. Torque Requirements: Tighten electrical connectors and terminals, including screws and bolts, in accordance with equipment manufacturers' published torque tightening recommendations. Where manufacturers' torquing requirements are not available, tighten connectors and terminals in accordance with UL Standard 486 A.

14.12 FIELD QUALITY CONTROL:

- A. Inspections: Inspect, adjust and check the installation for physical alignment, cable terminations and ventilation.
- B. Tests: Perform the following field tests:
 1. Close and open each circuit breaker and motor circuit protector to test operation.
 2. Energize the motor control center and test for hot spots.
 3. When site conditions permit, energize and de-energize each equipment item served by each motor control center, testing the complete control sequence of each item.

14.13 OPERATIONAL DEMONSTRATION:

- A. Manufacturer's Representative: Furnish the services of a qualified, factory-trained service engineer to assist in installation, start-up, field testing, calibration, placing into operation and provide training of each motor control center.
 1. Furnish the services of a service engineer when the equipment is placed into operation.

2. Furnish the services of a service engineer at job site as often as necessary until all problems are corrected and the equipment installation and operation are satisfactory.
3. Training: Following completion of installation and field testing provide training for 6 employees of the City in the proper operation, troubleshooting and maintenance of the equipment as outlined below. All training will be at the City's facilities at a time agreeable to the City:
 - a. Operational Training: A minimum of two 4-hour sessions combining both classroom and hands-on instruction, excluding travel time.
 - b. Maintenance Training: A minimum of two 4-hour sessions combining both classroom and hands-on instruction, excluding travel time.
- B. Operation and Maintenance: Furnish operation and maintenance instructions as specified in the General Provisions.

14.14 CLEANING AND PAINTING:

- A. Field Painting: Clean and touch up any scratched or marred surface to match original finish.

END OF SECTION

SECTION 15 – VARIABLE FREQUENCY DRIVES – PUMP STATION No. 1

GENERAL

15.01 RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 12 Specification sections, apply to work of this section.

15.02 DESCRIPTION OF WORK:

- A. This section covers the work necessary to furnish and install complete variable frequency drives (VFDs) for the proposed system as indicated on the Contract Documents. The scope of the work under this section is to furnish all labor, materials, equipment and incidentals required to complete the installation of 12 pulse Clean Power VFDs with input line reactors as described with cabinetry, wiring, manual and automatic circuitry, instrumentation and controls as necessary to fulfill the intent of these specifications for a complete system ready for operation.
- B. For this project, VFDs shall be furnished for the City of St. Pete Beach's Pump Station #1 Renovation. The Station shall require two (2) 140 hp VFD's.

15.03 REFERENCES:

- A. The VFD assembly must comply to all applicable design standards including the following:
 - 1. NEMA ICS 3.1 -Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable Speed Drive Systems.
 - 2. NEMA -Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 3. IEEE Standard 444 (ANSI-C343)
 - 4. IEEE 519 (1992) Recommended Practices for Electrical Harmonics
 - 5. IEC: 146A

15.04 SUBMITTALS:

- A. Submittal drawings shall include descriptive information as required to fully describe the VFD and associated components, circuit protection, solid state controllers, control logic, etc.
- B. Any proposed deviations or substitutions from the specification must be itemized and descriptive information provided to insure compliance with project requirements.
- C. Submittal data shall include; front and side views of enclosures, overall dimensions, conduit entrance locations, and requirements, nameplate legends, and enclosure details.

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- D. Submittal data shall include one-line diagram depicting all circuit protective, solid-state controllers, control logic, external control interface points, and power and harmonic filtering devices.
- E. A letter written on VFD Manufacturers letterhead stating the VFD MTBF (mean time between failure).
- F. Harmonic calculations showing VFD installation in conformance to IEEE519 (1992) shall be provided with submittals.
 - 1. Isc to IL ratio of 21 and fault current of 20,000 amps shall be used for all calculations.
 - 2. Calculations shall be made for all VFDs operating at full load.

15.05 QUALITY CONTROL AND QUALIFICATIONS:

- A. VFD shall have a minimum and documented MTBF (mean time between failure)rating of 28 years.
- B. Manufacturer must have a minimum of 10 (ten) years documented experience, specializing in VFDs.
- C. Manufacturer must have an authorized service technician within 200 miles of project job-site.

15.06 OPERATION AND MAINTENANCE DATA:

- A. Operation and Maintenance data will be submitted for approval after commissioning of VFDs and shall include all criteria listed in Specification Section 01730 in addition to the following:
 - 1. All data provided in the VFD submittal package shall be updated to as installed condition as part of final Operation and Maintenance data.
 - 2. Complete manufacturers technical manual covering VFD operation, programming, maintenance, and parts lists.
 - 3. Field harmonic test report showing compliance with IEEE 519 standards.
 - 4. List of all programmable parameters installed in VFD and any other configured device in VFD system.
 - 5. Statement of VFD warranty.

15.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site, under provisions of this section and instructions of VFD manufacturer. Accept VFD on site in original packing. Inspect for damage. Freight damage will be the responsibility of receiving on-site contractor.
- B. Store in a clean, dry non-condensing indoor space. Maintain factory wrapping, or provide an additional heavy canvas or heavy plastic cover, to protect units from dirt, water, construction debris, and traffic. Insure that VFD is not subject to moisture including condensation.

PRODUCTS

15.08 VARIABLE FREQUENCY DRIVE:

- A. The speed control for variable speed pumps shall be variable frequency drives suitable for installation as shown on the drawings.
- B. The variable frequency drives shall include all internal auxiliaries required to meet the functional specifications.
- C. The variable frequency drives shall conform to all requirements stipulated in this section and Division 16 - Electrical, and shall be designed for an extended speed range of 60% to 100% of full load motor speed.
- D. Each drive shall have the following design features.
 - 1. The drive shall employ microprocessor-based inverter logic isolated from power circuits.
 - 2. The drive shall employ a diode bridge on the input, SCR inputs are not acceptable.
 - 3. The drive shall employ a common Main Control Board.
 - 4. The drive shall employ a Pulse Width Modulated (PWM) inverter system using third generation IGBT's to minimize audible motor noise and increase overall performance.
 - 5. The drive shall employ a switching logic power supply operating from the DC bus.
 - 6. The drive shall employ phase to phase and phase to ground MOV protection.

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7. The drive shall have a documented 28 years mean time between failure. A letter certifying this shall be provided with the bid and as part of the formal submittals.
 8. The drive shall be designed to have a minimum of 2khz carrier frequency without de-rating and provide selectable PWM Swing carrier patterns to minimize audible motor noise.
 9. The drives shall be provided as 18-pulse dual rectifier input design. Passive harmonic filters are not acceptable. Multi-pulse technologies utilizing auto-wound transformers are not acceptable. Active harmonic rectification technology is not acceptable.
 10. The drive shall be designed to operate on an AC line which may contain line notching and up to 10% harmonic distortion.
 11. The drive shall be designed to shut down with no component failure in the event of an output phase to phase or phase to ground short circuit and provide annunciation of the fault condition.
 12. The drive shall be designed with a common control connection diagram for all ratings.
 13. The drive shall be designed such that the inverter section power semiconductors do not require commutation capacitors.
 14. The drive shall be designed to be variable torque rated. The drive shall supply 120% of rated current for up to one minute.
 15. The drive shall be designed to allow all parameter adjustments to be made with the door closed.
 16. The drive shall be designed with a common Customer Interface for all horsepower ratings. The Interface shall include an LCD digital display, programming keypad and operator keys option.
 17. The drive shall provide multiple programmable stop modes, including ramp, coast, brake and S-curve.
 18. The drive shall be designed to have an adjustable output frequency up to 60 Hz $\pm 10\%$.
- E. The drives shall have the following features.
1. Interface: The drive shall provide a removable Human Interface Module with integral display to show drive operating conditions, adjustments, and fault indications. The display shall be removable under power without causing a drive fault and be visible and operable without opening the enclosure door. The display shall consist of three lines of 16-character, alphanumeric, back-lit LCD with the display being configurable for three

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display values simultaneously with customized multi-lingual test, all scaled to user units.

2. Volts per Hertz Adjustment: Drive programming shall provide the ability to fully configure the volts per hertz for squared, cubed, straight line or full custom patterns.
3. Current Limit: The drive shall provide a programmable current limit from 20% to 150% of variable torque rating. Current limit shall be active for all drive states; accelerating, constant speed, and decelerating. The drive shall employ PI Regulation for smooth transition.
4. Acceleration/Deceleration: The Accel/Decel settings shall provide adjustments to allow either setting to be adjusted from 0 seconds to 600 seconds. The drive shall provide a second set of remotely selectable Accel/Decel settings.
5. Speed Regulation: The drive shall be capable of operating in a variety of speed regulation modes, including slip compensation with 0.5% speed regulation.
6. Speed Profiles: The drive shall be capable of producing speed profiles with linear acceleration/ deceleration or 'S-Curve' profiles that provide changing Accel/Decel rates. S-Curve profiles shall be selectable for fixed or adjustable values.
7. Adjustments: The digital interface shall be used for all set-up, operation, and adjustment settings. All adjustments shall be stored in non-volatile memory for factory default values as well as a programmable set of user defaults.
8. Auto Commissioning: The drive shall be capable of automatically determining the motor's stator resistance by outputting both an AC and DC voltage to the motor and monitoring motor current. Stator resistance shall be stored in drive memory for determining proper voltage and current requirements.
9. IR Compensation (DC Boost): The drive shall provide a selectable range for offsetting motor losses at low frequency operation DC Boost shall be current regulated and shall automatically adjust, on each start, to load changes. DC Boost shall be programmable from 15% to 120% of drive rated current.
10. Fault Reset/Run: The drive shall provide up to four automatic fault reset and restarts following a fault condition before locking out and requiring manual restart.

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11. Skip Frequencies: The drive shall provide three adjustable setpoints to lock out continuous operation at frequencies which may product mechanical resonance. The setpoints shall have an adjustable bandwidth of 0 Hz to 60 Hz.
12. Run On Power Up: The drive shall provide for automatic restart of equipment after restoration of power after an outage.
13. Fault Memory: The drive shall provide a means to store the last four faults as well as operating frequency, drive status, and power mode at time of fault. Information shall be maintained in the event of power loss.
14. Overload Protection: The drive shall provide NEC motor overload protection testing in accordance with UL Standard 991.
15. Terminal Blocks: The drive shall provide separate terminal blocks for control and power wiring.
16. Operator's Devices: The drive shall be provided with the following door mounted pilot devices in addition to the door mounted Human Interface Module:
 - a. Hand/Off/Auto selector switch
 - b. Maintained Emergency Stop (red mushroom head)
 - c. Start Pushbutton
 - d. Stop Pushbutton
 - e. Reset Pushbutton
 - f. Power On pilot light (red)
 - g. Run pilot light (green)
 - h. Fault pilot light (amber)
 - i. Auto Mode pilot light (amber)
 - j. High Pressure pilot light (amber)
 - k. Motor Over Temp/Seal Failure pilot light (amber)
 - l. No Flow Alarm pilot light (amber)
 - m. Speed Pot
17. Control Inputs: The drive shall provide a separate control input terminal block for customer wiring to remote start, stop, auxiliary, remote speed reference access and enable inputs. Four additional inputs shall be provided as programmable for functions such as preset speed access, job, second Accel and Decel time access and local control selection. Inputs shall be programmable to configure the drive for standard 3 wire, 2 wire, EC and serial operation requirements.
18. Ride Through: The drive shall be capable of control logic ride through in the event of power outages up to 2 seconds in duration.
19. Loss of Reference: In the event of loss of the 4 mA to 20 mA reference signal, the drive shall be user programmable to the following:
 - a. Fault and stop

- b. Alarm and maintain last reference (within 10%)
 - c. Alarm and go to preset speed
 - d. Alarm and go to minimum speed
 - e. Alarm and go to maximum speed.
20. Analog Output: The drive shall supply two analog outputs selectable 0 volt DC to 10 volt DC or 0 mA to 20 mA which shall be user programmable such that is proportional to output frequency, output current, bus voltage or output power, KW, output volts, or output current.
21. Digital I/O: The drive contact output ratings shall be 115 volt AC / 30 volt DC, 5.0 amps resistive, 2.0 amp inductive. The three contacts provided shall be as follows
- a. Form C Fault Contact
 - b. Two programmable Form A contacts.
22. Reference Signals:
- a. Analog: The drive shall be capable of operating from the following speed reference signals:
 - i. VFD Human Interface Module (Hand)
 - ii. 4 mA to 20 mA signal (Auto)
 - b. Analog inputs shall be programmable to include the following functions and digital display shall indicate the following condition status using the following English messages:
 - i. Speed referenece
23. The following pump specific control and protective features shall be provided. Protective features shall provide English language display on drive digital display when active:
- a. Loss of prime protection
 - b. Over Cycling protection
 - c. No flow detection
 - d. Thrust bearing start
 - e. Low input pressure
 - f. Low/high flow level
 - g. Anti Jam protection
 - h. De-scale operation

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24. In addition to the above functionality, provide control, power, and logic functionality as shown in applicable project drawings.
- F. Acceptable manufacturer for the variable frequency drive units is Yaskawa IQ Pump by ICON Technologies, no equal.

15.09 ENCLOSURE:

- A. Each VFD shall be pre-installed inside of a ventilated and filtered NEMA 1 enclosure.
- B. All VFD components must be contained internal to the enclosure.
- C. The manufacturer shall provide wire trough to allow for running power and control cable from existing conduit locations to the available bottom cable entry space in the variable frequency drive.
1. The wire trough shall be painted steel designed to support weight of the VFD. Width and depth of wire trough shall match VFD dimensions. Height of wire trough shall be designed to allow proper installation of power and control cables utilizing existing conduits.
 2. Variable frequency drive shall be no more than 84 inches in height to allow for wire trough such that proper height of VFD disconnect is maintained to applicable codes.
- D. Enclosure shall be designed to dissipate heat of VFD while operating at full load.
- C. Each VFD enclosure shall have the following:
1. Input circuit breaker disconnect.
 2. Each individual VFD shall be supplied with a surge protection device (SPD).
 3. Clean Power Harmonic Reduction Technology for each 18-pulse drive shall be provided by a full-kva rated, phase-shifting drive isolation transformer with a minimum 5% impedance.
 4. Phase shifting transformers shall be designed for convection cooling without the need for forced cooling airflow. The VFD phase shifting transformer system shall be designed for continuous operation.
 5. Output dv/dt filters should be provided if inverter duty motors are not supplied or if motor lead length is greater than 100 feet. If filters are to be provided, then they shall contain a 1.5% reactor and a resistive/capacitive network and they should be manufactured by TCI or equal.

- E. As a minimum, the VFD shall be provided with the following deadfront-mounted operator devices in addition to devices required by schematic diagrams that may be part of the project plans and specifications:

Hand-Off-Auto
Run, Fault, Power On, High Pressure Alarm, High Temp Alarm, High Motor
Temp/Seal Failure and No Flow Alarm pilot lights
Start Pushbutton
Stop Pushbutton
Reset Pushbutton
Maintained Emergency Stop Pushbutton (red mushroom head)
Keypad.
Speed Pot.

15.10 XYLEM MINICAS II UNIT:

- A. Each VFD shall accommodate one (1) Xylem MiniCAS II unit as indicated on the drawings. MiniCAS II units shall be supplied by the pump supplier and shall be installed by the VFD supplier. MiniCAS II unit input power shall be 120V AC.

15.11 POWER QUALITY AND TOLERANCES:

- A. VFD shall be rated for 460 plus 10% and minus 15% with full torque performance and operate in under-voltage conditions down to 270 volts (460 volt VFDs) without tripping.
- B. Displacement Power Factor: 0.98 over entire range of operating speed and load.
- C. Operating Ambient Temperature: -10 degrees C. to 45 degrees C.
- D. Humidity: non-condensing to 95%.
- E. Altitude: to 3300 feet, higher by derating.
- F. Minimum Efficiency: 96% at half speed; 98% at full speed.
- G. Starting Torque: 150% starting torque shall be available from 0.3 Hz to 60 Hz.
- H. Overload capability: 110% of rated FLA for 60 seconds for variable torque (centrifugal) and 150% FLA for 60 seconds for constant torque (positive displacement) loads. Instantaneous overload capacity shall be 180% of rated FLA.
- I. The VFD must meet the requirements for Radio Frequency Interference (RFI) above 7 MHz as specified by FCC regulations, part 15, subpart J, Class A devices.

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15.12 MANUFACTURES FIELD SERVICES:

- A. Field start-up assistance and customer on-site training will be included with the VFD quotation.
 - 1. Provide a minimum 3 days start-up assistance
 - 2. Provide training of City personnel. Minimum of one (1) – four (4) hour session.
- B. Harmonic Field measurements will be made and a report will be provided reviewing the installed VFD harmonic content and its conformance to IEEE-519 specifications.
 - 1. Measurements will be made with Reliable Power Meter Model 1656 or AEMC model 725 Harmonic Analyzer or Square D Power Logic Meter.
 - 2. Measurements shall be made and report generated by engineer or technician with background in Harmonic Analysis.
- C. The VFD supplier shall provide a pump vibration analysis. Vibration shall be monitored at all operating speeds. The drive shall be adjusted as necessary so as to minimize pump vibration.

EXECUTION

15.13 INSTALLATION

- A. The Drive manufacturer shall provide adequate drawings and instruction material to facilitate installation of the Drive by electrical and mechanical trades people employed by others.
- B. The new VFD's shall function in the exact same manner as the units to be replaced. The control wiring, I/O and connections to the existing PLC control system shall be identical to those that currently exist.

15.14 START UP

- A. Certified factory start-up shall be provided for each drive by a factory authorized service center. A certified start-up form shall be filled out for each drive with a copy provided to the owner, and a copy kept on file at the manufacturer.
- B. The factory will extend the normal warranty for the Drive with a certified factory start-up.

15.15 PRODUCT SUPPORT

- A. Factory trained application engineering and service personnel that are thoroughly familiar with the Drive products offered shall be locally available at both the specifying and installation locations.

15.16 WARRANTY

- A. Provide VFD warranty, for two years. Manufacturer's certification of warranty to be supplied in Operation and Maintenance data. Warranty shall include all parts, labor, and technician transportation costs and shall commence upon acceptance by the Owner (Date of Substantial Completion).

END OF SECTION

SECTION 16 – VARIABLE FREQUENCY DRIVES – PUMP STATION No. 2

GENERAL

16.01 RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 12 Specification sections, apply to work of this section.

16.02 DESCRIPTION OF WORK:

- A. This section covers the work necessary to furnish and install complete variable frequency drives (VFDs) for the proposed system as indicated on the Contract Documents. The scope of the work under this section is to furnish all labor, materials, equipment and incidentals required to complete the installation of 12 pulse Clean Power VFDs or 6 pulse VFDs with input line reactors and active filters with bypass starters as described with cabinetry, wiring, manual and automatic circuitry, instrumentation and controls as necessary to fulfill the intent of these specifications for a complete system ready for operation.
- B. For this project, VFDs shall be furnished for the City of St. Pete Beach's Pump Station #2 Renovation. The Station shall require three (3) 35 hp VFD's.

16.03 REFERENCES:

- A. The VFD assembly must comply to all applicable design standards including the following:
 - 1. NEMA ICS 3.1 -Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable Speed Drive Systems.
 - 2. NEMA -Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 3. IEEE Standard 444 (ANSI-C343)
 - 4. IEEE 519 (1992) Recommended Practices for Electrical Harmonics
 - 5. IEC: 146A

16.04 SUBMITTALS:

- A. Submittal drawings shall include descriptive information as required to fully describe the VFD and associated components, circuit protection, solid state controllers, control logic, etc.
- B. Any proposed deviations or substitutions from the specification must be itemized and descriptive information provided to insure compliance with project requirements.

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- C. Submittal data shall include; front and side views of enclosures, overall dimensions, conduit entrance locations, and requirements, nameplate legends, and enclosure details.
- D. Submittal data shall include one-line diagram depicting all circuit protective, solid-state controllers, control logic, external control interface points, and power and harmonic filtering devices.
- E. A letter written on VFD Manufacturers letterhead stating the VFD MTBF (mean time between failure).
- F. Harmonic calculations showing VFD installation in conformance to IEEE519 (1992) shall be provided with submittals.
 - 1. Isc to IL ratio of 21 and fault current of 20,000 amps shall be used for all calculations.
 - 2. Calculations shall be made for all VFDs operating at full load.

16.05 QUALITY CONTROL AND QUALIFICATIONS:

- A. VFD shall have a minimum and documented MTBF (mean time between failure)rating of 25 years.
- B. Manufacturer must have a minimum of 10 (ten) years documented experience, specializing in VFDs.
- C. Manufacturer must have an authorized service technician within 200 miles of project job-site.

16.06 OPERATION AND MAINTENANCE DATA:

- A. Operation and Maintenance data will be submitted for approval after commissioning of VFDs and shall include all criteria listed in Specification Section 01730 in addition to the following:
 - 1. All data provided in the VFD submittal package shall be updated to as installed condition as part of final Operation and Maintenance data.
 - 2. Complete manufacturers technical manual covering VFD operation, programming, maintenance, and parts lists.
 - 3. Field harmonic test report showing compliance with IEEE 519 standards.
 - 4. List of all programmable parameters installed in VFD, Bypass Starter, and any other configured device in VFD system.
 - 5. Statement of VFD warranty.

16.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site, under provisions of this section and instructions of VFD manufacturer. Accept VFD on site in original packing. Inspect for damage. Freight damage will be the responsibility of receiving on-site contractor.
- B. Store in a clean, dry non-condensing indoor space. Maintain factory wrapping, or provide an additional heavy canvas or heavy plastic cover, to protect units from dirt, water, construction debris, and traffic. Insure that VFD is not subject to moisture including condensation.

PRODUCTS

16.08 MANUFACTURERS:

- A. The following VFD suppliers have been pre-approved for this project:

Yaskawa by ICON Technologies
Square D Altivar 58TRX
- B. Any alternative products must be pre-approved by the project engineer at least 14 days from the original project bid date. This not extended should the project be postponed from initial advertised bid date.
- C. No other VFD suppliers or third party assemblers will be accepted unless pre-approved and named by addendum.

16.09 DESCRIPTION:

- A. Provide adjustable speed drives per operating and design conditions specified suitable for operating at the current, voltage, and horsepower indicated. All VFDs shall conform to requirements of NEMA ICS 3.1.
- A. Each VFD shall be pre-installed inside of a motor control center cabinet.
- C. Each VFD enclosure shall have the following:
 - 1. Input circuit breaker disconnect.
 - 2. Each individual VFD shall be supplied with a surge protection device (SPD). If a 6-pulse drive with active filter is provided, the active filter shall also be provided with a SPD.
 - 3. Clean Power Harmonic Reduction Technology for each 12-pulse drive shall be provided by a full-kva rated, phase-shifting drive isolation transformer with a minimum 5% impedance. Each 6-pulse drive supplied in "stand-

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alone" cabinets shall be provided with an isolation transformer with a minimum 5% impedance for harmonic reduction. Each 6-pulse drive supplied in MCC cabinets shall utilize 3% input line reactors in lieu of the isolation transformers. One (1) active filter shall be installed at each site and one (1) spare filter shall be provided to the Owner and stored as directed should 6 pulse drives be supplied on this project. Each active filter, excluding the spare, shall be furnished with a circuit breaker and SPD.

4. Phase shifting transformers shall be designed for convection cooling without the need for forced cooling airflow. The VFD phase shifting transformer system shall be designed for continuous operation.
 5. Output dv/dt filters should be provided if inverter duty motors are not supplied or if motor lead length is greater than 100 feet. If filters are to be provided, then they shall contain a 1.5% reactor and a resistive/capacitive network and they should be manufactured by TCI or equal.
- D. Each VFD shall be provided with a bypass starter.
1. The bypass shall incorporate four contactors. VFD output isolation contactor, RVSS output contactor (these two contactors are to be mechanically and electrically interlocked), an input isolation contactor and a shorting/bypass contactor that has a function of taking the SCRs off line once the motor has reached full speed.
 2. RVSS shall be manufactured by MagneTek model RVS-DN, Square-D model ATS48, or equal subject to the same pre-approval conditions stated herein for the VFD.
 3. Each RVSS shall have the following capabilities:
 - 1.15 service factor
 - Internal motor overload protection.
 - 100% to 400% current limit
 - Phase loss and heat sink over temperature protection
 - The SSRV bypass system shall be mounted within the VFD enclosure.
- E. As a minimum, the VFD shall be provided with the following deadfront-mounted operator devices in addition to devices required by schematic diagrams that may be part of the project plans and specifications:
- Hand-Off-Auto
 - VFD/Bypass selector switches
 - Run, Fault, & Power On pilot lights
 - Keypad.
 - Speed Pot.

16.10 POWER QUALITY AND TOLERANCES:

- A. VFD shall be rated for 460 plus 10% and minus 15% with full torque performance and operate in under-voltage conditions down to 270 volts (460 volt VFDs) without tripping.
- B. Displacement Power Factor: 0.98 over entire range of operating speed and load.
- C. Operating Ambient Temperature: -10 degrees C. to 45 degrees C.
- D. Humidity: non-condensing to 95%.
- E. Altitude: to 3300 feet, higher by derating.
- F. Minimum Efficiency: 96% at half speed; 98% at full speed.
- G. Starting Torque: 150% starting torque shall be available from 0.3 Hz to 60 Hz.
- H. Overload capability: 110% of rated FLA for 60 seconds for variable torque (centrifugal) and 150% FLA for 60 seconds for constant torque (positive displacement) loads. Instantaneous overload capacity shall be 180% of rated FLA.
- I. The VFD must meet the requirements for Radio Frequency Interference (RFI) above 7 MHz as specified by FCC regulations, part 15, subpart J, Class A devices.

16.11 DESIGN:

- A. Design Technology: VFD shall employ a voltage source PWM technology consisting of full-wave diode rectifier, fixed voltage DC link, and PWM output inverter section controlled by solid-state microprocessor based digital control platform isolated from all power circuits.
- B. Input AC to DC Diode Rectifier Section: VFD input power stage shall convert three-phase AC line power into a fixed DC voltage via a dual (12-pulse ready) full wave diode rectifier, using separately mounted MOV (metal oxide varistor) protection.
- C. Intermediate DC Link Section:
 - 1. DC bus as a supply to the VFD Output Section shall maintain a fixed voltage with filtering and short circuit protection.
 - 2. DC Bus shall be interfaced with the VFD diagnostic logic circuit, for continuous monitoring and protection of the power components.
 - 3. DC link shall be designed with circuit to allow a minimum of 2 seconds power-loss ride through without tripping via capturing motor rotational and

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DC link stored energy to keep VFD running during temporary loss of utility power and to allow time for standby generator starting.

- D. Output DC to AC Inverter Section:
1. Insulated gate bipolar transistors (IGBTs) shall convert DC bus voltage to variable frequency and voltage. Insulated gate bipolar transistors (IGBTs) shall convert DC bus voltage to variable frequency and voltage.
 2. All VFDs must be selected for operation at carrier frequencies at or above 4 kHz without de-rating; or shall utilize a noise cancellation technique for reducing noise. Audible motor noise, while operating under VFD control, shall be limited to 3 db above the amount of noise generated across the line measured at one meter from the motor. Should the motor generate more audible noise than specified the vendor shall, at no charge, provide sound shielding for the motor such that the installation meets the above performance specification.
 3. VFD shall have an adjustable carrier frequency: The carrier frequency shall have a minimum of five settings to allow adjustment in the field or shall utilize a noise cancellation technique for reducing motor noise.
- E. VFD Controls and System Interface (see electrical wiring diagram for controls specific to this project):
1. Circuit boards shall utilize surface-mount technology.
 2. All circuit boards shall be conformal coated to help protect microprocessors and complex integrated circuits from hydrogen sulfide and methane gasses.
 3. VFD shall include two independent remote reference inputs. One shall be 0-10 VDC. The other shall be programmable for either 0-10 VDC or 4-20 mA. Either input shall respond to a programmable bias and gain.
 4. VFD shall have two independent remote reference outputs capable of either 0-10 VDC or 4-20mA. Either output shall be programmable to model up to 10 VFD parameters.
 5. VFD shall include a minimum of five multi-function input terminals, capable of being programmed to determine their function when their state is changed. These terminals shall provide up to 20 functions, including, but not limited to:

Remote/Local operation selection.
Detection of external overheat condition.
Remote Reset
Multi-step speed commands
 6. VFD shall include two 4-20mA selectable analog output signals, proportional to output frequency, output current or output power, for either monitoring, or "speed tracking" the VFD.

7. VFD shall include at least one external fault input, which shall be programmable, for either a normally open, or a normally closed contact, for connection to system permissibles such as check-valves, pressure alarms, etc.
8. VFD shall include one fully rated form-"A" contact and one fully rated form "C" contact, capable of being programmed to determine what conditions must be met in order for them to change their state. These contacts shall be rated for at least 1A at 250 VAC. These terminals shall provide up to 15 functions, including, but not limited to:
 - a. HOA in Hand.
 - b. HOA in Auto.
 - c. Bypass selected.
 - d. VFD Running.
 - e. VFD Faulted.
 - f. RVSS Running.
 - g. RVSS Faulted.
9. VFD shall include a front mounted, deadfront panel, sealed keypad operator, with a digital display, to provide complete programming, operating, monitoring, and diagnostic capability.
10. The VFD shall be provide with a 3-position, maintained contact selector switch for Hand-Off-Auto selection. The VFD shall also include a 2-position, maintained contact selector switch for Bypass Starter selection.
11. A three line 16 character LCD display shall provide readouts of; output frequency in hertz, output voltage in volts, output current in amps, output power in kilowatts, DC bus voltage in volts, interface terminal status, and fault codes. All displays shall be labeled in easy-to-read English language. Codes are not acceptable.
12. VFD shall be capable of PID (Proportional, Integral, Derivative) logic, to provide closed-loop setpoint control capability, from a remote reference.
13. VFD shall include loss of input signal protection, with a speed default to 80% of the most recent speed.
14. The motors shall be supplied with a thermal switch to protect the motors from thermal overloads. The VFD and bypass starter control logic shall incorporate this switch as a system permissive.
15. VFD shall include electronic thermal overload protection for both the drive and motor, profilable for variable or constant torque. The electronic thermal

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motor overload shall be approved by UL. Otherwise, a separate UL approved thermal overload relay shall be provided in the VFD enclosure.

16. VFD shall include the following programming functions:
 - a. Critical frequency rejection capability: 2 selectable, adjustable bands.
 - b. Auto restart capability.
 - c. Stall prevention capability.
 - d. "s" curve soft start capability.
 - e. "Speed search" capability, in order to start a rotating motor.
 - f. Fifteen preset volts per hertz patterns.
 - g. One adjustable volts per hertz pattern.
 - h. Current limit adjustment capability, from 30 % to 200 % of rated full load current of the VFD.
 - i. Anti "wind milling" function capability.

F. Programming and Communications:

1. VFD shall include factory settings for all parameters, and the capability to be reset back to those settings.
2. VFD shall include the capability to adjust the following functions, while the VFD is running:

Acceleration adjustment from 0 to 3600 seconds.

Deceleration adjustment from 0 to 3600 seconds.

A minimum of five different preset speeds.

Analog output gain, to calibrate the signal for the application used.

16.12 ENCLOSURE:

- A. Each VFD and bypass starter shall be supplied inside of a Motor Control Center (MCC) assembly. The MCC dimensions shall be compatible with the pre-fabricated structure to provided and installed by others.
- B. All VFD and bypass starter components must be contained internal to the MCC and be operated at full load.
- C. Enclosure and MCC installations must be designed such that bypass starters can operate without air-conditioning inside the enclosure.
- D. Enclosure and MCC installations shall be designed to dissipate heat of VFD and bypass starters while operating at full load.
- E. Coordinate dimensions of cabinets with the Pre-Engineered, Pre-Assembled Electrical and Control Enclosure manufacturer.

16.13 MANUFACTURES FIELD SERVICES:

- A. Field start-up assistance and customer on-site training will be included with the VFD quotation.
 - 1. Provide a minimum 3 days start-up assistance
 - 2. Provide training of City personnel. Minimum of one (1) – four (4) hour session.
- B. Harmonic Field measurements will be made and a report will be provided reviewing the installed VFD harmonic content and its conformance to IEEE-519 specifications.
 - 1. Measurements will be made with Reliable Power Meter Model 1656 or AEMC model 725 Harmonic Analyzer or Square D Power Logic Meter.
 - 2. Measurements shall be made and report generated by engineer or technician with background in Harmonic Analysis.
- C. The VFD supplier shall provide a pump vibration analysis. Vibration shall be monitored at all operating speeds. The drive shall be adjusted as necessary so as to minimize pump vibration.

EXECUTION

16.14 INSTALLATION

- A. The Drive manufacturer shall provide adequate drawings and instruction material to facilitate installation of the Drive by electrical and mechanical trades people employed by others.

16.15 START UP

- A. Certified factory start-up shall be provided for each drive by a factory authorized service center. A certified start-up form shall be filled out for each drive with a copy provided to the owner, and a copy kept on file at the manufacturer.
- B. The factory will extend the normal warranty for the Drive with a certified factory start-up.

16.16 PRODUCT SUPPORT

- A. Factory trained application engineering and service personnel that are thoroughly familiar with the Drive products offered shall be locally available at both the specifying and installation locations.

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16.17 WARRANTY

- A. Provide VFD warranty, for two years. Manufacturer's certification of warranty to be supplied in Operation and Maintenance data. Warranty shall include all parts, labor, and technician transportation costs and shall commence upon acceptance by the Owner (Date of Substantial Completion).

END OF SECTION

SECTION 17 – VALVES AND ACCESSORIES

17.01 GENERAL

All valves shall be suitable for the purpose specified or as shown on the plans. All valves shall be complete with all necessary actuating handwheels and worm and gear actuators, as shown on the plans and which are required for proper operation upon completion of the work included in this project.

Renewable parts, including discs, packing and seats, shall be of types recommended by the valve manufacturer for the intended service.

All units shall have the name of the manufacturer, size and pressure rating of the valve cast on the body or bonnet or shown on a permanently attached metal plate in raised letters.

All units shall be cleaned and installed in accordance with the manufacturer's recommendations.

17.02 DATA TO BE SUBMITTED

The contractor shall submit the following information and documents:

A. Shop Drawings

1. Product data sheets for make and model.
2. Complete catalog information, descriptive literature, specifications, and identification of materials of construction.
3. Power and control wiring diagrams, including terminals and numbers.
4. Complete motor nameplate data.
5. Open/Close and throttle actuators sizing calculations.

B. Quality Control Submittals

1. Certificates of Compliance.
2. Tests and inspection data.
3. Operation and Maintenance Manuals.

17.03 ACTUATORS AND ACCESSORIES

The valve actuator types, as specified herein, describe only the general characteristics of the actuator. It shall be understood that the actuator shall be compatible with the valve that it will be used with and shall be of the same manufacturer, or a product that is recommended by the valve manufacturer.

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When the maximum force required to actuate a valve under full operating head exceeds 40 pounds, gear reduction actuators shall be provided.

Worm and gear actuators used on manual actuated valves shall be of totally-enclosed design, so proportioned as to permit actuation of the valve under full operating head with a maximum pull of 40 pounds on the handwheel, chainwheel or crank. The valve actuators shall be of the self-locking type to prevent the disc or plug from creeping. Self-locking worm gears shall be of one-piece design of gear bronze material, accurately machine cut. The worm shall be of hardened alloy steel, with thread ground and polished. The reduction gearing shall run in a proper lubricant. Valve actuators shall be provided with position indicators, where shown, to show the position of the valve disc or plug. Ferrous handwheels shall be galvanized and painted the same color as the valve and associated pipeline.

All valve actuators shall open by turning counterclockwise.

Handwheel actuator shall be the manufacturer's standard and shall be of rugged non-corrosive construction for the service intended.

17.04 SEWAGE SERVICE VALVES

Valves for use with wastewater shall be lined with the same materials as the adjacent ferrous piping, fusion-bonded epoxy in accordance with AWWA C-550, or an otherwise specially approved. Valves located aboveground shall be painted in accordance the appropriate coating system specified elsewhere.

A. Plug Valves

1. Plug Valves shall be of the non-lubricated eccentric type, with resilient plugs faced with natural or synthetic rubber suitable for service indicated on the plans.
2. Port areas shall be unobstructed when open and have smoothly-shaped waterways of not less than 100 percent of full-pipe area except valves 12-inches and larger shall have not less than 80 percent open area. Bodies shall be semi-steel (cast iron), suitable for 150 psi working water pressure and shall have raised seats. Valves three inches and larger shall have seats with a welded-in overlay of high, nickel content on all surfaces contacting the plug face. Valves less than three inches shall have plastic covered seats.
3. Valves up to 20 inches in size shall have permanently lubricated stainless steel bearings.
4. Valves for buried pipelines shall be designed for buried service and shall be equipped with a totally enclosed actuator housing permanently sealed with stainless bolts, springs and washers.
5. A suitable lever or wrench shall be provided for each wrench-actuated valve and at least one wrench for each operating station. Wrenches shall be suitable size and sufficient length for easy actuation of the valves at their rated working pressure.
6. In general, valves less than eight inches shall be wrench-actuated unless otherwise indicated on the plans. Where there is a lack of space for the valve wrench to operate, gear-operator handwheels shall be provided in lieu of the wrench.

7. Plug valves shall be manufactured by DeZurik, McWane or approved equal.

B. Check Valves

1. All check valves three inches and above, unless indicated otherwise, shall be swing check, iron body and bronze-mounted. Valve shall be designed for the purpose and operating conditions shown on the plans and meet a minimum working pressure of 150 psi and shall be factory-tested to double that pressure prior to shipment. The valve shall have a removable cover for inspection and removal of the disc assembly.
2. Ends of check valves shall be of the type conforming with the pipeline where installed. Discs shall be fully revolving and designed to swing freely without jamming in the open position.
3. Check valve bodies shall provide excess area through the valves to assure full delivery of line capacity. Unless otherwise required, all check valves shall be furnished with outside weighted levers.
4. Check valves shall be as manufactured by Mueller, M&H, or Kennedy. These are the only manufacturers that will be accepted on this project. No substitutions will be allowed.

C. Resilient Seated Gate Valves

1. Gate valves shall be resilient seated, manufactured to meet or exceed the requirements of AWWA C509 of latest revision and in accordance with the following specifications. Valves shall have an unobstructed waterway equal to or greater than the full nominal diameter of the valve.
2. The valves are to be non-rising stem with the stem made of cast, forged or rolled bronze shown in AWWA C509. The stem seals shall be provided and shall be of the O-ring type, one above and one below the thrust collar.
3. The sealing mechanism shall consist of a cast iron gate having a vulcanized synthetic rubber coating, or natural rubber seat ring. The resilient sealing mechanism shall provide zero leakage at the water working pressure when installed with the line flow in either direction.
4. The valve body, bonnet, and bonnet cover shall be cast iron ASTM A126, Class B. All ferrous surface inside and outside shall have a fusion-bonded epoxy coating in accordance with AWWA C-550. A handwheel shall be provided for operating the valve. All valves are to be tested in strict accordance with AWWA C509.
5. Gaskets for Flanges: Gaskets for flanged valves shall be described in the piping specification.
6. Valve Field Testing: Operate manual valves through two full cycles of opening and closing. Valves shall operate from full open to full close without sticking or binding. If valves stick or bind, repair or replace the valve and repeat the tests.
7. Valves shall be equal to those as manufactured by American M&H, Kennedy, Mueller, or equal.

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17.05 BACKWATER VALVES WITH EXTENSION KIT

All thermoplastic valves shall be Backwater type constructed from PVC Type I, ASTM D 1784 Cell Classification 12454. All Valve Seats shall be EPDM. All valves shall have external Arrow Flow Indicator. All valves shall be pressure rated to 43 psi (100 feet of Head) for water @ 73°F as manufactured by Spears Manufacturing Company.

Available as a complete unit, with or without valve, factory assembled to internal flap assembly, extension pipe, and external extension housing with top access adapter in convenient Increments of 12", 16", 20", 24", 36", and 48" (measured from top of valve to top of extension). All extension kits can be cut shorter in the field for custom fits. Also available as Extension Components Kits, with or without valve for assembly with user-supplied Class 125 or Schedule 40 pipe. Kits without valve require use of existing valve top Access Plug, all kits require solvent cement assembly to valve. Contact Spears® for pricing on custom cut lengths.

17.06 MISCELLANEOUS FITTINGS

This subsection provides for the furnishing and installing of miscellaneous pipe fittings and "specials."

Pipe for Use with Couplings:

- A. Flexible Connections: Where flexible connections in the piping are specified or indicated on the plans, they shall be obtained by the use of sleeve-type couplings, split couplings or mechanical joint pipe and/or fittings as herein specified.
- B. Sleeve-Type Couplings:
 - 1. To insure correct fittings of pipe and couplings, all sleeve-type couplings and accessories shall be furnished by the supplier of the pipe and shall be of a pressure rating at least equal to that of the pipeline in which they are to be installed. Sleeve-type couplings shall be made by Dresser Manufacturing Division, Rockwell International, or be approved equivalent products.
 - 2. Non-insulating couplings for buried pipe shall be of cast iron and shall be Dresser Style 53, Rockwell #431, or approved equivalent products. The couplings shall be provided with 304 stainless steel or monei bolts and nuts.
 - 3. Mechanical joint "cutting-in sleeves" for buried pipe shall be of cast iron and shall be McWane style F-1220, or approved equal. The gland shall be provided with set screws. All bolts and nuts shall be 304 stainless steel.
 - 4. Insulating couplings for buried pipe shall be of cast iron and shall be Dresser Style 39, Rockwell #438, or an approved equivalent product. The couplings shall be provided with 304 stainless steel bolts and nuts.
 - 5. Couplings for exposed pipe shall be of steel and shall be Dresser Style 38, Rockwell #411, or approved equivalent products. The couplings shall be suitable for installation on ductile iron pipe and provide with low carbon alloy steel bolts and nuts, center stops and harnesses as required.
 - 6. All non-insulating couplings shall be furnished with the pipe stop removed.

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7. Couplings shall be provided with gaskets of a composition suitable for exposure to the liquid within the pipe.
- C. Flange Adapter Couplings: Couplings shall be of the size and pressure rating required for each installation and shall be suitable for use on ductile iron pipe, similar and equal to Dresser Manufacturing Division, Style 127 or Rockwell #912 for pipe up to 12 inches in diameter. Larger pipe shall be approved and equal to Dresser Style 128, Rockwell #913.
- D. Flanged Fillers: The Contractor shall provide suitable flange fillers where the layout of the flanged piping is such as to necessitate their use. In materials, workmanship, facing and drilling, such rings shall conform to the ANSI standard for flanged pipe. Filling rings shall be of suitable length with non-parallel faces and corresponding drilling if necessary, to insure correct assembly of the adjoining pipe or equipment.
- E. Tapped Connections: Tapped connections in pipe and fittings shall be made in such a manner as to provide a watertight joint and adequate strength against pullout. The maximum size of taps in ductile iron pipe or fittings without bosses shall not exceed that listed in the appropriate table of the Appendix to AWWA Standard C 151/ANSI Standard A21.51 based on three full threads for cast iron and two full threads for ductile iron. Pipe taps shall be at bosses where available.
- F. Pressure Gage Cocks: Gage cocks shall be furnished with a brass body and plug, and operate by a tee handle. They will be furnished with ¼-inch female national pipe threads on both ends. Two ¼-inch by 2-inch brass nipples and one ¼-inch brass 90° elbow shall also be furnished and installed as shown on the Plans.
- G. Ductile Iron Flange Adapter: Flange adapters shall be used in lieu of threaded flanges where called out on the drawings. The flanges shall be cast from 60-42-10 as cast iron per ASTM 536-77 and shall have bolt circles and bolt holes to most ASNI B16.1 – 125 lbs. These flanges shall contain set screws made from ductile iron. The screws shall have a Rockwell hardness of C40-45 converted from Brinnell. Flange adapters shall be as manufactured by EBAA Iron, Inc., Series 1000, or an approved equal.
- H. Mechanical Joint Ductile Iron Retainer Glands: Retainer glands shall be used for underground pipe joints as called out on the Plans. They shall be designed to fit standard MJ bells with standard T-head bolts conforming to ANSI/AWWA C111/A21.11 and ANSI/AWWA C153/A21.53 of latest revision. Glands shall be manufactured of ductile iron conforming to ASTM A536-80 grade 60-42-10. Set screws shall be hardened ductile iron and required the same torque in all sizes. Stud set screws are not permitted. These devices shall have the stated pressure rating with minimum safety factor of 2:1 and shall be EBAA Iron, Inc., Series 1200, or approved equal.

17.07 MANUAL OPERATORS

General Requirements

- A. Operator force not to exceed 40 pounds under any operating condition, including initial breakaway. Gear reduction operator when force exceeds 40 pounds.
- B. Operator self-locking type or equipped with self-locking device.
- C. Position indicator on quarter-turn valves.

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- D. Worm and gear operators one-piece design worm-gears of gear bronze material. Worm hardened alloy steel with thread ground and polished. Traveling type nut operators threaded steel reach rods with internally threaded bronze or ductile iron nut.

Exposed Operators

- A. Galvanized and painted handwheels.
- B. Lever operators allowed on quarter-turn valves 8 inches and smaller.
- C. Cranks on gear type operators.
- D. Chain wheel operator with tiebacks, extension stem, floor stands, and other accessories to permit operation from normal operation level.
- E. Valve handles to take a padlock, and wheels a chain and padlock.

17.08 TESTING

Field valve testing, while testing pipelines or as a separate step shall be performed. Test that valves open and close smoothly with operating pressure on one side and atmospheric pressure on the other, in both direction for two-way valve and applications.

Count and record the number of turns to open and close valves; account for any discrepancies with manufacturer's data.

END OF SECTION

SECTION 18 – PAINTING

18.01 GENERAL

Painting materials for each system shall be manufactured by one manufacturer. Painting materials not obtainable from the prime manufacturer shall be obtained from a second source recommended by the prime manufacturer for compatibility. All products furnished shall meet current Federal Regulations for lead, mercury and other heavy metals, as well as current VOC air quality regulations. Products of the following acceptable manufacturers may be used on this project, except where noted otherwise.

- A. Ameron – Corrosion Control Division
- B. Devoe & Reynolds Company
- C. Indurall
- D. KopCoat –RPM
- E. MAB Paints
- F. PPG Industries, Inc.
- G. Rust-Oleum Corporation
- H. Sherwin-Williams
- I. Tnemec Company, Inc.

The Contractor shall paint or provide a protective coating for all interior and exterior wood and metal surfaces, all interior masonry, valves, and all submerged piping and other metal, whether specifically called for or not. In addition, all exposed piping shall be painted and further identified in accordance with other sections of these specifications. Because of their very nature, some areas or items do not require specific painting or coating for protection or appearance. The following generally do not require painting or coating unless specifically noted otherwise or required by manufacture, color coding, insulation from dissimilar metals, insulation from concrete or cement products, or architectural considerations:

- A. Non-Ferrous Alloys:
 - Aluminum
 - Monel
 - Stainless Steel
- B. Corrosion Resistant Metals:
 - Chromium Plated Steel
 - Weathering Steel
 - Galvanized Steel
- C. Non-Metallic Materials:
 - Exterior Brick
 - Concrete
 - Glass
 - Plastic &FRP
 - PVC
 - Porcelain

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- D. Pre-Finished Manufactured Items:
- Cabinets
 - Louvers
 - Motor Control Centers
 - Panels
 - Signs and Nameplates
 - Switchgear
 - Switchboards
 - Transformers
 - Tile

E. Electrical Conduits Attached to Unpainted Surfaces.

F. Insulation and Insulation Jackets.

All exposed piping and conduit within the fence enclosure shall be color-coded in accordance with the following Color Coding Schedule:

- | | |
|-----------------------------------------------------|---------------------|
| A. Electric | Gray |
| B. Gas, Oil, Dangerous Materials | Red |
| C. Telephone, Telegraph, Television, Communications | Safety Alert Orange |
| D. Potable Water | Safety Blue |
| E. Treated Sewage | Safety Green |

Other paint colors will be selected by the Engineer

All materials shall be pure and first quality. Materials listed shall be the standard for each such type of material. Primers and finish coats shall be compatible and of the same manufacture where possible. Emulsion and alkyd paints shall contain a mildewcide, and both the paint and mildewcide shall conform to OSHA and Federal requirements, including Fed. Spec. TT-P-19.

18.02 PAINTING SCHEDULES AND SYSTEMS

Painting and coating of surfaces shall conform to the following schedules and systems, unless otherwise specified or shown on the drawings:

- A. Schedule A: System 1 – Exposed exterior structural and miscellaneous steel, piping, equipment to include all stainless steel and carbon steel electrical control cabinets non-submerged, not exposed to corrosion, splash, fumes or immersion conditions.
1. Prime: One sprayed coat of a combination of a two-part epoxy primer, gray, of 3.0 mils, minimum dry film thickness as by Devoe Paints, Tru-Glaze Epoxy Primer Nos. 12735 and 12702 (ratio 19:1) or equal. If shop coat is damaged, re-prime bare areas in the field. The exterior of electrical cabinets, in stainless steel, shall be sand-blasted and spray-primed per the paint manufacturer's instructions.
 2. Finish: Two coats of "hanging moss green" (Devoe Paints FX-70), Semi-Gloss Advanced Technology Acrylic Resin of 1.5 to 2.0 mils, dry thickness as Exterior Waterborne Semi-

Gloss Enamel #83XX by Devoe Paints, or equal. Coats to be applied by spray painting in the shop.

- B. Schedule B: System 2 – Piping and pumping equipment – submerged or non-submerged, exposed to spray, splash or corrosive atmosphere, excluding chains and sprockets, and stainless steel bracing in the wetwell:
1. Prime: One coat chemical resistant red iron oxide, based on a polyamide cured epoxy resin, minimum of 3.0-5.0 mils dry film thickness as by Devoe Paints, Devron 201. If shop coat is damaged, re-prime bare areas in the field.
 2. Finish: Two coats of polyamide cured, epoxy resin coating, minimum of 4.0-6.0 mils dry film thickness per coat as by Devoe Paints, Devron 224HS-color, moss green as required above.

- C. Schedule C: System 3 – Non-Potable water exposed concrete surfaces inside valve vaults , meter vaults, and sanitary sewer manholes.

1. Coal Tar Epoxy (Non-Potable Only)

Must be recoated within four days at 75deg F. Higher temperature will shorten recoat time.

Surface Preparation: Brush-Off Blast Cleaning

1st Coat: 46-413 Tneme Tar	8.0 - 10.0 mils
2nd Coat: 46-413 Tneme Tar	<u>8.0 - 10.0 mils</u>

18.03 EXECUTION

All painting shall be done by skilled and experienced craftsmen and shall be of highest quality workmanship. Application of materials shall be done only on properly prepared surfaces as herein specified.

Before commencing work, the painter shall make certain that surfaces to be covered are in good condition. Should the painter find such surfaces not to be totally acceptable for covering, he shall report such fact to the Engineer. The application of paint shall be held as acceptance of the surfaces and working conditions and the painter will be held responsible for the results reasonably expected from the materials and processes specified.

Hardware, hardware accessories, machined surfaces, nameplates giving manufacturer's data, cover plates, grease fittings, lighting fixtures and similar items in contact with painted surfaces and not to be painted shall be removed, masked, or otherwise protected prior to surface preparation and painting operations so they remain clean and free from paint.

Ferrous metals (not shop primed) shall be sandblasted per SSPC-SP6 to remove mill scale and rust. Ferrous surfaces to be submerged or exposed to spray, splash, fumes or corrosive atmosphere shall be sandblasted to near-white metal blast cleaning according to SSPC-SP 10. Brush blast or clean other metals as appropriate to provide suitable surface. Surface profile as obtained from sandblasting shall be recommended by the coating manufacturer. All metal surfaces shall be completely degreased by solvent cleaning in compliance with SSPC-SP 1.

Galvanized surfaces shall be cleaned of dirt, grease and other foreign substances and solvent cleaned. Surfaces shall be pro-treated with one coat of proprietary acid bound resinous or crystalline zinc phosphate preparation, used in accordance with the manufacturer's directions.

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Remove glaze, of florescence, dirt, loose particles and grease (and existing paint, if applicable) from concrete receiving masonry paint. Fill all cracks, cut out defective joints and repaint.

In addition to the above listed surface preparations, all dirt, rust, scale, splinters, loose particles, disintegrated paint grease, oil and other deleterious substances shall be removed from all surfaces that are to be coated.

Work shall be done only under favorable weather conditions and as recommended by paint supplier. Exterior painting shall be done only in dry weather. Any surface coating damaged by moisture or rain shall be removed and redone as directed by the Engineer. Coatings shall be mixed, thinned, tinted and applied in accordance with the manufacturer's recommendations. The Contractor shall tint or match colors as selected by the Owner. A sample shall be applied on the job for review and approval before work is actually done. No thinners shall be used except those specifically mentioned and only in such quantity as directed by the manufacturer's instructions. If thinning is used, sufficient additional coat shall be applied to assure the required dry film thickness is achieved.

The manufacturer's recommended thinner or cleanup solvent shall be used for all cleanup. Application by brush, spray, airless spray or roller shall be as recommend by the manufacturer for optimum performance and appearance. Paint shall be applied in a neat manner with finished surface free of runs, sags, ridges, laps and brush marks.

Each coat shall be applied in a manner that will produce an even film of uniform and proper thickness, and no variation in sheen or color. Where more than one coat of paint is specified, each coat shall be sufficiently tinted to result in a perceptible difference in shades of the various coats of paints so that the application of subsequent coats can be properly and uniformly spread and inspected. Provision shall be made to allow thorough drying between coats as recommended by the manufacturer before the next coat is applied, and paint used in successive field coats shall be produced by the same manufacturer.

Seal coats shall be used over bitumen-coated surfaces as applicable. Plastic pipe shall be painted in accordance with the pipe manufacturer's recommendations. Pipes, shoot metal ducts and other metal items which are to be installed in inaccessible locations shall be painted prior to installation.

Pumps, motors, machinery, equipment, electrical panels and other manufactured items shall have surfaces prepared, primed and coating in accordance with the recommendations of the manufacturer, and be given at least one touch-up coat with the intermediate coat material and one compete finish cost in the field.

The prime and intermediate coats for the various coating systems shall be as specified earlier, and shall be compatible with the field coat or coats. Paint used in the first field coat over shop painted or previously painted surfaces shall cause no wrinkling, lifting or other damage to underlying paint.

All completed surfaces will be checked by the Engineer, and the Contractor shall provide the necessary properly calibrated gages. All non-ferrous surfaces shall be checked for number of coats and thickness by use of a Tooke gage. All ferrous surfaces shall be checked for film thickness by use of Elcometer or Micro-Test magnetic dry film gauge properly calibrated. All defects shall be corrected to the satisfaction of the Engineer.

All paint brushed, splattered, spilled, or splashed on any surface not specified to be painted shall be removed. Upon completion of the painting work, the Owner shall be furnished one (1) gallon of each type and color of finish paint for touching up at no additional cost. Paint container labels, in addition to other required information, shall have location of color and type marked thereon.

Surfaces to be painted shall be inspected before any paint materials are applied, and after preparation has been completed.

Painted surfaces shall be inspected between coats, prior to application of next coat of painting material. Failure to get acceptance between coats will nullify credits for coats previously applied.

All paint shall be delivered to the job site in unopened original containers.

All paint not intended for the job shall be removed from the job site.

END OF SECTION

SECTION 19 - ODOR CONTROL SYSTEM

PART 1 GENERAL

19.01 SCOPE OF WORK

- A. The work specified herein shall include designing, furnishing, and installing all equipment and materials to provide the Owner with a complete Odor Control System. The system shall be a completely packaged activated carbon adsorption system. The contractor shall be responsible for providing a complete Odor Control System that shall include, but not limited to:
1. Furnish odor control equipment including blower, dampers, nozzles, ducting, moisture/grease separator, carbon vessel, carbon media support, carbon, condensate drains, controls, and all necessary accessories.
 2. Shop drawings and operating manuals
 3. Start-up and acceptance testing services as specified herein.
- B. The System shall be comprised of the following major components:
1. Moisture /grease separator
 2. One carbon cross-linked high density polyethylene carbon vessel with 1,200 pounds of activated carbon media.
 3. One blower to evacuate odorous air at 500 to 600 cfm from the headworks channels and convey it to the vessel and through the carbon media.
 4. Blower motor starter panel.
 5. Accessories as required to make a complete working system.

19.02 STANDARDS

The following is a list of standards which may be referenced in this section:

- A. ASTM E679: "Standard Practice of Odor and Taste Thresholds By a Forced-Choice Ascending Concentration Series Method of Limits"
- B. ASTM D-2563: "Recommended Practice for Classifying Visual Defects in Glass Reinforced Plastic Laminate Parts"
- C. ASTM D-2583: "Test for Indentation Hardness of Rigid Plastics by Means of Barcol Impressor"
- D. ASTM D-883: "Definition of Terms Relating to Plastics"
- E. ASTM D-3299: "Standard Specification for Filament-Wound Glass-Fiber-Reinforced"
- F. ASTM D-4097: "Standard Specification for Contact Molded Glass Fiber Reinforced Thermoset Resin Chemical Resistant Tanks"
- G. PS 15-69: National Bureau of Standards Voluntary Product Standard "Custom Contact Molded Reinforced Polyester Chemical Resistant Process Equipment"
- H. American National Standards Institute (ANSI)

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- I. American Society of Mechanical Engineers (ASME)
- J. Institute of Electrical and Electronic Engineers (IEEE)
- K. National Electrical Manufacturers Association (NEMA)
- L. National Electrical Code (NEC)
- M. National Fire Protection Agency (NFPA)
- N. National Bureau of Standards (NBS)
- O. Underwriters Laboratories (UL)

19.03 PROCESS DESCRIPTION

- A. The Supplier shall provide a complete carbon adsorption based odor control system designed specifically for removal of H₂S. The system shall include:
 - 1. Moisture/grease separator
 - 2. A corrosion resistant cast aluminum blower with 2.0 hp “Washdown Duty” stainless steel 3 phase 230/460 volt induction duty motor.
 - 3. A cross-linked high density polyethylene carbon vessel with raised plenum media support system for even air distribution at low head loss.
 - 4. All necessary valves, fittings, ductwork, and all other equipment and accessories as specified to provide a complete and functioning system
- A. The system shall include 50-ft³ of non-impregnated, bituminous coal based catalytic activated media which has been specifically developed for removing hydrogen sulfide, sulfur compounds, organics and mercaptans from air streams.

19.04 SYSTEM PERFORMANCE

- A. System Shall Remove 99% of incoming H₂S or shall have less than 0.5 ppm in the outlet, whichever is greater
- B. Pressure drop through the adsorber shall not exceed 6.0 inches of water column at the maximum design flow rate as specified herein, for a period of up to one year after successful start-up.

19.05 QUALITY ASSURANCE

- A. The system shall be a HiCarb Model 50 as manufactured by Heyward Incorporated or approved equal.
- B. The manufacturer shall provide a list of names and contact numbers for 5 operating installations for similar installations.

19.06 WARRANTY

- A. The Manufacturer shall warrant that the System shall be supplied in accordance with these specifications and shall perform as described herein. The Manufacturer shall

warrant that the System will be free from defects in materials and workmanship for a period of two (2) year after delivery of the equipment to the Owner's facility. At the Manufacturer's discretion, the Manufacturer shall repair or provide replacement for any defective components under this warranty provided that any such defect was not the result of misuse of the component by the Owner or the Owner's Agents.

19.07 SUBMITTALS

- A. The Manufacturer shall submit the following information as a minimum to show complete compliance with these specifications. Submittals shall comply with specifications.
1. Dimensional drawings showing plan and elevation views of the System and all applicable connections / conduit placements.
 2. Details of all external termination points; electrical, water lines, drains, etc. in sufficient detail to allow installation by the Contractor.
 3. List of Materials of Construction for all components provided by the Manufacturer.
 4. Statement of Manufacturer's Warranty.
 5. Reference list as described in Section above.
 6. Information on hazards associated with the System and appropriate safety precautions.
 7. Installation instructions.
 8. Start-up instructions.
 9. Maintenance procedures.
 10. Troubleshooting guide.
 11. Individual operation and maintenance information on major system components.

19.08 OPERATION AND MAINTENANCE DATA

- A. Operating and maintenance instructions shall be furnished. The instructions shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, descriptions, etc, that are required to instruct operation and maintenance personnel unfamiliar with such equipment. The maintenance instructions shall include trouble shooting data and full preventive maintenance schedules.

19.09 DELIVERY, STORAGE & HANDLING

- A. All equipment and materials shall be properly protected such that no damage will occur from the time of shipment until the completion of the installation.
- B. Contractor shall inspect all equipment upon delivery. Contractor shall notify manufacturer within 24 hours if damage occurred as a result of shipping.

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PART 2 PRODUCTS

19.10 GENERAL

- A. All equipment shall be new and unused and suitable for the conditions of service to which they will be subjected. Workmanship shall be of the highest quality and shall be carried out by competent and experience workmen.

19.11 DESIGN REQUIREMENTS

- A. All components of the System shall be compatible with the conditions and chemicals to which they will be subjected to during normal operation. Compounds with which the materials of construction must be compatible with include, but are not limited to:
1. Hydrogen Sulfide
 2. Sulfuric Acid
 3. Ammonia
 4. Dimethyl Sulfide
 5. Methyl Mercaptan and other Mercaptans
 6. Other Reduced Sulfur Compounds (RSC's)
- B. The System shall be furnished to meet the following criteria:

Parameter	Value	Units
Capacity	500 to 600	cfm
H ₂ S Loading (average/ peak)	up to 50	ppmv
Inlet air temperature	50 – 100	degrees F
Inlet air relative humidity	60 – 100	%
Number of reactor vessels	one	count
Pressure drop across reactor	Approx 5	inches water column
Media capacity	50	cf

19.12 SYSTEM COMPONENTS

- A. REACTOR VESSEL
1. The reactor vessel shall be constructed of cross-linked high density polyethylene with a raised plenum media support system for even air flow distribution.
 2. The reactor vessel shall be approximately 4 ft diameter by 6 feet tall with a capacity of 50 ft³ of media.
 3. Each unit shall have air sampling ports to allow sampling to determine the remaining life of the media and at least one condensate drain.
 4. The unit shall be designed for easy carbon removal using a vacuum truck.
- B. ADSORPTION MEDIA

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1. The media shall be HICARB-731 which is a non-impregnated, bituminous coal based catalytic activated media which has been specially developed for removing hydrogen sulfide, sulfur compounds, organics, and mercaptans from air streams or approved equal.
2. Specifications:

Mesh Size:	4 x 8
Less than 4	5% (max)
Greater than 8	10% (max)
Mean Particle Diameter:	3.4 mm (avg)

C. ODOR CONTROL BLOWER

1. Blower shall be quiet, corrosion resistant of cast aluminum.
2. Blower shall be designed for 550 to 650-cfm with a 2 HP, "Washdown Duty" stainless steel 480 volt, 3 phase induction duty motor.

D. MOISTURE/GREASE SEPARATOR

1. Grease/moisture separator vessel shall be constructed from UV resistant PVC or HDPE. Vessel shall contain 6 cubic feet of synthetic packing material (media) for removal of grease- laden air and moisture prior to the blower and carbon vessel. Media shall have a minimum of 26-ft² of surface area per cubic foot. All vessel attachment hardware shall be 316 stainless steel. The vessel shall have 6-inch air inlet and outlets and capable of handling up to 800 cfm airflow on a continuous basis. Vessel interior shall be 36" long x 22" tall x 22" with inlet and outlet air plenums for even air distribution through media. Grease laden media shall be capable of in situ cleaning without removal of media from vessel or removal of vessel from piping. A 2" drain shall be located on the bottom of the separator for removal of collected condensate and to facilitate media cleaning as necessary.

E. ELECTRICAL PANEL

1. System shall include a NEMA 4X 316 stainless steel panel with all starters, breakers and other controls required to operate the system.
2. The panel shall require a single electrical connection, 480 VAC, 3-phase, and shall include all required power transformers.

PART 3 EXECUTION

19.13 INSTALLATION

- A. Installation of the System shall be completed by the Contractor in accordance with the Manufacturer's written instructions.

19.14 INSPECTION, START-UP & OPERATOR TRAINING

- A. Start-up of the System shall be the responsibility of the Manufacturer, who shall furnish factory-trained personnel to complete this activity. Start-up will commence following a visual inspection and check out of the System by the Manufacturer's technical representative. Air flow testing shall be performed after start-up to verify proper air flow through the unit. H₂S inlet and outlet readings shall be taken to insure

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removal efficiencies at design air flow rates.

- B. Provide a minimum of one man-day of operation and maintenance training to Owner's personnel. Training is to be provided by factory trained personnel.

END OF SECTION

SECTION 20 – PRECAST CONCRETE BUILDING

20.01 GENERAL

Contractor to furnish a precast concrete building. Building to be delivered pre-assembled and placed on owner's prepared stone foundation in accordance with manufacturer's recommendations. Or (option) Building to be field assembled by the manufacturer on the contractor's poured-in-place foundation or precast concrete floor panel as indicated on contract drawings and in accordance with manufacturer's recommendations. Precast building to be EASI-SET® brand as manufactured by Leesburg Concrete of Leesburg, FL a licensed manufacturer of Easi-Set Buildings. Building to be provided by manufacturer with all necessary openings as specified by contractor in conformance with manufacturer's structural requirements.

20.02 QUALITY ASSURANCE

- A. ACI-318-02, "Building Code Requirements for Reinforced Concrete". Concrete Reinforcing Institute, "Manual of Standard Practice".
- B. ANSI/ASCE-7-02 "Building Code Requirement for Minimum Design Loads in Buildings and Other Structures".
- C. IBC 2010
Concrete Reinforcing Institute, "Manual of Standard Practice".
- E. UL-752 test method level 5 for jacketed bullet resistance by a certified ballistic laboratory.
- F. Fabricator must be a certified producer/member of The Precast/Prestressed Concrete Institute (PCI), National Precast Concrete Association (NPCA) or equal.
- G. Building fabricator must have a minimum of 5 years experience manufacturing and setting transportable precast concrete buildings.
- H. No alternate building designs to the pre-engineered EASI-SET® building will be allowed unless pre-approved by the owner 10 days prior to the bid date.

20.03 DESIGN REQUIREMENTS

- A. Standard Models Dimensions:

Model 1012: exterior - 10' x 12' x 8'-8", interior: 9'-6" x 11'-6" x 8'-0"

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- B. Design Loads:
1. Seismic load performance category 'C', Exposure Group III
 2. Standard Live Roof Load – 60 PSF
 3. Standard Floor Load – 250 PSF
 4. Standard Wind Loading – 130 MPH
- C. Gabled Roof: Roof panel shall slope approximately 24" from left to right or front to back in the short-sided direction. The roof shall extend a minimum of 6" beyond the wall panel all around. An optional turndown feature is available where the design extends ½" below the top edge of the wall panels to further prevent water migration into the building along top of wall panels. Only available with broom finish or top surface applied finishes. Roof shall also have an integral architectural ribbed edge.
- D. Roof, floor, and wall panels must each be produced as single component monolithic panels. No roof, floor, or vertical wall joints will be allowed, except at corners. Wall panels shall be set on top of floor panel.
- E. Floor panel must have ½" step-down around the entire perimeter to prevent water migration into the building along the bottom of wall panels.
- F. All panel penetrations for utilities and electrical including the floor and roof must be according to the approved plans and specifications in coordination with the structural engineer of record.

20.04 SUBMITTALS

- A. Engineering calculations that are designed and sealed by a professional engineer, licensed to practice in the state where the project is located, shall be submitted for approval.

20.05 MATERIALS

- A. Concrete: Steel-reinforced, 5000 PSI minimum 28-day compressive strength, air-entrained (ASTM C260).
- B. Reinforcing Steel: ASTM A615, grade 60 unless otherwise specified.
- C. Post-tensioning Strand: 41K Polystrand CP50, .50, 270 KSI, 7-wire strand, enclosed within a greased plastic sheath, (ASTM A416). Roof and floor to be each post-tensioned by a single, continuous tendon. Said tendon shall form a substantially rectangular configuration having gently curving corners wherein the positioning of the cable member results in a pattern of one or more loops and a bisecting of the loop(s). The cable member starts from one corner of the concrete building panel, forms a gentle perimeter loop(s) returning to a point where the cable member entered the concrete building panel. The tendon then turns 90 degrees and follows the cable member(s) to a point midway along the “Y” axis of the concrete building panel and then turns 90 degrees along the “X” axis of the concrete building panel. This bisects the concrete building panel and crosses the opposite parallel portion of the cable member and exits from an adjacent side of the concrete building panel.
 - 1. If post-tensioning is not used in the roof panel, the following guidelines must be followed to ensure a watertight roof design.
 - a. The entire precast concrete roof panel surface must be cleaned and primed with a material that prepares the concrete surface for proper adherence to the coating material.
 - b. The entire precast concrete roof panel surface shall be sealed with a .045 EPDM continuous membrane cemented to the concrete with a compound designed for this purpose.
 - c. The roof and floor panels shall be increased in thickness by 1” and 20% additional reinforcing to meet the punch shear capacity of the post-tensioned roof and floor.

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- D. Caulking: Joint between building and floor slab shall be caulked on the exterior and interior surface of the joints. Caulking shall be SIKAFLEX-1A elastic sealant or equal. Exterior caulk joint to be 3/8" x 3/8" square so that sides of joint are parallel for correct caulk adhesion. Back of joint to be taped with bond breaking tape to ensure adhesion of caulk to parallel sides of joint and not the back.
- E. Ventilation: Building to be air conditioned by Wall-Mount Air Conditioner. Unit to be mounted on the north wall of the building with a minimum of 6" of clearance from the roof. See plans for details on location.

Cooling Performance Project Parameters for the Wall-Mount Air Conditioner Unit include:

- Gross cooling capacity of 24,322 Btuh
- Gross sensible capacity of 19,398 Btuh
- Efficiency (at AHRI) of 9 EER
- Outdoor DB temp of 95.1° F
- Entering DB temp 80° F
- Entering WB temp 67° F

Wall-Mount Air Conditioner shall be Bard air conditioner unit model #W24A2-A05 or approved equal.

- F. Panel Connections: All panels shall be securely fastened together with 3/8" thick steel brackets. Steel is to be of structural quality, hot-rolled carbon complying with ASTM A283, Grade C and hot dipped galvanized after fabrication. All fasteners to be 1/2" diameter bolts complying with ASTM A307 for low-carbon steel bolts. Cast-in anchors used for panel connections to be Dayton-Superior #F-63, or equal. All inserts for corner connections must be secured directly to form before casting panels. No floating-in of connection inserts shall be allowed.

20.06 ACCESSORIES

- A. Doors and Frames: Shall comply with Steel Door Institute "Recommended Specifications for Standard Steel Doors and Frames" (SDI-100) and as herein specified. The buildings shall be equipped with double 3'-0" x 6'-8" x 1-3/4", 18-gauge galvanized/insulated Dominion Imperial right hand reverse metal doors with 16-gauge galvanized frames. Doors and frames shall be bonderized and painted one coat of rust inhibitive primer and one finish coat of enamel paint; color shall be Yorktown Brown unless otherwise specified.
- B. Door Hardware:

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1. Handle: Lindstrom stainless steel, 8-1/2" x 2" or equal.
2. Hinges: PB-31/NRP/26D 4 1/2" x 4 1/2" (chrome-plated with non-removable hinge pins), 3 per door or equal.
3. Lock Set: PDQ Industries KR116 – 32D (stainless steel finish) or equal.
4. Surface Bolt, Upper: Cal-Royal 045901426D (satin chrome finish) or equal.
5. Surface Bolt, Lower: Cal-Royal 045901426D (satin chrome finish) or equal.
6. Astragal: A4441/68R or equal.
7. Threshold: National Guard 897V60 raised interior, extruded aluminum threshold with neoprene seal or equal.
8. Door Holder: Glynn-Johnson 904H US32D (stainless steel finish), overhead slide type surface mounted door holder or equal.
9. Drip Cap: National Guard 15D72 or equal.
10. Door Stop: Ives 445B26D (Inactive leaf only) or equal.

20.07 FINISHES

- A. Interior of Building: Smooth steel form finish on all interior panel surfaces.
- B. Exterior of Building: Architectural precast concrete skip trowel form lined finish: The skip trowel surface will be coated with a concrete stain: 1) Cementrate by FOSROC; or, 2) Canyon Tone stain by United Coatings. Stain color must be coordinated and approved by City of St. Pete Beach before fabrication or construction. Color samples of the finish shall be sent to the City before a decision can be made. Stain shall be applied per manufacturer's recommendation. Vertical edge of panels shall have a reveal for acceptance of caulk.
- C. Exterior of Building (Option): Additional finishes are available and will vary by local producer.

20.08 SITE PREPARATION REQUIREMENTS (MANUFACTURER'S RECOMMENDATION)

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- A. EASI-SET® building shall bear fully on a concrete that is at least one foot larger than the length and width of building.

- B. Concrete shall be a minimum of 12” thick. The vertical soil capacity under concrete shall be compacted to have minimum bearing of 1,500 pounds per square foot. Concrete shall meet Section 3- Concrete, Masonry, and Reinforcing Steel in the specifications. Concrete shall be placed within a perimeter form with flat and level top edge for screeding.

- C. Provide positive drainage for the fill, concrete pad, or slab as required.

20.08 ACCESS

Contractor must provide a level unobstructed area large enough for a crane and a tractor-trailer to park adjacent to the pad. Crane must be able to place outriggers within 5'-0" of edge of pad and truck and crane must be able to get side by side under their own power. No overhead lines may be within 75' radius of center of pad. Firm roadbed with turns that allow 65' lowbed tractor-trailer must be provided directly to site. No building shall be placed closer than 2'-0" to an existing structure.

SECTION 21 - PAY ITEM DESCRIPTIONS

21.01 INTRODUCTION

It is the intent of the City to itemize major construction associated with the Project as Pay Items in the Proposal, and specify method of measurement and payment for all listed Pay Items. As may be noted below, incidental work which may be associated with a specific Pay Item is to be included in the cost proposed by the bidding contractor for that Pay Item. It is not the intent of the City to allow for additional compensation beyond those Pay Items included in the Proposal. It is therefore important that all Bidders fully acquaint themselves with all Plans, Specifications, City Standard Details, and other details pertaining to the Work.

Work not shown or called out in either the Plans or the Specifications, but necessary in carrying out the intent of the Project or in the complete and proper execution of the Work, is required and shall be performed by the Contractor as though it were specifically delineated or described. No additional compensation will be considered for this associated and necessary Work.

The Contractor shall not use contingency Pay Items without written approval from the Engineer.

21.02 PAY ITEMS

Pay Item 1 Pump Station No. 2 Rehabilitation

Payment will be made on a lump sum basis for the Pump Station No. 2 Rehabilitation, complete, tested and ready for operation. Payment includes, but is not limited to, furnishing all labor, material, equipment and incidentals necessary to accomplish the construction including the following: erosion control, traffic control, by-pass pumping, clearing, excavation, partial demolition of the existing pump station, salvage of equipment as indicated on the plans, construction of the new pump station components with modified top slab, valve vault, hatches, guide rails, submersible pumps, level controls, force main piping and valves, modified control panel and associated electrical equipment, removal and disposal of all components not salvaged, salvage equipment from the existing pump station (as directed by the City). The work shall also include furnishing all labor, material, and equipment necessary for site restoration including but not limited to fill replacement, grading, irrigation, pavement, walkways, restoring areas disturbed, removing and relocating/ replacing existing landscaping, testing, cleanup, warranties, and all other incidentals required to complete the Work.

Payment will also include costs associated with preparatory work and operations necessary to begin work on the Project, including but not limited to those operations necessary for the movement of personnel, equipment, supplies, and incidentals to the Project sites, and for the establishment of temporary offices, buildings, safety equipment and first aid supplies, sanitary and other facilities as required by the Plans and Specifications, traffic control, and all applicable federal, state, and local laws and regulations.

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The cost of bonds and any other required insurance, consideration for indemnification to the City and the Engineer, and any other pre-construction expenses necessary for the start of the Work, excluding the cost of construction materials, shall also be included in this Pay Item.

Pay Item 2 Pump Station No. 1 Rehabilitation

Payment will be made on a lump sum basis for the Pump Station No. 1 Rehabilitation, complete, tested and ready for operation. Payment includes, but is not limited to, furnishing all labor, material, equipment and incidentals necessary to accomplish the construction including the following: erosion control, traffic control, by-pass pumping, clearing, excavation, partial demolition of the existing pump station, salvage of equipment as indicated on the plans, construction of the new pump station components with guide rails, submersible pumps, force main piping and valves, modified control panel and associated electrical equipment, removal and disposal of all components not salvaged, salvage equipment from the existing pump station (as directed by the City). The work shall also include furnishing all labor, material, and equipment necessary for site restoration including but not limited to fill replacement, grading, irrigation, pavement, walkways, restoring areas disturbed, removing and relocating/ replacing existing landscaping, testing, cleanup, warranties, and all other incidentals required to complete the Work.

Payment will also include costs associated with preparatory work and operations necessary to begin work on the Project, including but not limited to those operations necessary for the movement of personnel, equipment, supplies, and incidentals to the Project sites, and for the establishment of temporary offices, buildings, safety equipment and first aid supplies, sanitary and other facilities as required by the Plans and Specifications, traffic control, and all applicable federal, state, and local laws and regulations.

The cost of bonds and any other required insurance, consideration for indemnification to the City and the Engineer, and any other pre-construction expenses necessary for the start of the Work, excluding the cost of construction materials, shall also be included in this Pay Item.

Pay Item 3 Allowance for City- Authorized Contract Amendments

The proposal includes an allowance for various extra work contingencies. Any amount of extra work and/or alterations to the proposed Work charged to the allowance shall be fully documented and authorized by the Engineer as follows:

1. The Contractor shall include in the Contract Total Price the allowance so named in the Proposal Form.
2. The Contractor shall not proceed on any additional Work to be covered by the allowance until authorized in writing by the Engineer.
3. The Contractor shall cause the Work so covered to be done by such subcontractors or suppliers, and for such sum within the limit of the allowance as authorized by the Engineer.

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4. Prior to final payment, an appropriate change order will be issued as recommended by the Engineer to reflect actual amounts due to the Contractor on account of Work covered by the allowance, and the Contract Total Price shall be correspondingly adjusted.

5. The allowance shall not be used for incidental work shown on the Plans or specified in the Contract Documents, or for other work required to render the Project complete.

END OF SECTION

SECTION 22 – SIDE HINGED LIP SEAL AND COMPRESSION GASKET FLOOD GATE

GENERAL

22.01 DESCRIPTION

- A. Provide flood barrier(s) factory assembled with frame(s) and all operating components in accordance with contract specifications and approved drawings.

22.02 ACCEPTABLE MANUFACTURERS

- A. Flood barrier shall be as manufactured by Walz & Krenzer, Inc. or approved equal.

22.03 STANDARDS

- A. Comply with the provisions of the following (as applicable):
 1. AISC “Specifications for Design, Fabrication, and Erection of Structural Steel for Buildings”.
 2. The Aluminum Assoc. “Aluminum Design Manual”.
 3. AWS Structural Welding Code D1
 4. ASME Structural Welding Code Section IX
 5. FEMA Bulletin 3-93, #102 & #114

22.04 SUBMITTALS:

- A. Manufactures Data: Submit installation and maintenance manuals for flood barriers.
- B. Shop Drawings: Submit shop drawings approved by licensed Professional Engineer for flood barriers including dimensional plans and elevations, sections and details for all mountings and connections, and parts list.
- C. Calculations (optional for critical applications): Submit calculations approved by licensed Professional Engineer verifying the flood barriers ability to withstand the design pressure loading.
- D. QA Submittals: Submit test reports showing compliance with specified performance characteristics.

22.05 QUALIFICATIONS

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- A. Manufacturer shall present evidence attesting to at least five years successful experience in the design and manufacture of similar closures.

PRODUCTS

22.06 PRODUCT DESCRIPTION

- A. Large side hinged flood barrier shall be Model FG-LS and small side hinged flood barrier shall be Model FG-C as manufactured by Walz & Krenzer, Inc.

22.07 MATERIALS

Large Flood Gate (14' W x 7' H)

- A. Panel – 5052-H32 or 6061-T6 aluminum plate with 6061-T6 aluminum stiffeners.
- B. Frame – 304 Stainless Steel.
- C. Latches – determined by MFG.
- D. Gasket – Walz & Krenzer neoprene or EPDM lip seal gasket, 60 duro with fully molded corners.
- E. Finish – aluminum panel primed and painted with shop standard epoxy or acrylic paint system.
Frame blast: Abrasive Clean.
- F. Grab Handle and Panel Stops – 6061-T6 aluminum
Hinges – hinges to include bronze oil-impregnated thrust bearing and stainless steel hinge pins.

Small Flood Gate (3' W x 7' H)

- A. Panel – 5052-H32 or 6061-T6 aluminum plate with 6061-T6 aluminum stiffeners.
- B. Frame – 304 Stainless Steel.
- C. Gasket – ASTM D2000 GR DE neoprene gasket, 25 duro with fully molded corners.
- D. Dogs/drop bolts – stainless steel/bronze dogs operable from both sides of gate. or drop bolts. Utilize drop bolts for reduced maintenance and lower cost where operation is from outside only.
- E. Hinges - hinges to include bronze oil-impregnated thrust bearing and stainless steel hinge pins. Hinges to have slotted hinge blades.
- F. Finish – aluminum panel primed and painted with shop standard epoxy or acrylic paint system.
Frame blast: Abrasive Clean Finish.

- G. Removable bottom ramp available as an option to be placed over raised bottom sill (for vehicular traffic). Must be specified at time of quote and purchase.

22.08 DESIGN

Large Flood Gate

- A. Side frames are available as angles for mounting on the exterior face of the wall surface, or as flatbars for mounting inside doorjamb.
- B. Bottom frame is a 1/2"-3/4" flatbar, which can be recessed into floor surface to achieve a flush bottom sill.
- C. Corners of flood barriers have small (2") radius.
- D. Roller assembly is provided on gates wider than 4', or for gates with flush bottom sills.
- E. Opening device for latching gate provided.
- F. Frame(s) shall have mounting holes for expansion anchors (options include masonry subframe with welded anchors for embedment in concrete).

Small Flood Gate

- A. Side frames are angles for mounting on the exterior face of the wall surface.
- B. Bottom frame is a flatbar with a raised machined knife-edge or machined/welded block. Standard bottom sill is raised 1-1/2" from floor surface.
- C. Roller assembly is provided on gates wider than 6'.
- D. Frame(s) shall have mounting holes for expansion anchors (options include masonry subframe with welded anchors for embedment in concrete).
- E. Frame knife-edge shall be rounded and smooth to maximize sealing.

22.09 QUALITY ASSURANCE

- A. Perform shop operational test
- B. Perform shop hose test
- C. Liquid Penetrant Test (for critical applications): Welds in the "potential" leak path shall be liquid penetrant inspected in accordance with Appendix VIII of Section VIII of ASME Code Div. 1

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22.10 FABRICATION

- A. The finished product shall be rigid, neat in appearance, and free from all defects, warps, and buckles. All exposed joints and corners shall be well rounded.
- B. The panel and frame shall be flat within 1/8" in any 6' length.

22.11 INSTALLATION

- A. Install flood barrier in accordance with manufactures instructions and approved shop drawings.

22.12 WARRANTY

- A. Flood barrier shall operate satisfactorily and be free of defects in material and workmanship for a period of not less than one year from the date of delivery.

END OF SECTION

SECTION 23 – PVC LINER

23.01 GENERAL

- A. This specification covers the supply and installation of a flexible PVC sheet liner with continuous locking extensions in reinforced concrete pipe and auxiliary structures to effectively protect the exposed concrete surfaces from corrosion. To accomplish this, the liner must be continuous and free of pinholes both across the joints and in the liner itself. All work for and in connection with the installation of the lining in concrete pipe, and the field sealing and welding of joints, shall be done in strict conformity with all applicable specifications, instructions and recommendations of the lining manufacturer. The manufacturer of the lining shall furnish an affidavit attesting to the successful use of its material as a lining for sewer pipes for a minimum period of 50 years in sewage conditions recognized as corrosive or otherwise detrimental to concrete.

23.02 MATERIAL

- A. Liner shall be Ameron T-Lock or an approved equal.

23.03 COMPOSITION

- A. The material used in the liner, welding strips and other accessory items, shall be a combination of poly vinyl chloride resin, pigments and plasticizers, specially compounded to remain flexible. Poly vinyl chloride resin shall constitute not less than 99 percent by weight, of the resin used in the formulation. Copolymer resins will not be permitted.

23.04 PHYSICAL PROPERTIES

- A. All plastic liner plate sheets, welding strips and other accessory items, shall have the following physical properties when tested at 77°F±5° (25°C±3°).

Property	Initial	(Par. 2.4)
Tensile Strength	2200 psi min. (15 MPa min.)	2100 psi min. 14.5 MPa min.)
Elongation at break	200% min.	200% min.
Shore durometer, Type D	1-sec. 50-60	±5
(with respect to initial test results)	10-sec. 35-50	±5
Weight change		±1.5%

- B. Tensile specimens shall be prepared and tested in accordance with ASTM D412 using Die B. Weight change specimens shall be 1-inch (25-mm) by 3-inch (75-mm) samples. Specimens for testing of initial physical properties may be taken from liner sheet and welding strip at any time prior to final acceptance of the work.

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- C. Continuous locking extensions embedded in concrete shall withstand a test pull of at least 100 pounds per linear inch (1800 kg/m), applied perpendicularly to the concrete surface for a period of one minute, without rupture of the locking extensions or withdrawal from embedment. This test shall be made at a temperature of 70°- 80°F (21° - 27°C) inclusive.
- D. All plastic liner plate sheets, including locking extensions, all joint, corner and welding strips shall be free of cracks, cleavages or other defects adversely affecting the protective characteristics of the material. The engineer may authorize the repair of such defects by approved methods.
- E. The lining shall have good impact resistance, shall be flexible and shall have an elongation sufficient to bridge up to 1/4-inch (6 mm) settling cracks, which may occur in the pipe or in the joint after installation, without damage to the lining.
- F. The lining shall be repairable at any time during the life of the pipe or the structure.

23.05 CHEMICAL RESISTANCE

- A. After conditioning to constant weight at 110°F (43°C), tensile specimens and weight change specimens shall be exposed to the following solutions for a period of 112 days at 77°F±5° (25°C±3°). At 28-day intervals, tensile specimens and weight change Specimens shall be removed from each of the chemical solutions and tested in accordance with Paragraph 2.3.2. If any specimen fails to meet the 112-day requirement before completion of the 112-day exposure, the material will be subject to rejection.

Chemical Solution	Concentration
Sulfuric acid	20%**
Sodium hydroxide	5%
Ammonium hydroxide	5%**
Nitric acid	1%**
Ferric chloride	1%
Sodium hypochlorite	1%
Soap	0.1%
Detergent (linear alkyl benzyl sulfonate or LAS)	0.1%
Bacteriological	BOD not less than 700 ppm.

* This is to be used as a pre-qualification test and when material formulations are changed.

** Volumetric percentages of concentrated C.P. grade reagents.

23.06 DETAILS AND DIMENSIONS OF BASIC SIZE SHEETS (4-FOOT WIDTHS)

- A. Liner sheets shall be a minimum of 0.065 inch (1.65 mm) in thickness. Locking extensions (T-shaped) of the same material as that of the liner shall be integrally extruded with the sheet. Locking extensions shall be approximately 2 1/2 inches (64 mm) apart and shall be at least 0.375-inch (9.5 mm) high.

- B. Sheets shall have a nominal width of 48 inches (1200 mm) and a length of not more than 24 feet (7.3 m), except that longer lengths may be supplied on special order. Lengths specified shall include a tolerance at a ratio of $\pm 1/4$ inch (6 mm) for each 100 inches (2500 mm).
- C. Sheets not used for shop fabrication into larger sheets shall be shop tested for pinholes using an electrical spark tester set between 18,000 and 22,000 volts. Any holes shall be repaired and retested.
- D. Special sized, factory pre-welded sheets are available on special order.

23.07 PIPE SIZE SHEETS AND ACCESSORIES

- A. Pipe linings shall be supplied as pipe-size sheets, fabricated by shop-welding the basic-size sheets together. Shop welds shall be made by lapping sheets a minimum of $1/2$ inch and applying heat and pressure to the lap to produce a continuous welded joint. Tensile strength measured across shop-welded joints in accordance with ASTM D412 shall be at least 2000 psi (14 MPa).
- B. If required, strap channels shall be 1-inch (25-mm) wide maximum and formed by removing the locking extensions so that a maximum of $3/16$ inch (5 mm) remains.
- C. Sheets also can be supplied in prefabricated, pipe-size tubular-shaped sheets, ready to lower onto the inner pipe forms. These normally do not require the use of strap channels.
- D. Transverse flaps may be provided at the ends of sheets for pipe. Locking extensions shall be removed from flaps so that a maximum of $1/32$ inch (1mm) of the base of the locking extension is left on the sheet.
- E. Welding strips shall be approximately 1-inch (25 mm) wide with a minimum width of $7/8$ inch (22 mm). The edges of weld strips shall be beveled in the manufacturing process. Thickness of weld strip shall be a nominal $1/8$ inch (3 mm).
- F. Joint strips for pipe shall be 4-inches (100 mm) wide with a minimum width of $3/4$ inches (94 mm). Thickness of joint strips shall be a nominal of $3/32$ inch (2.3 mm).
- G. Prior to preparing sheets for shipment, they shall be tested for pinholes using an electrical spark tester set between 18,000 and 22,000 volts. Any holes shall be repaired and retested.

23.08 INSTALLATION OF LINING

- A. Installation of the lining, including preheating of sheets in cold weather and the welding of all joints, shall be done in accordance with the recommendations of the liner manufacturer
- B. Coverage of the lining shall not be less than the minimum shown on the plans.

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- C. The lining shall be installed with the locking extensions running parallel with the longitudinal axis of the pipe.
- D. The lining shall be held snugly in place against inner forms.
- E. Locking extensions shall terminate not more than 1 1/2 inches (38 mm) from the end of the inside surface of the pipe section. Joint flaps when used shall extend approximately 4 inches (100 mm) beyond the end of the inside surface.
- F. Concrete poured against lining shall be vibrated, spaded or compacted in a careful manner so as to protect the lining and produce a dense, homogenous concrete, securely anchoring the locking extensions into the concrete.
- G. In removing forms, care should be taken to protect the lining from damage. Sharp instruments shall not be used to pry forms from lined surfaces. When forms are removed, any nails that remain in the lining shall be pulled, without tearing the lining, and the resulting holes clearly marked.
- H. All nail and tie holes and all cut, torn and seriously abraded areas in the lining shall be patched. Patches made entirely with welding strip shall be fused to the liner over patch area. Larger patches may consist of smooth liner sheet applied over the damaged area with adhesive. All edges must be covered with welding strip fused to the patch and the sound lining adjoining the damaged area.
- I. Hot joint compounds, such as coal tar, shall not be poured or applied to the lining.
- J. The contractor shall take all necessary measures to prevent damage to installed lining from equipment and materials used in or taken through the work.

23.09 APPLICATION TO CONCRETE PIPE- SPECIAL REQUIREMENTS

- A. The lining shall be set flush with the inner edge of the bell or spigot end of a pipe section and shall extend to the opposite end or to approximately 4 inches (100 mm) beyond the opposite end depending upon the type of lining joint to be made with the adjoining concrete pipe.
- B. Wherever concrete pipe or cast-in-place structures protected with lining joint structures not so lined (such as brick structures, concrete pipe or cast-in-place structures with clay lining or clay pipe), the lining shall be extended over and around the end of the pipe and back into the structure for not less than 4 inches (100 mm). This protecting cap may be molded or fabricated from the lining material but need not be locked into the pipe.
- C. Where a pipe lateral (not of plastic lined concrete) is installed through lined concrete pipe, the seal between the lined portion and the lateral shall be made by the method prescribed for cast-in-place structures in paragraph B in 23.11.
- D. Lined concrete pipe may be cured by standard curing methods.
- E. Care shall be exercised in handling, transporting and placing lined pipe to prevent damage to the lining. No interior hooks or slings shall be used in lifting pipe. All handling operations shall be done with an exterior sling or with a suitable fork lift.
- F. On pipe having a 360° liner coverage, the longitudinal edges of the sheet shall be butt welded. When pipe tubes are furnished, these are shop-welded joints made in accordance with paragraph A in 23.07.
- G. No pipe with damaged lining will be accepted until the damage has been repaired to the satisfaction of the engineer.

23.10 FIELD JOINTS IN LINING FOR CONCRETE PIPING

- A. The joint between sections of lined pipe shall be prepared in the following manner: If required, the inside joint shall be filled and carefully pointed with cement mortar in such a manner that the mortar shall not, at any point, extend into the pipe beyond the straight line connecting the surfaces of the adjacent pipe sections. Pipe joints must be dry before lining joints are made.
- B. All mortar and other foreign material shall be removed from lining surfaces adjacent to the pipe joint, leaving them clean and dry.
- C. Field joints in the lining at pipe joints may be either of the following described types: Type P-1: The joint shall be made with a separate 4-inch (100 mm) joint strip and two welding strips. The 4-inch (100 mm) joint strip shall be centered over the joint, heat sealed to the lining, then welded along each edge to adjacent liner sheets with a 1-inch (25 mm) weld strip. The 4-inch (100 mm) joint strip shall lap over each sheet a minimum of 1/2 inch (13 mm). Type P-2: The joint shall be made with a joint flap with locking extensions removed per Paragraph 2.6.4 and extending approximately 4 inches (100 mm) beyond the

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pipe end. The joint flap shall overlap the lining in the adjacent pipe section a minimum of 1/2 inch (13 mm) and be heat-sealed in place prior to welding. The field joint shall be completed by welding the flap to the lining of the adjacent pipe using 1-inch (25 mm) weld strip. Care shall be taken to protect the flap from damage. Excessive tension and distortion in bending back the flap to expose the pipe joint during laying and joint mortaring shall be avoided. At temperatures below 50°F (10°C), heating of the liner may be required to avoid damage.

- D. The joint flap or strip on beveled pipe shall be trimmed to a width (measured from the end of the spigot) of approximately 4 inches (100 mm) for the entire circumferential length of the lining.
- E. All welding of joints is to be in strict conformance with the specifications and instructions of the lining manufacturer. Welding shall fuse both sheets and weld strip together to provide a continuous joint equal in corrosion resistance and impermeability to the basic liner sheet. Hot-air welding tools shall provide effluent air to the sheets to be joined at a temperature between 500° and 600°F (260° and 316°C). Welding tools shall be held approximately 1/2 inch (13 mm) from and moved back and forth over the junction of the two materials to be joined. The welding tool shall be moved slowly enough as the weld progresses to cause a small bead of molten material to be visible along both edges and in front of the weld strip.
- F. The following special requirement shall apply when the liner coverage is 360 degrees: When groundwater is encountered the lining joint shall not be made until pumping of groundwater has been discontinued for at least three days and no visible leakage is evident at the joint. When welding the downstream side of a joint strip or flap, do not weld 6 to 8 inches (150 to 200 mm) at the pipe invert to provide relief of potential future groundwater buildup.

23.11 APPLICATION TO CAST-IN-PLACE CONCRETE STRUCTURES- SPECIAL REQUIREMENTS

- A. Liner sheets shall be closely fitted and properly secured to the inner forms. Sheets shall be cut to fit curved and warped surfaces using a minimum number of separate pieces.
- B. Unless otherwise shown on the plans, the lining shall be returned at least 3 inches (75 mm) at the surfaces of contact between the concrete structure and items not of concrete (including manhole frames, gate guides, clay pipe or brick manholes and clay or cast iron pipes). The same procedure shall be followed at joints where the type of protective lining is changed or the new work is built to join existing unlined concrete. At each return, the returned liner shall be sealed to the item in contact with the plastic-lined concrete using Ameron T-Lock 19Y adhesive system. If the liner cannot be sealed with this adhesive because of the joint at the return being too wide or rough or because of safety regulations, the joint space shall be densely caulked with lead wool or other approved caulking material to a depth of 2 inches (50 mm) and finished with a minimum of 1 inch (25 mm) of an approved corrosion resistant material.

23.12 JOINTS IN LINING FOR CAST-IN-PLACE CONCRETE STRUCTURES

- A. Lining at joints shall be free of all mortar and other foreign material and shall be clean and dry before joints are made.
- B. Field joints in the lining shall be of the following described types, used as prescribed: Type C-1: The joint shall be made with a separate 4-inch (100 mm) joint strip and two welding strips. The 4-inch (100 mm) joint strip shall be centered over the joint, heat-sealed to the liner then welded along each edge to adjacent sheets with a 1-inch (25 mm) wide welding strip. The width of the space between adjacent sheets shall not exceed 2 inches (50 mm). The 4-inch (100 mm) joint strip shall lap over each sheet a minimum of 1/2 inch (13 mm). It may be used at any transverse or longitudinal joint. Type C-2: The joint shall be made by lapping sheets not less than 1/2 inch (13 mm). One 1-inch (25 mm) welding strip is required. The upstream sheet shall overlap the one downstream. The lap shall be heat-sealed into place prior to welding on the 1-inch (25 mm) welding strip. Type C-3: The joint shall be made by applying 2-inch (50mm) wide waterproof tape or 1-inch (25 mm) wide welding strip on the back of the maximum 1/4-inch (6 mm) gap butt joint or by some other method approved by the engineer to prevent wet concrete from getting under the sheet. After the forms have been stripped, a 1-inch (25 mm) welding strip shall be applied over the face of the sheet.
- C. All welding is to be strict conformance with the specifications of the lining manufacturer and Paragraph E under 23.10.

23.13 TESTING AND REPAIRING DAMAGED SURFACES

- A. After the pipe is installed in the trench, all surfaces covered with lining, including welds, shall be tested with an approved electrical holiday detector (Tinker & Razor Model No. AP-W with power pack) with the instrument set between 18,000 and 22,000 volts. All welds shall be physically tested by a nondestructive probing method. All hatches over holes, or repairs to the liner wherever damage has occurred, shall be accomplished in accordance with Paragraph H under 21.08.
- B. Each transverse welding strip which extends to a lower edge of the liner will be tested by the purchasing agency. The welding strips shall extend 2-inches (50 mm) below the liner to provide a tab. A 10-pound (5 kg) pull will be applied to each tab. The force will be applied normal to the face of the structure by means of a spring balance. Liner adjoining the welding strip will be held against the concrete during application of the force. The 10-pound (5 kg) pull will be maintained if a weld failure develops, until no further separation occurs. Defective welds will be retested after repairs have been made. Tabs shall be trimmed away neatly by the installer of the liner after the welding strip has passed inspection. Inspection shall be made within 2 days after the joint has been completed in order to prevent tearing the protecting weld strip and consequent damage to the liner from equipment and materials used in or taken through the work.

23.14 WARRANTY

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- A. Ameron warrants that the product conforms to the specific description in Ameron trade literature as to character and quality of the raw materials, workmanship and adaptability for recommended use. Within one year from date of purchase, Ameron shall supply replacement material for this product or any portion thereof, or at its option equivalent material, F.O.B. Ameron manufacturing facility, if it fails to meet the foregoing warranty, provided that installation and application of the product have been properly accomplished and that Ameron has been promptly notified of the defect. The preceding constitutes the sole remedy of the Buyer and the sole liability of Ameron for product defect. No other express or implied warranties, whether of merchantability or of fitness for any particular purpose or use, shall apply. Ameron shall not be responsible for consequential damages. Ameron's Standard Terms and Conditions of Sale apply to purchase of this product. The product data sheet and the recommendations for usage it contains were based on test data believed to be reliable, and are intended for use by personnel having skill and know-how, at their own discretion and risk, in accordance with current industry practice and normal operating conditions. Variation in environment, changes in operating procedures or extrapolation of data may cause unsatisfactory results. Since we have no control over the conditions or service, we expressly disclaim responsibility for the results obtained or for any consequential or incidental effects of any kind. Also refer to Ameron "Safety Precautions," and Ameron International Corporation—Terms and Conditions of Sale.

END OF SECTION

SECTION 24 - PIPING MATERIALS: HDPE PRESSURE PIPE

24.01 SCOPE OF WORK

- A. The Contractor shall furnish all labor, materials, equipment and incidentals required to install polyethylene pressure pipe, fittings and appurtenances as shown on the Drawings and specified in the Contract Documents and these Standards.
- B. Newly installed pipe shall be kept clean and free of all foreign matter & gouges.
- C. All pipe shall be correctly color coded / identified.

24.02 QUALIFICATIONS

All polyethylene pipe, fittings and appurtenances shall be furnished by a single manufacturer who is fully experienced, reputable and qualified in the manufacture of the items to be furnished.

24.03 POLYETHYLENE PRESSURE PIPE

- A. Polyethylene pipe 4" diameter and larger shall be high-density PE 3408 polyethylene resin per ASTM D 3350, Cell Classification 345464C, Class 160, DR 11, CPChem DriscoPlex 4000, 4300 or 4500 or an approved equal, meeting the requirements of AWWA C906. All pipe materials used in potable water systems shall comply with NSF Standard 61. Outside diameters of water, reclaimed water and pressure sewer HDPE pipes shall be ductile iron size (DIPS).
- B. Polyethylene pipe and tubing 3" diameter and smaller shall be pressure Class 200, DR 9 "Driscopipe 5100", Endo Pure by Endot, or equal, meeting the requirements of AWWA C901 (latest revision) and the following ASTM requirements:

Material Designation PPI/ASTM PE 3408
Material Classification ASTM D-1248 III C5 P34
Cell Classification ASTM D-3350

24.04 JOINTS

- A. Where PE pipe is joined to PE pipe, it shall be by thermal butt fusion. Thermal fusion shall be accomplished in accordance with the written instructions of the pipe manufacturer and fusion equipment supplier. The installer of the thermal butt fused PE pipe shall have received training in heat fusion pipe joining methods and shall have had experience in performing this type of work.
- B. Where thermal butt fusion cannot be used, or when specifically called for on the plans, electro-fused couplings may be used. Fusion shall be in accordance with the written instructions of the fitting manufacturer.

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- C. Flanged joints, mechanical joints, tapping saddles, and molded fittings shall be in accordance with AWWA C901, C906 or C909, ASTM D3350 and D3140, as applicable. Fusion and mechanical connections are allowed, chemical (solvents, epoxies, etc.) are not allowed.

24.05 DETECTION

- A. Direct buried HDPE pipe shall have 3" detectable metallic tape of the proper color placed directly above the pipe and 12" below finished grade or 6" detectable tape between 12" and 24" below finished grade.
- B. Direct buried or horizontal directional drilled HDPE pipe shall also have tracer wire installed along the pipe alignment. The tracer wire to be used shall be a solid, 10 gauge, high strength, copper clad steel wire with a polyethylene jacket of appropriate color manufactured by Copperhead Industries or approved equal.

24.06 IDENTIFICATION

- A. Pipe shall bear identification markings in accordance with AWWA C906.
- B. Pipe shall be color coded blue for water, purple (Pantone 522 C) for reclaimed water or green for pressure sewer using a solid pipe color or embedded colored stripes. Where stripes are used, there shall be a minimum of three stripes equally spaced.

24.07 INSTALLING POLYETHYLENE PRESSURE PIPE AND FITTINGS

All polyethylene pressure pipe shall be installed by direct bury, directional bore, or a method approved by the City prior to construction. If directional bore is used, or if directed by the City, the entire area of construction shall be surrounded by silt barriers during construction.

END OF SECTION