	Issued for Bid
NRO Wells 117N and 119N Improvements Collier County, Florida	
Contract Documents and Technical Specifications	
	Prepared for: <i>Collier County</i>
	Issue Date: <i>March 2024</i>
	<b>CDM</b> Smith

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np (for Water Well)
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# **WELL CONDITIONING SPECIFICATIONS (By Water Science Associates, Inc.)** Specifications for Rehabilitation of Two Collier County Production Wells: RO-117N & RO-119N

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## DOCUMENT 000107 - SEALS PAGE

## 1.1 DESIGN PROFESSIONALS OF RECORD

- A. Structural Engineer:
  - 1. Kevin M. Francoforte
  - 2. License #73949.
  - 3. Responsible for Division 03 and Division 13.





- B. Process Mechanical Engineer:
  - 1. Isaac David Holowell.
  - 2. License #83413.
  - 3. Responsible for Division 40, Sections 400506 to 400578.19 and Division 43



- C. Electrical Engineer:
  - 1. Spencer Perry.
  - 2. License #62587.
  - 3. Responsible for Division 26.



- D. Instrumentation and Controls Engineer:
  - 1. Michael Graham.
  - 2. License #71194.
  - Responsible for Division 27 and Division 40, Sections 406100 to 407856.



END OF DOCUMENT 000107

## SECTION 012000 MEASUREMENT AND PAYMENT

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

A. This section includes measurement and payment criteria applicable to portions of the Work performed under unit price, lump sum, or allowance payment methods.

## 1.3 UNIT QUANTITIES SPECIFIED

- A. Quantities and measurements indicated in the Bid Form are for bidding and contract purposes only. Quantities and measurements supplied or placed in the Work and verified by the ENGINEER shall determine payment.
- B. If the actual Work requires more or fewer quantities than those quantities indicated, provide the required quantities at the unit sum/prices contracted.

## 1.4 MEASUREMENT OF QUANTITIES

- A. Measurement Devices:
  - 1. Weigh Scales: Inspected, tested and certified for use in the State of Florida by the applicable state Weights and Measures department within the past year.
  - 2. Platform Scales: Of sufficient size and capacity to accommodate the conveying vehicle.
  - 3. Metering Devices: Inspected, tested and certified by the applicable State of Florida Weights and Measures department within the past year.
- B. Measurement by Weight: Concrete reinforcing steel, rolled or formed steel or other metal shapes will be measured by handbook weights. Welded assemblies will be measured by handbook or scale weight.
- C. Measurement of quantities expressed as volume shall be based upon a neat plan line projection to the work limits as determined by survey record drawings for each item with no additional allowances for shrinkage, swelling or creep.
  - 1. In computing volumes of excavation and fill, the average end area method or other methods, acceptable to the ENGINEER, will be used.

- D. Measurement of quantities expressed as area shall be based upon a horizontal, planimetric projection to the work limits as determined by survey record drawings for each item with no additional allowances for slopes.
- E. Measurement of linear items such as piping will be for quantities actually field installed to the specified work limits, based upon surveyed stations recorded along the straight or curved centerline of each respective item.
- F. Stipulated Sum/Price Measurement: Items measured by weight, volume, area, or linear means or combination, as appropriate, as a completed item or unit of the Work.

## 1.5 PAYMENT

- A. Payment for each lump sum and unit price stated in the itemized bid schedule shall constitute full compensation for all required labor, products, tools, equipment, material, plant, transportation, services and incidentals; erection, application or installation of an item of the Work required to complete all work specified under that particular item including cleanup, and all costs for doing related work as set forth in these Specifications and /or the on the Contract Drawings or implied in carrying out their intent.
  - 1. The price bid for each lump sum and unit price stated in the itemized bid schedule shall be deemed to include overhead and profit. CONTRACTOR'S Insurance is not a separate pay item and shall be included in the price for each lump sum and unit price stated in the itemized bid schedule.
  - 2. Relevant specification section references are provided to facilitate pricing. However, Contractor shall, using his own judgment, determine which sections are relevant to each pay item prior to submitting a comprehensive price that covers all Work identified in the Contract Documents.
- B. Final payment for Work governed by unit prices will be made on the basis of the actual measurements and quantities accepted by the ENGINEER multiplied by the unit sum/price for Work which is incorporated in or made necessary by the Work.
- C. Requests for payment shall be in accordance with the County's standard contract language.
- D. Payment will be made to the limits as specified in the Contract Documents. If the constructed limits are less that the specified limit, payment will be made to the actual limits of construction as shown on the As-Built Drawings. Payment for quantities that exceed the specified contract limits will only be made with the approval of the ENGINEER. The payment for quantities that exceed the contract quantities can only be obtained through an approved Change Order before contract quantities are exceeded.
- E. No partial payments shall be made for the installation of items that have not been tested and approved.
- F. Partial payment may be requested for material delivered to the site, and adequately stored and protected until installation. Materials may be paid for at direct cost plus shipping, upon presentation of a valid receipt or bill with the payment request at the sole discretion of the

OWNER. All such requests must have material quantities verified by the ENGINEER prior to payment.

- 1. Qualification for partial payment for materials delivered shall be in accordance with the General Conditions and the Agreement.
- G. Upon installation, the unit cost for the item will be paid less any prior payments for stored material. Upon installation, an adjustment will be made in payment to account for the quantity of materials actually installed in the work. Final payment will be subject to the acceptance of the unit item following approval of final testing, if applicable. OWNER will not pay for material in excess of what is actually installed in the work.
- H. Payment for unit price items (all items except Lump Sum items) will be made monthly until completion of each unit price item based on quantity estimated by CONTRACTOR and verified by ENGINEER. Final payment will be based on quantity calculated from As-Built Drawings.

## 1.6 VARIATIONS IN ESTIMATED QUANTITIES

- A. The quantities given in the Contract Documents are approximate only and are given as a basis for the uniform comparison of bids, and the OWNER does not expressly or by implication agree that the actual amount of work will correspond therewith.
- B. The CONTRACTOR must provide, for Unit Price Work, a proposed contract price determined on the basis of estimated quantities required for each item. The estimated quantities of items are not guaranteed and are solely for the purpose of comparing bids. Each such unit price will be deemed to include an amount for overhead, profit and indirect costs for each separately defined item.
- C. An increase or decrease in the quantity for any unit price item shall not be regarded as sufficient grounds for an increase or decrease in the price of the items.

## 1.7 DEFECT ASSESSMENT

- A. Replace defective Work, or portions of defective Work, not conforming to specified requirements.
- B. If, in the opinion of the ENGINEER, it is not practical to remove and replace the Work, the ENGINEER will direct a remedy in accordance with the requirements of the Agreement.

## 1.8 NON-PAYMENT FOR REJECTED PRODUCTS

- A. Payment will not be made for any of the following:
  - 1. Products wasted or disposed of in a manner that is not acceptable.
  - 2. Products determined as unacceptable before or after placement.
  - 3. Products not completely unloaded from the transporting vehicle.
  - 4. Products placed beyond the lines and levels of the required Work.
  - 5. Products remaining on hand after completion of the Work.

- 6. Loading, hauling and disposing of rejected Products.
- 7. Submittal and approval of Schedule Update per Section 013200.

## 1.9 SCHEDULE OF VALUES

A. Approval of Schedule: Submit for approval a preliminary schedule of values, in duplicate, for all of the Work.

## 1.10 SAVINGS PROPOSALS

A. The CONTRACTOR may make proposals to change the Work, which result in savings in the cost to perform the Work. When such proposals are made, they will be referred to the OWNER for evaluation. If it is determined by the OWNER that the proposal provides the same level of service and if the OWNER accepts the change, the CONTRACTOR shall provide an estimate of the savings resulting from the proposed change. A change order documenting the changes will be issued by the OWNER to incorporate the changes including the savings through revised Unit Prices.

#### 1.11 BID ITEM DESCRIPTIONS

## A. ITEM 1 – MOBILIZATION AND DEMOBILIZATION

- 1. Measurement for payment for mobilization and demobilization as described in the Specifications will be on a lump sum basis.
- 2. The lump sum price bid for Mobilization and Demobilization shall be a total of ten percent (10%) and shall be based on mobilization costs that shall not exceed five percent (5%) and demobilization costs that shall not exceed five percent (5%).
- 3. Payment for mobilization will be made at the Bid Form lump sum price which shall be full compensation for the cost of bond premiums, survey layout and record drawings, preconstruction videos, maintenance of traffic, erosion and sedimentation control, and contract closeout.
- B. ITEM 2 WELL 117 STRUCTURAL SUPPORTS
  - 1. Measurement for payment for structural support items shall be on a lump sum basis.
  - 2. Payment will be made at the Bid Form lump sum price for structural supports at Well 117 which will be full compensation for all labor, materials, and equipment necessary to install pipe supports for the aboveground wellhead piping.

## C. ITEM 3 – WELL 117 - MISCELLANEOUS ELECTRICAL

- 1. Measurement for payment for miscellaneous electrical shall be on a lump sum basis.
- 2. Payment will be made at the Bid Form lump sum price for Miscellaneous Electrical at Well 117 which will be full compensation for all labor, materials, and equipment necessary to install all electrical components for the well. This item will include all material and labor for the installation of conduit, wiring, electrical components, cabinets, cabinet sunshades, lightning protection system, modifications to existing control panels.

## 1.12 ITEM 4 – WELL 117 - INSTRUMENTATION AND CONTROLS

- A. Measurement for payment for instrumentation and controls shall be on a lump sum basis.
- B. Payment will be made at the Bid Form lump sum price for Instrumentation and Controls at Well 117 which will be full compensation for all labor, materials, and equipment necessary to construct the complete Instrumentation and Controls system associated with the well. Integrator shall be selected from the County's pre-approved list of vendors.

#### 1.13 ITEM 5 – WELL 117 - WELLHEAD, PUMP, AND MOTOR

- A. Measurement for payment for wellhead, pump and motor shall be on a lump sum basis.
- B. Payment will be made at the Bid Form lump sum price for Wellhead, Pump and Motor at Well 117 which will be full compensation for all labor, materials, and equipment necessary to construct the wellhead, drop pipe, pump, and motor.

#### 1.14 ITEM 6 – WELL 117-PIPING, VALVES, FITTINGS, AND MISCELLANEOUS

- A. Measurement for payment for piping, valves, fittings and miscellaneous shall be on a lump sum basis.
- B. Payment will be made at the Bid Form lump sum price for Piping, Valves, Fittings, and Miscellaneous at Well 117 which will be full compensation for all labor, materials, and equipment necessary to construct the stainless steel piping, HDPE piping, meter, valves, air release valves, fittings, sample taps, excavation, backfill, surface restoration (gravel drive and sod), testing, chlorination, dewatering, dewatering permit, and connection to existing raw water main.

#### 1.15 ITEM 7 – WELL 119 - MISCELLANEOUS STRUCTURAL

- A. Measurement for payment for structural support items shall be on a lump sum basis.
- B. Payment will be made at the Bid Form lump sum price for structural supports at Well 119 which will be full compensation for all labor, materials, and equipment necessary to install pipe supports for the aboveground wellhead piping, structural slabs and canopy structure.

## 1.16 ITEM 8 – WELL 119 - MISCELLANEOUS ELECTRICAL

- A. Measurement for payment for miscellaneous electrical shall be on a lump sum basis.
- B. Payment will be made at the Bid Form lump sum price for Miscellaneous Electrical at Well 119 which will be full compensation for all labor, materials, and equipment necessary to install all electrical components for the well. This item will include all material and labor for the installation of conduit, wiring, electrical components, cabinets, cabinet sunshades, lightning protection system.

## 1.17 ITEM 9 – WELL 119 - INSTRUMENTATION AND CONTROLS

- A. Measurement for payment for instrumentation and controls shall be on a lump sum basis.
- B. Payment will be made at the Bid Form lump sum price for Instrumentation and Controls at Well 119 which will be full compensation for all labor, materials, and equipment necessary to construct the complete Instrumentation and Controls system associated with the well. Integrator shall be selected from the County's pre-approved list of vendors.
- 1.18 ITEM 10 WELL 119 WELLHEAD, PUMP, AND MOTOR
  - A. Measurement for payment for wellhead, pump and motor shall be on a lump sum basis.
  - B. Payment will be made at the Bid Form lump sum price for Wellhead, Pump and Motor at Well 119 which will be full compensation for all labor, materials, and equipment necessary to construct the wellhead, drop pipe, pump, and motor.
- 1.19 ITEM 11 WELL 119 PIPING, VALVES, FITTINGS, AND MISCELLANEOUS
  - A. Measurement for payment for piping, valves, fittings and miscellaneous shall be on a lump sum basis.
  - B. Payment will be made at the Bid Form lump sum price for Piping, Valves, Fittings, and Miscellaneous at Well 119 which will be full compensation for all labor, materials, and equipment necessary to construct the stainless steel piping, HDPE piping, meter, valves, air release valves, fittings, sample taps, excavation, backfill, surface restoration (gravel drive and sod), testing, chlorination, dewatering, dewatering permit, and connection to existing raw water main.
- 1.20 ITEM 12 WELL 119 SITE CIVIL
  - A. Measurement for payment for site civil shall be on a lump sum basis.
  - B. Payment will be made at the Bid Form lump sum price for Site Civil at Well 119 which will be full compensation for all labor, materials, and equipment necessary to fill to grade, sod disturbed areas, and install gravel access drive.

## 1.21 ITEM 13 - WELL CONDITIONING

- A. Measurement for payment for well conditioning shall be as indicated on the supplemental specifications provided by WSA, Inc and the Exhibit A attached to them (these are provided at the end of this document).
- B. Payment will be made at the Bid Form lump sum price or per hour as detailed on the bid tabulation and in the supplemental specifications for Well Conditioning at Well 117 and 119 which will be full compensation for all labor, materials, and equipment necessary to provide a permitted well.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 012000

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## SECTION 033000 - CAST-IN-PLACE CONCRETE

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.
- B. Related Requirements:
  - 1. Section 036000 "Grouting" for grouting.
  - 2. Section 312000 "Earthwork" for drainage fill under slabs-on-grade.

#### 1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.
- B. W/C Ratio: The ratio by weight of water to cementitious materials.

## 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Design Mixtures: For each formulation of concrete proposed for use, submit constituent quantities per cubic yard (cubic meter), water cementitious ratio, air content, concrete slump, type and manufacturer of cement and type and manufacturer of fly ash or ground granulated blast furnace slag. For each concrete mixture, submit alternate design mixtures when characteristics of materials change, source of cement or aggregate change or test results do not meet specification requirements, or other circumstances warrant adjustments..
  - 1. Indicate amounts of mixing water to be withheld for later addition at Project site.
- C. Steel Reinforcement Shop Drawings: Placing Drawings that detail fabrication, bending, and placement. Include bar sizes, spacing, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement. Reference bars to be the same identification marks shown on the bar bending details.

- D. Construction Joint Layout: As shown on the Drawings.
- E. Welding certificates.
- F. Material Certificates: For each of the following, signed by manufacturers:
  - 1. Cementitious materials.
  - 2. Admixtures.
  - 3. Form materials and form-release agents.
  - 4. Steel reinforcement and accessories.
  - 5. Fiber reinforcement.
  - 6. Curing compounds.
  - 7. Bonding agents.
  - 8. Adhesives.
  - 9. Repair materials.
- G. Material Test Reports: For the following, from a qualified testing agency:
  - 1. Aggregates: Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
  - 2. Mill Test Reports:
    - a. Cementitious materials.
    - b. Steel Reinforcing.

## 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.
  - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

## 1.6 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Provide reinforcement free from mill scale, rust, mud, dirt, grease, oil, ice, or other foreign matter that will reduce or destroy bond. Deliver, store, and handle steel reinforcement to prevent bending and damage. Store reinforcement off the ground, protect from moisture, and keep out of standing water, and free from rust, mud, dirt, grease, oil, ice, or other contaminants and deleterious films that will reduce or destroy bond.

## 1.7 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

- 1. When average high and low temperature is expected to fall below 40 degrees F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
- 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
- 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:
  - 1. Maintain concrete temperature below 90 degrees F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
  - 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

## PART 2 - PRODUCTS

## 2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
  - 1. ACI 301.
  - 2. ACI 117.

## 2.2 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
  - 1. Plywood, metal, or other approved panel materials.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- D. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.
  - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- E. Form Ties: Factory-fabricated, removable or snap-off glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

- 1. Furnish units that leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
- 2. Furnish ties that, when removed, leave holes no larger than 1 inch in diameter in concrete surface.
- 3. Furnish ties with integral water-barrier plates to below grade walls.

## 2.3 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.
- B. Reinforcing bars to be welded or field bent: Low-Alloy-Steel Reinforcing Bars, ASTM A706/A706M, deformed.
- C. Deformed-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, flat sheet.

## 2.4 REINFORCEMENT ACCESSORIES

- A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
  - 1. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
- B. Tie wires for reinforcement: 16 gauge or heavier black annealed wire to tie uncoated reinforcing. Use zinc coated wire to tie galvanized reinforcing. Use epoxy coated wire to tie epoxy coated reinforcing.

## 2.5 CONCRETE MATERIALS

- A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- B. Cementitious Materials:
  - 1. Portland Cement: ASTM C150/C150M, Type I/II, gray.
  - 2. Fly Ash: ASTM C618, Class F.
  - 3. Slag Cement: ASTM C989/C989M, Grade 100 or 120.
- C. Normal-Weight Aggregates: ASTM C33/C33M, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source.
  - 1. Maximum Coarse-Aggregate Size: ASTM C33 Size Number 57 nominal.
  - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- D. Air-Entraining Admixture: ASTM C260/C260M.

- E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
  - 1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
  - 2. Accelerating Admixture: ASTM C494/C494M, Type C.
  - 3. Water-Reducing and Accelerating Admixture: ASTM C494/C494M, Type E.
  - 4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
- F. Water: ASTM C94/C94M and potable.

#### 2.6 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. BASF Corporation.
    - b. Dayton Superior.
    - c. Euclid Chemical Company (The); an RPM company.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- C. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C309, Type 1, Class B, dissipating.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Dayton Superior.
    - b. Euclid Chemical Company (The); an RPM company.
    - c. W.R. Meadows, Inc.
- F. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C1315, Type 1, Class A.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Dayton Superior.
    - b. Euclid Chemical Company (The); an RPM company.
    - c. W.R. Meadows, Inc.

#### 2.7 REPAIR MATERIALS

- A. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
  - 1. Cement Binder: ASTM C150/C150M, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C219.
  - 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
  - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
  - 4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C109/C109M.

## 2.8 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
  - 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
  - 1. Fly Ash: 25 percent.
  - 2. Combined Fly Ash and Pozzolan: 25 percent.
  - 3. Slag Cement: 50 percent.
  - 4. Combined Fly Ash or Pozzolan and Slag Cement: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
  - 5. Combined Fly Ash, and Pozzolans: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
  - 6. Combined Fly Ash or Pozzolans, Slag Cement: 50 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
  - 1. Use water-reducing admixture in concrete, for placement and workability.
  - 2. High-range water-reducing admixture in concrete, may be used, for placement and workability.
  - 3. Plasticizing admixture in concrete, may be used, for placement and workability.
  - 4. Water-reducing and -retarding admixture, may be used, when required by high temperatures, low humidity, or other adverse placement conditions.
  - 5. Use accelerating admixtures in cold weather. Use of admixtures will not relax cold-weather placement requirements.
  - 6. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

E. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

## 2.9 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Slabs-on-Grade: Normal-weight concrete.
  - 1. Minimum Compressive Strength: 4000 psi at 28 days.
  - 2. Maximum W/C Ratio: 0.45.
  - 3. Minimum Cementitious Materials Content: 520 lb/cu. yd.
  - 4. Slump Limit: 4 inches, plus or minus 1 inch.
  - 5. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.
  - 6. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.

## 2.10 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

## 2.11 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C94/C94M, and furnish batch ticket information.
  - 1. When air temperature is between 85 and 90 degrees F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 degrees F, reduce mixing and delivery time to 60 minutes.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C94/C94M. Mix concrete materials in appropriate drum-type batch machine mixer.
  - 1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
  - 2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd.
  - 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

## PART 3 - EXECUTION

## 3.1 FORMWORK INSTALLATION

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
  - 1. Class A, 1/8 inch for smooth-formed finished surfaces.
  - 2. Class B, 1/4 inch for rough-formed finished surfaces.
- D. Construct forms tight to prevent loss of concrete mortar.
- E. Construct forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
  - 1. Install reglets, recesses, and the like, for easy removal.
  - 2. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Chamfer exterior corners and edges of permanently exposed concrete.
- I. Form openings, chases, offsets, sinkages, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, ice, snow and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

## 3.2 EMBEDDED ITEM INSTALLATION

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.
  - 2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
  - 3. Install dovetail anchor slots in concrete structures as indicated.

#### 3.3 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 degrees F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.
  - 1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
  - 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material are not acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Engineer.

## 3.4 STEEL REINFORCEMENT INSTALLATION

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose mill scale, rust, mud, dirt, grease, oil, ice, and other foreign materials that reduce or destroy the bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
  - 1. Weld reinforcing bars according to AWS D1.4/D 1.4M, only where indicated.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded-wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing, 1.3 times the development length, or 8 inches, whichever is greater. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.
- F. Splicing:
  - 1. Lap splices in welded wire fabric in accordance with the requirements of ACI 318 but not less than 12 inches. Tie the spliced fabrics together with wire ties spaced not more than 24 inches on center and lace with wire of the same diameter as the welded wire fabric. Offset splices in adjacent widths to prevent continuous splices.
  - 2. If not indicated on Drawings, locate reinforcement splices at point of minimum stress.

#### 3.5 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Engineer.
  - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated.
  - 2. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
  - 3. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
  - 4. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces. Intentionally roughen concrete surface and remove laitance prior to applying bonding agent.
  - 5. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces. Intentionally roughen concrete surface and remove laitance prior to applying epoxy-bonding adhesive.
  - 6. At construction joints and at concrete joints indicated on Drawings to be "roughened", uniformly roughen the surface of concrete to a full amplitude (distance between high and low points and side to side) of 1/4 inch with chipping tools to expose a fresh face. Thoroughly clean joint surfaces of loose or weakened materials by waterblasting or sandblasting and prepare for bonding. At least two hours before and again shortly before the new concrete is deposited, saturate joints with water. After glistening water disappears, coat joints with neat cement slurry mixed to consistency of very heavy paste. Coat surfaces to a depth of at least 1/8 inch thick, scrubbed-in by means of stiff bristle brushes. Deposit new concrete before the neat cement dries.
  - 7. Do not use keyways in construction joints unless specifically shown on the Drawings or approved by the Engineer.

#### 3.6 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Engineer.
  - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
  - 1. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid "cold" joints.

- 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
- 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- D. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
  - 1. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
  - 2. Maintain reinforcement in position on chairs during concrete placement.
  - 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
  - 4. Slope surfaces uniformly to drains where required.
  - 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

## 3.7 FINISHING FORMED SURFACES

- A. Finish concrete surfaces according to ACI 301 or ACI 318.
- B. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
  - 1. Apply to concrete surfaces.
- C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

## 3.8 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.
  - 1. Apply float finish to surfaces to receive trowel finish.
- C. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Engineer before application.

## 3.9 MISCELLANEOUS CONCRETE ITEM INSTALLATION

A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with inplace construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

## B. Equipment Pads:

- 1. Coordinate sizes and locations of concrete pads with actual equipment provided.
- 2. Minimum Compressive Strength: 4000 psi at 28 days.
- 3. Install reinforcing dowels; to connect concrete pad to concrete floor. Unless otherwise indicated.
- 4. For supported equipment, install anchor bolts that extend through concrete pad and anchor into structural concrete substrate.
- 5. Prior to pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
- 6. Cast anchor-bolt insert into pads. Install anchor bolts to elevations required for proper attachment to supported equipment.

## 3.10 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 305.1 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for remainder of curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
  - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

- a. Water.
- b. Continuous water-fog spray.
- c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
- 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
  - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
  - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
  - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies does not interfere with bonding of floor covering used on Project.
- 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
  - a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.
- 4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

## 3.11 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Engineer. Remove and replace concrete that cannot be repaired and patched to Engineer's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
  - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit sawcut at the perimeter of the area to a depth of 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen

with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

- 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar matches surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
- 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Engineer.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
  - 1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
  - 2. After concrete has cured at least 14 days, correct high areas by grinding.
  - 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
  - 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
  - 5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
  - 6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
  - 7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Engineer's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Engineer's approval.

#### 3.12 FIELD QUALITY CONTROL

- A. Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Notify the Owner when the reinforcing is complete and ready for inspection, at least six working hours prior to the proposed concrete placement. Do not cover reinforcing steel with concrete until the installation of the reinforcement, including the size, spacing and position of the reinforcement has been inspected by the Owner's inspection agency and the Owner's inspection agency release to proceed with the concreting has been obtained. Keep forms open until the Owner's inspection agency has completed inspection of the reinforcement.
- C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C172/C172M shall be performed according to the following requirements by the Owner's testing agency:
  - 1. Testing Frequency: One composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.
    - a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
  - 2. Slump: ASTM C143/C143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests will be performed when concrete consistency appears to change.
  - 3. Air Content: ASTM C231/C231M, pressure method, for normal-weight concrete;one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
  - 4. Concrete Temperature: ASTM C1064/C1064M; one test hourly when air temperature is 40 degrees F and below or 80 degrees F and above, and one test for each composite sample.
  - 5. Unit Weight: ASTM C567/C567M, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
  - 6. Compression Test Specimens: ASTM C31/C31M.
    - a. Cast and laboratory cure two sets of two standard 6-inch diameter cylinder specimens for each composite sample.
  - 7. Compressive-Strength Tests: ASTM C39/C39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
    - a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
    - b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
  - 8. When strength of field-cured cylinders is less than 85 percent of companion laboratorycured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.

- 9. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
- 10. Test results shall be reported in writing to Engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
- 11. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Engineer.
- 12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- 13. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

END OF SECTION 033000

## SECTION 036000 - GROUTING

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Nonshrink epoxy grout.
  - 2. Nonshrink cementitious grout.
- B. Related Requirements:
  - 1. Section 033000 "Cast-in-Place Concrete."

## 1.3 ACTION SUBMITTALS

- A. Product Data: Submit manufacturer information regarding grout and surface preparation, mixing and installation.
  - 1. Commercially manufactured nonshrink cementitious grout. Include catalog cuts, technical data, storage requirements, product life, working time after mixing, temperature considerations, and conformity to the specified ASTM standards.
  - 2. Commercially manufactured nonshrink epoxy grout. Include catalog cuts, technical data, storage requirements, product life, working time after mixing, temperature considerations, and conformity to the specified ASTM standards.

## 1.4 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- B. Manufacturer Instructions: Submit instructions for mixing, handling, surface preparation, and placing epoxy-type and nonshrink grouts.
- C. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- D. Qualifications Statement:
  - 1. Submit qualifications for manufacturer.

#### 1.5 QUALITY ASSURANCE

- A. Maintain one copy of each standard affecting Work of this Section on Site.
- B. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum ten years' experience in production and use of provided grouts.
- C. Independent testing laboratory shall meet the requirements of ASTM E329 and ASTM C1077 and be acceptable to the Engineer. Laboratories affiliated with the Contractor or in which the Contractor or officers of the Contractor's organization have beneficial interest are not acceptable.
- D. Field Testing:
  - 1. All field testing and inspection services will be provided by Owner. Assist in the sampling of materials, and cooperate by allowing free access to the work and permitting the use of ladders, scaffolding, and such incidental equipment as may be required. Methods of testing will comply with the applicable ASTM Standards.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- B. Store materials according to manufacturer instructions. Limit total storage time from date of manufacture to date of installation to six months or the manufacturer's recommended storage time, whichever is less.
- C. Remove immediately from the site material which becomes damp, contains lumps, or is hardened and replace with acceptable material.
- D. Protection:
  - 1. Protect materials from moisture and dust by storing in clean, dry location.
  - 2. Provide additional protection according to manufacturer instructions.

## 1.7 AMBIENT CONDITIONS

- A. Maximum Conditions: Do not perform grouting if temperatures exceed 90 degrees F.
- B. Minimum Conditions: Do not perform grouting if the minimum temperature of base plates, supporting concrete and grout are less than 40 degrees F. Maintain minimum temperature of 40 degrees F before, during, and after grouting, until grout has set.

Grouting

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#### PART 2 - PRODUCTS

#### 2.1 NONSHRINK EPOXY GROUT

- A. Description:
  - 1. Pre-proportioned, prepackaged, three-component, nonshrink epoxy grout, 100 percent solids system consisting of epoxy resin, hardener, and blended aggregate.
- B. Performance and Design Criteria:
  - 1. Minimum Compressive Strength:
    - a. 10,000 psi at seven days.
    - b. Comply with ASTM C579.
  - 2. Coefficient of Expansion:
    - a. 30x10-6 inch per degree F.
    - b. Comply with ASTM C531.
  - 3. Minimum Tensile Strength:
    - a. 1,800 psi.
    - b. Comply with ASTM C307.
- C. Product: Provide one of the following or equal:
  - 1. Masterflow 648 CP; by BASF Building Systems.
  - 2. Five Star HP Epoxy Grout; by Five Stars Products, Inc.
  - 3. Sikadur 42 Grout-Pak; by Sika Corp.
  - 4. E3-G Epoxy Grout; by Euclid Chemical Co.

## 2.2 NONSHRINK CEMENTITIOUS GROUT

- A. Products:
  - 1. Sika Grout 212 by Sika Corp.
  - 2. NS Grout by The Euclid Chemical Co.
  - 3. Five Star Grout by Five Star Products, Inc.
- B. Description:
  - 1. Pre-mixed and ready-for-use formulation requiring only addition of water.
  - 2. Nonshrink, non-corrosive, nonmetallic, non-gas forming, not containing expansive cement and no chlorides.
  - 3. No shrinkage when tested in conformity with ASTM C827/C827M.

- C. Performance and Design Criteria:
  - 1. Certified to maintain initial placement volume or expand after set, and to meet following minimum properties when tested according to ASTM C1107/C1107M for Grades B, C, D and CRD-C621 nonshrink grout:
    - a. Setting Time:
      - 1) Initial: Approximately two hours.
      - 2) Final: Approximately three hours.
      - 3) Comply with ASTM C191.
    - b. Maximum Expansion: 0.10 to 0.40 percent.
    - c. Minimum Compressive Strength:
      - 1) One-Day: 4,000 psi.
      - 2) Seven-Day: 7,000 psi.
      - 3) 28-Day: 10,000 to 10,800 psi.
      - 4) Comply with CRD-C621.

## 2.3 FORMWORK

A. As specified in this Section and in Section 033000 "Cast-in-Place Concrete".

## PART 3 - EXECUTION

## 3.1 EXAMINATION

A. Verify areas to receive grout.

## 3.2 PREPARATION

- A. Place grout where indicated or specified over existing concrete and cured concrete which has attained its specified design strength unless otherwise approved by Engineer.
- B. Remove defective concrete, ice, laitance, dirt, oil, grease, form release agents, paints, and other foreign material from concrete surfaces, which may affect the bond or performance of the grout by brushing, hammering, chipping, sand blasting or other similar dry mechanical means until sound and clean concrete surface is achieved. Irregular voids or projecting coarse aggregate need not be removed if they are sound, free of laitance and firmly embedded into the parent concrete.
  - 1. Air compressors used to clean surfaces in contact with grout shall be the oil-less type or equipped with an oil trap in the airline to prevent oil from being blown onto the surface.
- C. Roughen concrete lightly, but not to interfere with placement of grout.
- D. Remove foreign materials from metal surfaces in contact with grout.
- E. Align, level, and maintain final positioning of components to be grouted.
- F. Wash concrete surfaces clean and then keep moist for at least 24-hours prior to the placement of nonshrink cementitious or cement grout. Saturation may be achieved by covering the concrete with saturated burlap bags, use of a soaker hose, or flooding the surface or other method acceptable to Engineer. Upon completion of the 24-hour period, remove visible water from the surface prior to grouting.
- G. Nonshrink epoxy grouts do not require saturation of concrete substrate. Do not wet concrete surfaces to receive nonshrink epoxy grout. Completely dry surfaces in contact with epoxy grout before grouting.
- H. Support equipment during alignment and installation of grout by shims, wedges, blocks, or other approved means. Prevent bond of shims, wedges and blocking devices by bond breaking coatings and remove after grouting unless otherwise approved by Engineer. Grout voids created by the removal of shims, wedges, and blocks.

## 3.3 INSTALLATION - GENERAL

- A. Formwork:
  - 1. Construct leakproof forms anchored and shored to withstand grout pressures.
  - 2. Install formwork with clearances to permit proper placement of grout.
  - 3. As specified in Section 033000 "Cast-in-Place Concrete".
- B. Placing of Grout:
  - 1. Place grout material quickly and continuously.
  - 2. Do not use pneumatic-pressure or dry-packing methods.
  - 3. Apply grout from one side only to avoid entrapping air.
  - 4. Do not vibrate placed grout mixture or permit placement if area is being vibrated by nearby equipment.
  - 5. Thoroughly compact final installation and eliminate air pockets.
  - 6. Do not remove leveling shims for at least 48 hours after grout has been placed.
- C. Curing:
  - 1. Prevent rapid loss of water from grout during first 48 hours by use of approved membrane curing compound or by using wet burlap bags, soaker hoses or ponding.
  - 2. Immediately after placement, protect grout from premature drying, excessively hot or cold temperatures, and mechanical injury.
  - 3. After grout has attained its initial set, keep damp for minimum three days.
- D. Reflect existing underlying expansion joints, partial contraction joints, and construction joints through the grout.

### 3.4 INSTALLATION - NONSHRINK EPOXY GROUTS

- A. Mix in accordance with manufacturer's recommendations. Mix full batches only, to maintain proper proportions of resin, hardener and aggregate. Do not vary the ratio of components or add solvent to change the consistency of the grout mix. Do not overmix. Do not entrain air bubbles by mixing too quickly.
- B. Monitor ambient weather conditions and contact the grout manufacturer for special placement procedures to be used for temperatures below 60 degrees F or above 90 degrees F.
- C. Place grout rapidly and continuously to avoid cold joints. Place grout in lifts in accordance with manufacturer's recommendations.
- D. Provide forms as specified in Paragraph 3.3A. Place grout into the designated areas and prevent entrapment of air. Fill all spaces and provide full contact between grout and adjoining surfaces. Provide grout holes and vent holes as necessary.
- E. Minimize 'shoulder' length (extension of grout horizontally beyond base plate). In no case shall the shoulder length of the grout be greater than the grout thickness.
- F. Finish grout by puddling to cover all aggregate and provide smooth finish. Break bubbles and smooth top surface of grout in conformity with manufacturer's recommendations.
- G. Epoxy grouts are self-curing and do not require the application of water. Maintain formed grout within its recommended placement temperature range for at least 24 hours after placement, until grout compressive strength reaches 1,000 psi or as recommended by manufacturer, whichever is longer.
- H. Provide grout control joints as indicated on Drawings.

## 3.5 SCHEDULE

- A. Use particular types of grout as follows:
  - 1. General Purpose Nonshrink Cementitious Grout (CRD-C621 Grade D): Use at locations where nonshrink grout is indicated, except for base plates greater in area than 3-feet wide by 3-feet long.
  - 2. Flowable (precision) Nonshrink Cementitious Grout (CRD-C621 Grade B or C): Use under base plates greater in area than 3-feet wide by 3-feet long. Use at locations indicated to receive flowable (precision) nonshrink grout. Flowable (precision), nonshrink, cementitious grout may be substituted for general purpose nonshrink cementitious grout.
  - 3. Nonshrink Epoxy Grout: Use at locations specifically indicated to receive nonshrink epoxy grout.

#### END OF SECTION 036000

# SECTION 133419 - METAL BUILDING SYSTEMS

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

- A. Section Includes:
  - 1. Structural-steel framing.
  - 2. Metal roof panels.
  - 3. Accessories.
  - 4. Delegated Design.

### 1.3 DEFINITIONS

A. Terminology Standard: See MBMA's "Metal Building Systems Manual" for definitions of terms for metal building system construction not otherwise defined in this Section or in standards referenced by this Section.

#### 1.4 COORDINATION

- A. Coordinate sizes and locations of concrete foundations and casting of anchor-rod inserts into foundation walls and footings. Anchor rod installation, concrete, reinforcement, and formwork requirements are specified in Section 033000 "Cast-in-Place Concrete."
- B. Coordinate metal panel assemblies with rain drainage work, flashing, trim, and construction of supports and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of metal building system component.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
    - a. Metal roof panels.
- B. Shop Drawings: Indicate components by others. Include full building plan, elevations, sections, details and the following:
  - 1. Anchor-Rod Plans: Submit anchor-rod plans and templates before foundation work begins. Include location, diameter, and minimum required projection of anchor rods required to attach metal building to foundation. Indicate column reactions at each

location in individual load cases and in load combinations. Foundation engineer to provide embedment into concrete after final reactions are received.

- 2. Structural-Framing Drawings: Show complete fabrication of primary and secondary framing; include provisions for openings. Indicate welds and bolted connections, distinguishing between shop and field applications. Include transverse cross-sections.
- 3. Metal Roof Panel Layout Drawings: Show layouts of panels including methods of support. Include details of edge conditions, joints, panel profiles, corners, anchorages, clip spacing, trim, flashings, closures, and special details. Distinguish between factory-and field-assembled work; show locations of exposed fasteners.
  - a. Show roof-mounted items including roof hatches, equipment supports, pipe supports and penetrations, lighting fixtures, and items mounted on roof curbs.
- 4. Accessory Drawings: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches:
  - a. Flashing and trim.
  - b. Gutters.
  - c. Downspouts.

# 1.6 DELEGATED DESIGN SUBMITTALS

- A. For metal building systems:
  - 1. Include analysis data indicating compliance with performance requirements and design data signed and sealed by the qualified professional engineer responsible for their preparation.

## 1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer.
- B. Welding certificates.
- C. Letter of Design Certification: Signed and sealed by a qualified professional engineer. Include the following:
  - 1. Name and location of Project.
  - 2. Order number.
  - 3. Name of manufacturer.
  - 4. Name of Contractor.
  - 5. Building dimensions including width, length, height, and roof slope.
  - 6. Indicate compliance with AISC standards for hot-rolled steel and AISI standards for cold-rolled steel, including edition dates of each standard.
  - 7. Governing building code and year of edition.
  - 8. Design Loads: Include dead load, roof live load, collateral loads, roof snow load, deflection, wind loads/speeds and exposure.
  - 9. Load Combinations: Indicate that loads were applied acting simultaneously with concentrated loads, according to governing building code.

- 10. Building-Use Category: Indicate category of building use and its effect on load importance factors.
- D. Erector Certificates: For qualified erector, from manufacturer.
- E. Material Test Reports: For each of the following products:
  - 1. Structural steel including chemical and physical properties.
  - 2. Bolts, nuts, and washers including mechanical properties and chemical analysis.
  - 3. Tension-control, high-strength, bolt-nut-washer assemblies.
  - 4. Shop primers.
  - 5. Nonshrink grout.
- F. Source quality-control reports.
- G. Field quality-control reports.
- H. Surveys: Show final elevations and locations of major members. Indicate discrepancies between actual installation and the Contract Documents. Have surveyor who performed surveys certify their accuracy.
- I. Sample Warranties: For special warranties.

# 1.8 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal panel finishes to include in maintenance manuals.

## 1.9 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer.
  - 1. Accreditation: Manufacturer's facility accredited according to the International Accreditation Service's AC472, "Accreditation Criteria for Inspection Programs for Manufacturers of Metal Building Systems."
  - 2. Engineering Responsibility: Preparation of comprehensive engineering analysis and Shop Drawings by a professional engineer who is legally qualified to practice in jurisdiction where Project is located.
- B. Erector Qualifications: An experienced erector who specializes in erecting and installing work similar in material, design, and extent to that indicated for this Project and who is acceptable to manufacturer.
- C. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code Steel."
  - 2. AWS D1.3, "Structural Welding Code Sheet Steel."
- D. Land Surveyor Qualifications: A professional land surveyor who practices in jurisdiction where Project is located and who is experienced in providing surveying services of the kind indicated.

### 1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, sheets, panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

## 1.11 FIELD CONDITIONS

A. Weather Limitations: Proceed with panel installation only when weather conditions permit metal panels to be installed according to manufacturers' written instructions and warranty requirements.

### 1.12 WARRANTY

- A. Special Warranty on Metal Panel Finishes: Manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Hunter units when tested according to ASTM D2244.
    - b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  - 2. Finish Warranty Period: 20 years from date of Substantial Completion.
- B. Special Weathertightness Warranty for Standing-Seam Metal Roof Panels: Manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that leak or otherwise fail to remain weathertight within specified warranty period.
  - 1. Warranty Period: 20 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE AND DESIGN CRITERIA

- A. Delegated Design: Engage a qualified professional engineer to design metal building system.
- B. Structural Performance: Metal building systems shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to procedures in MBMA's "Metal Building Systems Manual."

- 1. Design Loads:
  - a. Dead Loads: Self weight of structure, roofing, and accessories, and 5 psf collateral.
  - b. Roof Live Load: 20 psf.
  - c. Wind Load: Per requirements indicated on S drawings.
- 2. Design Calculations:
  - a. Column base reactions shall be vertical and horizontal only. No bending moments shall be allowed at the base of the columns.
- Deflection and Drift Limits: Design metal building system assemblies to withstand serviceability design loads without exceeding deflections and drift limits recommended in AISC Steel Design Guide No. 3 "Serviceability Design Considerations for Steel Buildings."
- 4. Deflection and Drift Limits: No greater than the following:
  - a. Purlins and Rafters: Vertical deflection of 1/240 of the span.
  - b. Metal Roof Panels: Vertical deflection of 1/240 of the span.
  - c. Design secondary-framing system to accommodate deflection of primary framing and construction tolerances, and to maintain clearances at openings.
  - d. Lateral Drift: Maximum of 1/100 of the building height.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
  - 1. Temperature Change: 120 degrees F, ambient; 180 degrees F (100 degrees C), material surfaces.
- D. Structural Performance for Metal Roof Panels: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592:
  - 1. Wind Loads: As indicated on Drawings.
- E. Water Penetration for Metal Roof Panels: No water penetration when tested according to ASTM E1646 or ASTM E331 at the following test-pressure difference:
  - 1. Test-Pressure Difference: 2.86 lbf/sq. ft.
- F. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.
  - 1. Uplift Rating: UL 90.

## 2.2 MANUFACTURERS

A. Source Limitations: Obtain metal building system components, including primary and secondary framing and metal panel assemblies, from single source from single manufacturer.

### 2.3 SYSTEM DESCRIPTION

- A. Provide a complete, integrated set of mutually dependent components and assemblies that form a metal building system capable of withstanding structural and other loads, thermally induced movement, and exposure to weather without failure or infiltration of water into building interior.
- B. Primary-Frame Type:
  - 1. Rigid Clear Span: Solid-member, structural-framing system without interior columns.
- C. Secondary-Frame Type: Manufacturer's standard purlins and joists and exterior-framed (bypass) girts.
- D. Eave Height: Manufacturer's standard height, as indicated by nominal height on Drawings.
- E. Bay Spacing: As indicated on Drawings.
- F. Roof Slope: 1/4 inch per 12 inches.
- G. Roof System: Manufacturer's standard lap-seam, tapered-rib metal roof panels.

## 2.4 STRUCTURAL-STEEL FRAMING

- A. Structural Steel: Comply with AISC 360, "Specification for Structural Steel Buildings."
- B. Bolted Connections: Comply with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
- C. Cold-Formed Steel: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" for design requirements and allowable stresses.
- D. Primary Framing: Manufacturer's standard primary-framing system, designed to withstand required loads and specified requirements. Primary framing includes transverse and lean-to frames; rafters, rake, and canopy beams; sidewall, intermediate, end-wall, and corner columns; and wind bracing.
  - 1. General: Provide frames with attachment plates, bearing plates, and splice members. Factory drill for field-bolted assembly. Provide frame span and spacing indicated.
    - a. Slight variations in span and spacing may be acceptable if necessary to comply with manufacturer's standard, as approved by Engineer.
  - 2. Rigid Clear-Span Frames: I-shaped frame sections fabricated from shop-welded, built-up steel plates or structural-steel shapes. Interior columns are not permitted.
  - 3. Frame Configuration: One-directional, sloped.
  - 4. Exterior Column: Uniform depth.
  - 5. Rafter: Uniform depth.
- E. Secondary Framing: Manufacturer's standard secondary framing, including purlins, girts, eave struts, flange bracing, base members, gable angles, clips, headers, jambs, and other

miscellaneous structural members. Unless otherwise indicated, fabricate framing from either cold-formed, structural-steel sheet or roll-formed, metallic-coated steel sheet, prepainted with coil coating, to comply with the following:

- 1. Purlins: C- or Z-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes; minimum 2-1/2-inch- wide flanges.
  - a. Depth: As needed to comply with system performance requirements.
- 2. Eave Struts: Unequal-flange, C-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes; to provide adequate backup for metal panels.
- 3. Flange Bracing: Minimum 2-by-2-by-1/8-inch structural-steel angles or 1-inch- diameter, cold-formed structural tubing to stiffen primary-frame flanges.
- 4. Sag Bracing: Minimum 1-by-1-by-1/8-inch structural-steel angles.
- 5. Purlin Clips: Manufacturer's standard clips fabricated from steel sheet. Provide galvanized clips where clips are connected to galvanized framing members.
- 6. Miscellaneous Structural Members: Manufacturer's standard sections fabricated from cold-formed, structural-steel sheet; built-up steel plates; or zinc-coated (galvanized) steel sheet; designed to withstand required loads.
- F. Bracing: Provide adjustable wind bracing using any method as follows:
  - 1. Rods: ASTM A36/A36M; ASTM A572/A572M, Grade 50; or ASTM A529/A529M, Grade 50; minimum 1/2-inch- diameter steel; threaded full length or threaded a minimum of 6 inches at each end.
  - 2. Cable: ASTM A475, minimum 1/4-inch- diameter, extra-high-strength grade, Class B, zinc-coated, seven-strand steel; with threaded end anchors.
  - 3. Angles: Fabricated from structural-steel shapes to match primary framing, of size required to withstand design loads.
  - 4. Diaphragm Action of Metal Panels: Design metal building to resist wind forces through diaphragm action of metal panels.
- G. Anchor Rods: Headed anchor rods as indicated in Anchor Rod Plan for attachment of metal building to foundation.
- H. Materials:
  - 1. W-Shapes: ASTM A992/A992M; ASTM A572/A572M, Grade 50 or 55; or ASTM A529/A529M, Grade 50 or 55.
  - 2. Channels, Angles, M-Shapes, and S-Shapes: ASTM A36/A36M; ASTM A572/A572M, Grade 50 or 55; or ASTM A529/A529M, Grade 50 or 55.
  - 3. Plate and Bar: ASTM A36/A36M; ASTM A572/A572M, Grade 50 or 55; or ASTM A529/A529M, Grade 50 or 55.
  - 4. Steel Pipe: ASTM A53/A53M, Type E or S, Grade B.
  - 5. Cold-Formed Hollow Structural Sections: ASTM A500, Grade B or C, structural tubing.
  - Structural-Steel Sheet: Hot-rolled, ASTM A1011/A1011M, Structural Steel (SS), Grades 30 through 55, or High-Strength Low-Alloy Steel (HSLAS) or High-Strength Low-Alloy Steel with Improved Formability (HSLAS-F), Grades 45 through 70; or cold-rolled, ASTM A1008/A1008M, Structural Steel (SS), Grades 25 through 80, or HSLAS, Grades 45 through 70.

- 7. Metallic-Coated Steel Sheet: ASTM A653/A653M, SS, Grades 33 through 80, or HSLAS or HSLAS-F, Grades 50 through 80; with G60 coating designation; mill phosphatized.
- 8. Metallic-Coated Steel Sheet Prepainted with Coil Coating: Steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A755/A755M.
  - a. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653/A653M, SS, Grades 33 through 80, or HSLAS or HSLAS-F, Grades 50 through 80; with G90 coating designation.
  - b. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A792/A792M, SS, Grade 50 or 80; with Class AZ50 coating.
- 9. Non-High-Strength Bolts, Nuts, and Washers: ASTM A307, Grade A, carbon-steel, hexhead bolts; ASTM A563 carbon-steel hex nuts; and ASTM F844 plain (flat) steel washers.
  - a. Finish: Hot-dip zinc coating, ASTM F2329, Class C.
- 10. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M,Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.
  - a. Finish: Hot-dip zinc coating, ASTM F2329, Class C.
- 11. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A490, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.
- 12. Unheaded Anchor Rods: ASTM F1554, Grade 36.
  - a. Configuration: Straight.
  - b. Nuts: ASTM A563 heavy-hex carbon steel.
  - c. Plate Washers: ASTM A36/A36M carbon steel.
  - d. Washers: ASTM F436 hardened carbon steel.
  - e. Finish: Hot-dip zinc coating, ASTM F2329, Class C.
- 13. Headed Anchor Rods: ASTM F1554, Grade 36.
  - a. Configuration: Straight.
  - b. Nuts: ASTM A563 heavy-hex carbon steel.
  - c. Plate Washers: ASTM A36/A36M carbon steel.
  - d. Washers: ASTM F436 hardened carbon steel.
  - e. Finish: Hot-dip zinc coating, ASTM F2329, Class C.
- 14. Threaded Rods: ASTM A36/A36M.
  - a. Nuts: ASTM A563 heavy-hex carbon steel.
  - b. Washers: ASTM F436 hardened carbon steel.
  - c. Finish: Hot-dip zinc coating, ASTM F2329, Class C.

- I. Finish: Factory primed. Apply specified primer immediately after cleaning and pretreating.
  - 1. Clean and prepare in accordance with SSPC-SP2.
  - 2. Coat with manufacturer's standard primer. Apply primer to primary and secondary framing to a minimum dry film thickness of 1 mil.
    - a. Prime secondary framing formed from uncoated steel sheet to a minimum dry film thickness of 0.5 mil on each side.

# 2.5 METAL ROOF PANELS

- A. Exposed Fastener, Tapered-Rib, Metal Roof Panels: Formed with raised, trapezoidal major ribs and intermediate stiffening ribs symmetrically spaced between major ribs; designed to be installed by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps.
  - 1. Material: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.024-inch nominal uncoated steel thickness. Prepainted by the coil-coating process to comply with ASTM A755/A755M.
    - a. Exterior Finish: Two-coat fluoropolymer.
    - b. Color: As selected by Engineer from manufacturer's full range.
  - 2. Major-Rib Spacing: 12 inches o.c.
  - 3. Panel Coverage: 36 inches.
  - 4. Panel Height: 1.5 inches.
- B. Finishes:
  - 1. Exposed Coil-Coated Finish:
    - a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
  - 2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

## 2.6 ACCESSORIES

- A. General: Provide accessories as standard with metal building system manufacturer and as specified. Fabricate and finish accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes. Comply with indicated profiles and with dimensional and structural requirements.
  - 1. Form exposed sheet metal accessories that are without excessive oil-canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.

- B. Roof Panel Accessories: Provide components required for a complete metal roof panel assembly including copings, fasciae, corner units, ridge closures, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels unless otherwise indicated.
  - 1. Closures: Provide closures at eaves and ridges, fabricated of same material as metal roof panels.
  - 2. Clips: Manufacturer's standard, formed from steel sheet, designed to withstand negativeload requirements.
  - 3. Cleats: Manufacturer's standard, mechanically seamed cleats formed from steel sheet.
  - 4. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
  - 5. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- thick, flexible closure strips; cut or premolded to match metal roof panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
  - 6. Thermal Spacer Blocks: Where metal panels attach directly to purlins, provide thermal spacer blocks of thickness required to provide 1-inch standoff; fabricated from extruded polystyrene.
- C. Flashing and Trim: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.018inch nominal uncoated steel thickness, prepainted with coil coating; finished to match adjacent metal panels.
  - 1. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers.
  - 2. Opening Trim: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.030-inch nominal uncoated steel thickness, prepainted with coil coating. Trim head and jamb of door openings, and head, jamb, and sill of other openings.
- D. Gutters: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.018-inch nominal uncoated steel thickness, prepainted with coil coating; finished to match roof fascia and rake trim. Match profile of gable trim, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch- long sections, sized according to SMACNA's "Architectural Sheet Metal Manual."
  - 1. Gutter Supports: Fabricated from same material and finish as gutters.
  - 2. Strainers: Bronze, copper, or aluminum wire ball type at outlets.
- E. Downspouts: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.018-inch nominal uncoated steel thickness, prepainted with coil coating; finished to match metal wall panels. Fabricate in minimum 10-foot- long sections, complete with formed elbows and offsets.
  - 1. Mounting Straps: Fabricated from same material and finish as gutters.
- F. Materials:
  - 1. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide fasteners

with heads matching color of materials being fastened by means of plastic caps or factory-applied coating.

- a. Fasteners for Metal Roof Panels: Self-drilling or self-tapping, zinc-plated, hexhead carbon-steel screws, with a stainless steel cap or zinc-aluminum-alloy head and EPDM sealing washer.
- b. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws with hex washer head.
- c. Blind Fasteners: High-strength aluminum or stainless steel rivets.
- 2. Corrosion-Resistant Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
- 3. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.
- 4. Metal Panel Sealants:
  - a. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylenecompound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape of manufacturer's standard size.
  - b. Joint Sealant: ASTM C920; one-part elastomeric polyurethane or polysulfide; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended by metal building system manufacturer.

# 2.7 FABRICATION

- A. General: Design components and field connections required for erection to permit easy assembly.
  - 1. Mark each piece and part of the assembly to correspond with previously prepared erection drawings, diagrams, and instruction manuals.
  - 2. Fabricate structural framing to produce clean, smooth cuts and bends. Punch holes of proper size, shape, and location. Members shall be free of cracks, tears, and ruptures.
- B. Tolerances: Comply with MBMA's "Metal Building Systems Manual" for fabrication and erection tolerances.
- C. Primary Framing: Shop fabricate framing components to indicated size and section, with baseplates, bearing plates, stiffeners, and other items required for erection welded into place. Cut, form, punch, drill, and weld framing for bolted field assembly.
  - 1. Make shop connections by welding or by using high-strength bolts.
  - 2. Join flanges to webs of built-up members by a continuous, submerged arc-welding process.
  - 3. Brace compression flange of primary framing with steel angles or cold-formed structural tubing between frame web and purlin web or girt web, so flange compressive strength is within allowable limits for any combination of loadings.
  - 4. Weld clips to frames for attaching secondary framing if applicable, or punch for bolts.

- 5. Shop Priming: Prepare surfaces for shop priming according to SSPC-SP 2. Shop prime primary framing with specified primer after fabrication.
- D. Secondary Framing: Shop fabricate framing components to indicated size and section by roll forming or break forming, with baseplates, bearing plates, stiffeners, and other plates required for erection welded into place. Cut, form, punch, drill, and weld secondary framing for bolted field connections to primary framing.
  - 1. Make shop connections by welding or by using non-high-strength bolts.
  - 2. Shop Priming: Prepare uncoated surfaces for shop priming according to SSPC-SP 2. Shop prime uncoated secondary framing with specified primer after fabrication.
- E. Metal Panels: Fabricate and finish metal panels at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements. Comply with indicated profiles and with dimensional and structural requirements.
  - 1. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of metal panel.

# 2.8 SOURCE QUALITY CONTROL

- A. Special Inspection: Owner will engage a qualified special inspector to perform source quality control inspections and to submit reports.
  - 1. Accredited Manufacturers: Special inspections will not be required if fabrication is performed by an IAS AC472-accredited manufacturer approved by authorities having jurisdiction to perform such Work without special inspection.
    - a. After fabrication, submit copy of certificate of compliance to authorities having jurisdiction, certifying that Work was performed according to Contract requirements.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with erector present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Before erection proceeds, survey elevations and locations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments to receive structural framing, with erector present, for compliance with requirements and metal building system manufacturer's tolerances.
  - 1. Engage land surveyor to perform surveying.
- C. Proceed with erection only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition.
- B. Provide temporary shores, guys, braces, and other supports during erection to keep structural framing secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural framing, connections, and bracing are in place unless otherwise indicated.

## 3.3 ERECTION OF STRUCTURAL FRAMING

- A. Erect metal building system according to manufacturer's written instructions and drawings.
- B. Do not field cut, drill, or alter structural members without written approval from metal building system manufacturer's professional engineer.
- C. Set structural framing accurately in locations and to elevations indicated, according to AISC specifications referenced in this Section. Maintain structural stability of frame during erection.
- D. Base and Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
  - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
  - 2. Tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
  - 3. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- E. Align and adjust structural framing before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with framing. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
  - 1. Level and plumb individual members of structure.
  - 2. Make allowances for difference between temperature at time of erection and mean temperature when structure will be completed and in service.
- F. Primary Framing: Erect framing level, plumb, rigid, secure, and true to line. Level baseplates to a true even plane with full bearing to supporting structures, set with double-nutted anchor bolts. Use grout to obtain uniform bearing and to maintain a level base-line elevation. Moist-cure grout for not less than seven days after placement.
  - 1. Make field connections using high-strength bolts installed according to RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt type and joint type specified.
    - a. Joint Type: Snug tightened or pretensioned as required by manufacturer.

- G. Secondary Framing: Erect framing level, plumb, rigid, secure, and true to line. Field bolt secondary framing to clips attached to primary framing.
  - 1. Provide rake or gable purlins with tight-fitting closure channels and fasciae.
  - 2. Locate and space wall girts to suit openings such as doors and windows.
  - 3. Provide supplemental framing at entire perimeter of openings, including doors, windows, louvers, ventilators, and other penetrations of roof and walls.
- H. Bracing: Install bracing in roof and sidewalls where indicated on erection drawings.
  - 1. Tighten rod and cable bracing to avoid sag.
  - 2. Locate interior end-bay bracing only where indicated.
- I. Erection Tolerances: Maintain erection tolerances of structural framing within AISC 303.

# 3.4 METAL PANEL INSTALLATION, GENERAL

- A. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. Examination: Examine primary and secondary framing to verify that structural-panel support members and anchorages have been installed within alignment tolerances required by manufacturer.
  - 1. Examine roughing-in for components and systems penetrating metal panels, to verify actual locations of penetrations relative to seams before metal panel installation.
- C. General: Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
  - 1. Field cut metal panels as required for doors, windows, and other openings. Cut openings as small as possible, neatly to size required, and without damage to adjacent metal panel finishes.
    - a. Field cutting of metal panels by torch is not permitted unless approved in writing by manufacturer.
  - 2. Install metal panels perpendicular to structural supports unless otherwise indicated.
  - 3. Flash and seal metal panels with weather closures at perimeter of openings and similar elements. Fasten with self-tapping screws.
  - 4. Locate and space fastenings in uniform vertical and horizontal alignment.
  - 5. Locate metal panel splices over structural supports with end laps in alignment.
  - 6. Lap metal flashing over metal panels to allow moisture to run over and off the material.
- D. Lap-Seam Metal Panels: Install screw fasteners using power tools with controlled torque adjusted to compress EPDM washers tightly without damage to washers, screw threads, or metal panels. Install screws in predrilled holes.

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- 1. Arrange and nest side-lap joints so prevailing winds blow over, not into, lapped joints. Lap ribbed or fluted sheets one full rib corrugation. Apply metal panels and associated items for neat and weathertight enclosure. Avoid "panel creep" or application not true to line.
- E. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.
- F. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal panel assemblies. Provide types of gaskets, fillers, and sealants indicated; or, if not indicated, provide types recommended by metal panel manufacturer.
  - 1. Seal metal panel end laps with double beads of tape or sealant the full width of panel. Seal side joints where recommended by metal panel manufacturer.
  - 2. Prepare joints and apply sealants to comply with requirements.

# 3.5 METAL ROOF PANEL INSTALLATION

- A. General: Provide metal roof panels of full length from eave to ridge unless otherwise indicated or restricted by shipping limitations.
  - 1. Install ridge and hip caps as metal roof panel work proceeds.
  - 2. Flash and seal metal roof panels with weather closures at eaves and rakes. Fasten with self-tapping screws.
- B. Lap-Seam Metal Roof Panels: Fasten metal roof panels to supports with exposed fasteners at each lapped joint, at location and spacing recommended by manufacturer.
  - 1. Provide metal-backed sealing washers under heads of exposed fasteners bearing on weather side of metal roof panels.
  - 2. Provide sealant tape at lapped joints of metal roof panels and between panels and protruding equipment, vents, and accessories.
  - 3. Apply a continuous ribbon of sealant tape to weather-side surface of fastenings on end laps and on side laps of nesting-type metal panels, on side laps of ribbed or fluted metal panels, and elsewhere as needed to make metal panels weatherproof to driving rains.
  - 4. At metal panel splices, nest panels with minimum 6-inch end lap, sealed with butylrubber sealant and fastened together by interlocking clamping plates.
- C. Metal Fascia Panels: Align bottom of metal panels and fasten with blind rivets, bolts, or selfdrilling or self-tapping screws. Flash and seal metal panels with weather closures where fasciae meet soffits, along lower panel edges, and at perimeter of all openings.
- D. Metal Roof Panel Installation Tolerances: Shim and align metal roof panels within installed tolerance of 1/4 inch in 20 feet on slope and location lines and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

### 3.6 ACCESSORY INSTALLATION

- A. General: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
  - 1. Install components required for a complete metal roof panel assembly, including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
  - 2. Install components for a complete metal wall panel assembly, including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
  - 3. Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by manufacturer.
- B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible and set units true to line and level. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
  - 1. Install exposed flashing and trim that is without excessive oil-canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
  - 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).
- C. Gutters: Join sections with riveted-and-soldered or lapped-and-sealed joints. Attach gutters to eave with gutter hangers spaced as required for gutter size, but not more than 36 inches o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.
- D. Downspouts: Join sections with 1-1/2-inch telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c. in between.
  - 1. Provide elbows at base of downspouts to direct water away from building.
  - 2. Tie downspouts to underground drainage system indicated.

# 3.7 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform field quality control special inspections and to submit reports.
- B. Product will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

# 3.8 CLEANING AND PROTECTION

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.
- B. Touchup Painting: After erection, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted structural framing, bearing plates, and accessories.
  - 1. Clean and prepare surfaces by SSPC-SP 2, "Hand Tool Cleaning," or by SSPC-SP 3, "Power Tool Cleaning."
  - 2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.
- C. Metal Panels: Remove temporary protective coverings and strippable films, if any, as metal panels are installed. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
  - 1. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

# END OF SECTION 133419

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# SECTION 260510 – LIMITED ELECTRICAL FOR SMALL PROJECTS

# PART 1 - GENERAL

# 1.1 RELATED DOCUMENTS

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

# 1.2 SUMMARY

- A. Section Includes:
  - 1. Copper power and control wire rated 600V or less.
  - 2. Low-voltage instrumentation cable.
  - 3. Industrial Ethernet cable.
  - 4. Connectors, splices, and terminations.
  - 5. Grounding and bonding components.
  - 6. Support systems for raceways, boxes, and electrical equipment.
  - 7. Metal conduits and fittings.
  - 8. Nonmetallic conduit and fittings.
  - 9. Boxes, enclosures, and cabinets.
  - 10. Handholes and boxes for exterior underground cabling.
  - 11. Switches.
  - 12. Wiring Devices.
  - 13. Identification requirements.

#### 1.3 DEFINITIONS

- A. ARC: Aluminum rigid conduit. See also RAC.
- B. Direct Buried: Duct or a duct bank that is buried in the ground, without any additional casing materials such as concrete.
- C. Duct: A single duct or multiple ducts. Duct may be installed singly or as a component of a duct bank.
- D. Duct Bank:
  - 1. Two or more ducts installed in parallel, with or without additional casing materials.
  - 2. Multiple duct banks.
- E. EMI: Electromagnetic interference.
- F. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50V or for remote-control and signaling power-limited circuits.

- G. RAC: Rigid aluminum conduit. See also ARC.
- H. RoHS: Restriction of Hazardous Substances.
- I. Trafficways: Locations where vehicular or pedestrian traffic is a normal course of events.
- J. National Electrical Code (NEC) / NFPA conduit types:
  - 1. RMC rigid metal conduit.
  - 2. FMC flexible metal conduit.
  - 3. LFMC liquidtight flexible metal conduit.
  - 4. PVC rigid polyvinyl chloride conduit.
  - 5. LFNC liquidtight flexible nonmetallic conduit.
  - 6. RNC rigid nonmetallic conduit.
  - 7. EMT Electrical metallic tubing.

# 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product used on this project. Note that not all products listed are used on this project.
- B. Shop Drawings:
  - 1. Precast Handholes: Include plans, elevations, sections, and details.
- C. Installation Working Drawings: For underground conduit routing.

## 1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

## PART 2 - PRODUCTS

# 2.1 ELECTRICAL MATERIALS

- A. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with associated UL Standards as applicable and listed in this specification.

# 2.2 WIRE

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. Alpha Wire Company.
  - 2. Encore Wire Corporations.

- 3. General Cable Technologies Corporation.
- 4. Okonite Company (The).
- 5. Service Wire Co.
- 6. Southwire Company.
- B. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V.
- C. Standards:
  - 1. RoHS compliant.
  - 2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- D. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.
- E. Size: Minimum No. 12 AWG for power circuits, minimum No. 14 AWG for control circuits.
- F. Stranding: Refer to Part 3 "Conductor Applications" Article.
- G. Conductor Insulation: Refer to Part 3 "Conductor Applications" Article.
  - 1. Type RHW-2: Comply with UL 44.
  - 2. Type TC-ER: Comply with NEMA WC 70/ICEA S-95-658 and UL 1277.
  - 3. Type THHN and Type THWN-2: Comply with UL 83.
  - 4. Type XHHW-2: Comply with UL 44.

## 2.3 INSTRUMENTATION CABLE

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. Belden.
  - 2. Rockbestos.
- B. Single of Multiple Paired Cable: NEC type ITC (Instrumentation Tray Cable), UL Type TC for 4-20mA process instrumentation signals and use under NEC Article 72.
  - 1. One or Multi-pair, twisted, shielded, No. 16 AWG, stranded (19x29) tinned-copper conductors.
  - 2. XLPE insulation, 600V.
  - 3. Shield: 100 percent aluminum/polyester foil with drain wire. Pairs individually shielded.
  - 4. PVC jacket with manufacturer's identification.
  - 5. Standards: UL 1277 Type TC, UL 1581.

### 2.4 INDUSTRIAL ETHERNET CABLE

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. Rockwell Automation 1585-C8HB-S.
- B. Description: Four-pair, balanced-twisted pair cable, certified to meet transmission characteristics of Category 5e cable at frequencies up to 100 MHz *Ethernet/IP* compliant.
- C. Standard: UL, UL PLTC, UL AWM 2570 80C 600V, TIA 568B.
- D. Conductors: 100-ohm, No. 22 AWG solid copper.
- E. Shielding/Screening: Overall foil shield.
- F. Cable Rating: 600V.
- G. Jacket: PVC.

# 2.5 CONNECTORS, SPLICES, AND TERMINATIONS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. 3M Electrical Products.
  - 2. Ideal Industries, Inc.
  - 3. TE Connectivity Ltd.
  - 4. Thomas & Betts Corporation; A Member of the ABB Group.
- B. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- C. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.
  - 1. Material: Tin-plated copper.
  - 2. Type:
    - a. Locking spade with insulated sleeve for No. 10 AWG and smaller.
    - b. One hole with long barrels for No. 8 AWG to No. 4/0 AWG.
    - c. Two holes with long barrels for 250 kcmil and larger.
  - 3. Termination: Compression for No. 8 AWG and larger.
- D. Connectors:
  - 1. Solderless pressure type (wirenuts) for No. 10 AWG and smaller.
  - 2. Pre-filled with silicone-based sealant for exterior, wet, or corrosive locations.
  - 3. Split bolt type for No. 8 AWG and larger splices.

- E. Motor Terminations: Mechanical compression ring type, secured with bolt, nut, and spring washer. Insulated with Raychem type RVC, roll-on stub insulator or equal.
- F. Industrial Ethernet Cable Terminations: Match conductor count, RJ45 type, intended for shielded cable. Rockwell Automation Bulletin 1585J or equal.

# 2.6 GROUNDING AND BONDING MATERIALS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. ERICO; a brand of nVent.
  - 2. Hubbell Incorporated (Construction and Energy Group).
  - 3. O-Z/Gedney; a brand of Emerson Industrial Automation.
  - 4. Thomas & Betts Corporation; A Member of the ABB Group.
- B. Standard: Comply with UL 467 for grounding and bonding materials and equipment.
- C. Grounding Conductors:
  - 1. Insulated conductors to match corresponding 600V phase conductor insulation requirements.
  - 2. Bare copper conductors: tin-plated.
- D. Ground rods: Copper-clad steel, sectional type; 3/4-inch diameter by 10-foot; minimum copper thickness 0.25 mm (10 mil).
- E. Grounding conduit hubs: Malleable iron type, mechanical type, terminal with threaded hub, sized for the associated conduit.
- F. Waterpipe ground clamps: cast bronze saddle type, sized for the associated water pipe.
- G. Exothermic weld: CADWELD process, or equal. Molds and powder furnished by same manufacturer and selected for specific combination of conductors and connected items. Use low emission type, CADWELD EXOLON or equal for welds used indoors in occupied buildings or confined spaces.

## 2.7 SUPPORT SYSTEMS

- A. Aluminum Channel:
  - 1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
  - 2. Channel Material: 6063-T5 aluminum alloy.
  - 3. Fittings and Accessories Material: 5052-H32 aluminum alloy.
- B. Stainless Steel Channel:
  - 1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
  - 2. Material for Channel, Fittings, and Accessories: Stainless steel, Type 316.

- C. Hot-dipped Galvanized Steel Channel:
  - 1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
  - 2. Material for Channel, Fittings, and Accessories: Hot-dipped galvanized steel.
- D. Nonmetallic Channel:
  - 1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
  - 2. Channel Material: Ultraviolet resistant FRP.
  - 3. Fittings and Accessories Material: Stainless steel, Type 316 or compatible non-metallic.
- E. Accessories: conduit clamps, straps, hangers, rods, backplates, anchors, nuts, washers, etc. shall match channel material as listed in the SUPPORT MATERIALS APPLICATION Article. Use of galvanized steel components is only allow with galvanized steel channel.
- F. Threaded rod: 3/8-inch minimum diameter.
- G. Expansion anchors: 3/8-inch minimum diameter.

# 2.8 METAL CONDUITS AND FITTINGS

- A. Rigid Aluminum Conduit: Comply with ANSI C80.5 and UL 6A.
- B. EMT: Comply with ANSI C80.3 and UL 797.
- C. LFMC: Sealtite<sup>®</sup>, Type UA, continuously interlocked flexible steel conduit with sunlight and chemical resistant PVC jacket and complying with UL 360.
- D. FMC: Comply with UL 1; zinc-coated steel.
- E. Metallic Fittings: Comply with NEMA FB 1 and UL 514B.
  - 1. Use cast aluminum fittings with RAC.
  - 2. Use malleable iron, three-piece screw in type with LMFC.
  - 3. Use Myers Electric Products, Inc. or equal, grounding type for conduit hubs.
  - 4. Use die cast compression type fittings with EMT, no set-screw type.

# 2.9 NONMETALLIC CONDUIT AND FITTINGS

- A. RNC: Schedule 40 or Schedule 80 PVC based on application; comply with NEMA TC 2 and UL 651.
- B. LFNC-B: Comply with UL 1660, Type B.
- C. Nonmetallic Fittings:
  - 1. RNC: Comply with NEMA TC 3; match conduit type and material.
  - 2. LFNC: Comply with UL 514B; dust-tight, liquid-tight, chemical resistant thermoplastic/nylon construction with tapered thread hub and neoprene O-ring gasket. Push-on fittings are prohibited.

D. Solvents and Adhesives: As recommended by conduit manufacturer.

# 2.10 BOXES, ENCLOSURES, AND CABINETS

- A. Sheet Metal Outlet and Device Boxes: Pressed steel. Comply with NEMA OS 1 and UL 514A.
- B. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, aluminum, Type FD, with gasketed cover.
- C. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- D. NEMA 1 and NEMA 12 Pull and Junction Boxes:
  - 1. Material: Sheet steel, minimum 14 gauge, without knockouts.
  - 2. Construction: flanged box, galvanized with continuous weld seams that are ground smooth.
  - 3. Cover: Gasketed, hanged, fastened with quick connect door clamp.
- E. NEMA 4X Pull and Junction Boxes:
  - 1. Material: Type 316 stainless steel, minimum 14 gauge, without knockouts.
  - 2. Construction: flanged box, continuous weld seams that are ground smooth.
  - 3. Cover: Gasketed, hanged, fastened with quick connect door clamp.
- F. NEMA 4X Chemical Area Pull and Junction Boxes: When Drawings classify the area as CORROSIVE, ultraviolet resistant fiberglass reinforced plastic (FRP) with Type 316 stainless steel hardware and gasketed covers.
- G. NEMA 7/4 Pull and Junction Boxes: When Drawings classify the area for Class 1, Division 1, Group D hazardous area, cast aluminum with stainless steel bolts; Type EJB-N4 as manufactured by Crouse Hinds or equal.
- H. Handholes and Boxes for Exterior Underground Cabling: Comply with details as indicated on the Drawings.

## 2.11 SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Eaton.
  - 2. Square D; Schneider Electric USA.
- B. Non-Fusible Disconnect Switch: Type HD, Heavy Duty, Three Pole, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position. NEMA 4X stainless steel enclosure for outdoor locations.
- C. Manual Motor Starter Switch: Quick-make, quick break toggle action switch; marked to show whether unit is off, on or tripped, intended for use with fractional horsepower motors, melting

alloy type overloads, and hasp for lockout/tagout padlock. Square D Type F, 16A, single or double pole as indicated on Drawing, or equal by Eaton.

## 2.12 WIRING DEVICES

- A. General Wiring Device Requirements:
  - 1. Comply with NEMA WD 1.
  - 2. Device Color: Gray.
- B. Tamper- and Weather-Resistant, GFCI Duplex Receptacles, 125 V, 20 A:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Eaton (Arrow Hart).
    - b. Leviton Manufacturing Co., Inc.
    - c. Pass & Seymour/Legrand (Pass & Seymour).
    - d. Hubbell (Kellems).
  - 2. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two-pole, three-wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
  - 3. Configuration: NEMA WD 1, Configuration 5-20R.
  - 4. Type: Non-feed through.
  - 5. Standards: Comply with UL 498 and UL 943 Class A.
  - 6. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" and "Receptacles in Damp or Wet Locations" articles.
- C. Wall Plates:
  - 1. Single Source: Obtain wall plates from same manufacturer of wiring devices.
  - 2. Single and combination types shall match corresponding wiring devices.
    - a. Plate-Securing Screws: Metal with head color to match plate finish.
    - b. Material for Finished Spaces: Steel with white baked enamel, suitable for field painting.
    - c. Material for Unfinished Spaces: Cast aluminum.
    - d. Material for Indoor Damp Locations: Cast aluminum with spring-loaded lift cover and listed and labeled for use in wet and damp locations.
  - 3. Wet-Location, Weatherproof receptacle While-In-Use Cover Plates: heavy duty die-cast aluminum back and cover, deep cover, gasketed, single or double gang as required, lockable hasp, as manufactured by Thomas & Betts (Red Dot); Eaton (Arrow Hart); Carlon; or equal.

### 2.13 IDENTIFICATION

- A. Factory applied insulation color for No. 8 AWG conductors and smaller. Factory applied insulation color or field applied colored electrical tape for No. 6 AWG conductors and larger:
  - 1. Color for 208/120V Circuits:
    - a. Phase A: Black.
    - b. Phase B: Red.
    - c. Phase C: Blue.
    - d. Neutral: White.
  - 2. Color for 240/120V Circuits (Single Phase):
    - a. Phase A: Black.
    - b. Phase B: Red.
    - c. Neutral: White.
  - 3. Color for  $240\Delta/120V$  Circuits (Three Phase, Four Wire, high leg, center tap):
    - a. Phase A: Black.
    - b. Phase B: Orange (high leg).
    - c. Phase C: Blue. Neutral: White.
  - 4. Color for 480/277V Circuits:
    - a. Phase A: Brown.
    - b. Phase B: Orange.
    - c. Phase C: Yellow.
    - d. Neutral: Gray.
  - 5. Color for Equipment Grounds: Green.
  - 6. Color of Individual Control Conductors:
    - a. AC: Red.
    - b. DC: Blue.
- B. Nameplates and Labels:
  - 1. Equipment Identification and Source Nameplates:
    - a. Black letters on a white field.
    - b. Engraved, laminated plastic, 3/16-inch-high lettering.
    - c. Provide for all electrical equipment. Match Drawing designation.
    - d. Include power source information, i.e., "FED FROM MCC-2" or provide separate nameplate.
  - 2. Device Identification Labels:
    - a. Black letters on a white field.
    - b. Machine generated, self-adhesive, 1/4-inch-high lettering.

- c. Provide for all receptacles, wall switching, lighting fixtures, photocells, exit lights, instruments, etc.
- d. Include power source and branch circuit information, i.e., "LP-2/15" indicates panelboard LP-2, branch circuit 15.
- 3. Wire and Cable Labels:
  - a. Black letters on a white field.
  - b. Wraparound or sleeve type.
- C. Detectable Underground-Line Warning Tape:
  - 1. Foil-backed, detectable buried utility tape with black lettering on a bright background.
  - 2. Width: 6 inches.
  - 3. Overall Thickness: 5 mils.
  - 4. Background Color / Description:
    - a. Red / Electric: electrical power, control, or instrumentation.
    - b. Orange / Fiber: fiber optic cables.

# PART 3 - EXECUTION

- 3.1 GENERAL
  - A. Comply with the applicable National Electrical Contractors Association (NECA) documents for installation requirements except where requirement on Drawings or in this specification are stricter.
    - 1. NECA 1: Standard for Good Workmanship in Electrical Construction.
    - 2. NECA 101: Standard for Installing Steel Conduits.
    - 3. NECA 102: Standard for Installing Aluminum Rigid Metal Conduit.
    - 4. NECA 111: Standard for Installing Nonmetallic Raceways.
    - 5. NECA 331: Standard for Installing Building and Service Entrance Grounding and Bonding.
    - 6. NECA / NEMA 605: Recommended Practice for Installing Underground Nonmetallic Utility Duct.

## 3.2 CONDUCTOR APPLICATIONS

- A. Wires and Cables: Copper, stranded, except for lighting and receptacle wiring which may be solid.
- B. Wire for lighting, receptacles, and other circuits not exceeding 150 volts to ground shall be NEC type THWN-2/THHN. Below grade and underground the wire shall be typeTHWN-2/THHN.
- C. Wire for power circuits over 150 volts to ground shall be NEC type XHHW-2 for sizes No. 4/0 AWG and smaller, and shall be NEC type RHW-2 for sizes 250 kcmil and larger.

- D. Equipment grounding conductors shall be the same NEC type as the phase conductors described previously, green and sized per NEC Table 250.122.
- E. Bare copper ground wire shall be stranded, tinned soft drawn annealed copper wire.
- F. Ground grid conductors shall be uninsulated unless shown otherwise on the Drawings.
- G. Wire for control, status, and alarm shall be NEC type THWN-2/THHN.
- H. Multi-conductor power cable shall be stranded, 600V, cross-linked polyethylene insulated with PVC jacket, Type TC (XLP) with ground.
- I. Multi-conductor control cable shall be NEC type TC (tray cable), stranded, No. 14 AWG, THHN/THWN-2 600V insulated color coded conductors, bare stranded ground wire, with overall PVC cable jacket.

# 3.3 CONDUCTOR INSTALLATION

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway. Use of steel fish tapes and/or steel pulling cables in PVC conduit or raceways that terminate into energized enclosures is prohibited.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.
- F. Adequately support cables.
- G. Tighten electrical connectors and terminals according to manufacturer's published torquetightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- H. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors. Do not splice service or feeder cables without prior written approval of Engineer. Instrumentation and Ethernet cables may not be spliced and shall be continuous from terminal to terminal.
- I. Wiring at Outlets:
  - 1. Install conductor at each outlet, with at least 6 inches of slack.
  - 2. Form solid wire into loop to fit around device terminal screw. Do not overlap wire.

- J. Identify and color-code conductors and cables.
- K. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.
- L. Identify circuit number associated with lights, receptacles, and other miscellaneous loads to panelboards. Identify phase and neutral conductors with circuit number.
- M. Install instrumentation and Ethernet cabling in separate raceway from control or power wiring.
- N. Separation from EMI Sources:
  - 1. Separation between open instrumentation cables or cables in non-metallic or non-ferrous raceways and unshielded power conductors and electrical equipment shall be as follows:
    - a. Equipment or circuits rated less than 2 kVA: Minimum 5 inches.
    - b. Equipment or circuits rated between 2 and 5 kVA: Minimum 12 inches.
    - c. Equipment or circuits rated more than 5 kVA: Minimum 24 inches.

## 3.4 GROUNDING

- A. Comply with NEC Article 250.
- B. Install insulated green equipment grounding conductor in all power and control raceways.
- C. For instrumentation wiring, ground shield at one end only as recommended by instrument manufacturer and in accordance with Owner's standard.
- D. Install grounding conductors in conduit or sleeves when passing through floor slabs.
- E. Use exothermic welding process for all underground connections, connections to structural steel, connections to ground rods, or other connections which will become inaccessible at project completion.

## 3.5 SUPPORT MATERIALS APPLICATON

- A. Dry, indoor, conditioned, non-process space: Hot-dipped galvanized steel.
- B. Outdoor, process areas, or areas shown on the drawings as "DUST", "DAMP", or "WET": Aluminum and/or stainless-steel channel, depending upon load requirements.
- C. Areas shown on the drawings as "CORROSIVE": Nonmetallic.

## 3.6 RACEWAY APPLICATIONS

- A. Refer to Appendix Table 260510-1 for specific raceway application requirements.
- B. Minimum Raceway Size: 3/4-inch trade size.

### 3.7 BOX APPLICATIONS

- A. All boxes shall be metallic unless specified herein or indicated on the Drawings.
- B. Use cast malleable iron for boxes and condulet fittings for exposed switch, receptacle, and lighting outlets.
- C. Use pressed steel boxes for concealed switch, receptacles, and lighting outlets.
- D. Pull boxes, junction boxes, cabinets, etc. shall be suitable for the location and conform to the NEMA enclosure rating and material descriptions as indicated on the Drawings.
- E. Where no size is indicated for junction boxes, pull boxes, or terminal cabinets, size in accordance with NEC Article 314.

## 3.8 RACEWAY INSTALLATIONS

- A. Complete raceway installation before starting conductor installation.
- B. Tightly plug ends of conduits during construction to exclude dust and moisture.
- C. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- D. Arrange conduit system to allow liquids such as water, condensation, etc. will drain away from equipment served. If conduit drainage is not possible, plug conduits using conduit seals.
- E. Install no more than the equivalent of three 90-degree bends in any conduit run. Support within 12 inches of changes in direction.
- F. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.
- G. Support conduit within 12 inches of enclosures to which attached.
- H. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- I. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- J. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits. Install Meyers grounding type hubs when conduits terminate at gasketed enclosures.
- K. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

- L. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- M. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- N. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- O. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.
- P. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways using "Duxseal" or seal fitting at the following points:
  - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  - 2. Where an underground service raceway enters a building or structure.
  - 3. Conduit extending from interior to exterior of building.
  - 4. Conduit extending into pressurized duct and equipment.
  - 5. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
  - 6. Where otherwise required by NFPA 70.
- Q. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- R. Install expansion joint fittings where necessary to compensate for thermal expansion and contraction.
- S. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for equipment subject to vibration, noise transmission or movement; and for transformers and motors.
- T. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- U. A maximum continuous run of conduit shall not exceed 300 feet and shall be reduced by 75 feet for each 90-degree elbow.
- V. Provide a 4-inch concrete housekeeping pad at all slab and grade penetrations. Provide a 45 degree, 3/4-inch chamfer at all exposed edges.
- W. Protect metallic finish conduit installed in contact with concrete or below grade with two coats of bitumastic paint, heat shrink tubing, or approved equivalent. Extend protection on riser conduits from 12 inches below slab to 6 inches above slab.

- X. In hazardous locations, seal conduits terminating at boxes enclosing circuit opening equipment at the entrance to the enclosure with approved compound filled sealing fittings to prevent passage of explosive or combustible gases through the conduits. Similarly seal all conduits leading from or entering hazardous locations at points of exit or entrance. Seal exposed conduits passing through hazardous locations at both the entrance to and the exit from the hazardous locations.
- Y. Install conduit sealing and drain fittings in all hazardous (classified) areas designated Class 1, Division 1, and Class 1, Division 2.

# 3.9 UNDERGROUND SYSTEM INSTALLATION

- A. Coordinate final arrangement with other underground utilities, site grading, and surface features.
- B. Comply with Division 31 specifications for earthwork, excavation, trenching, backfill, and compaction.
- C. Raceway Drainage:
  - 1. Drain away from buildings.
  - 2. Drain towards manholes or handholes.
  - 3. Slope raceway not less than 3-inches per 100-feet.
- D. Restoration: Restore surface features and re-establish grade, paving, and vegetation to original unless otherwise indicated.
- E. Separate underground copper signal conduits (instrumentation and telecommunication) from power conduits by a minimum of 12 inches unless noted otherwise. Keep crossing of these conduits to a minimum; cross at 90-degree angles.
- F. Transition to Metal Conduit:
  - 1. Use fittings manufactured for RNC to metal conduit transition.
  - 2. Make transition from underground duct to metal conduit at least 10 feet outside the building wall, without reducing duct line slope away from building and without forming a trap in the line.
- G. Minimum Cover and Additional Detail: As indicated per details on Drawings.
- H. Where Drawings call for concrete encased duct bank, color concrete red.

#### 3.10 ELECTRICAL PENETRATIONS

- A. Provide and place all sleeves for conduits penetrating floors, walls, partitions, etc.
- B. Locate all slots and concealed conduits and stub-ups for electrical work and place and form as required before concrete is poured.
- C. Make weathertight and restore finishes on exterior penetrations.

- D. Use conduit wall seals where underground conduits penetrate walls or at other locations indicated on the Drawings.
- E. Seal openings where conduits pass through walls or floors to prevent passage of flame and smoke. Maintain fire rating of walls.
- F. Patch and paint interior wall penetrations to match original.

## 3.11 SWITCH INSTALLATION

- A. Coordinate layout and installation of switches with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Mount disconnect switches on Type 316 stainless steel or aluminum channel or as shown on the Drawings.
- C. Install equipment and device identification.

# 3.12 WIRING DEVICE INSTALLATION

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated in the drawing.
- B. Device Mounting Heights (as measured to the center of the device box): As noted on the drawings.
- C. Coordination with Other Trades:
  - 1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes, and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
  - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
  - 3. Install wiring devices after all wall preparation, including painting, is complete.
- D. Conductors:
  - 1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
  - 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
  - 3. The length of free conductors at outlets for devices shall comply with NFPA 70, Article 300, without pigtails.
  - 4. Existing Conductors:
    - a. Cut back and pigtail or replace all damaged conductors.
    - b. Straighten conductors that remain and remove corrosion and foreign matter.
    - c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.
#### E. Device Installation:

- 1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
- 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
- 3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
- 4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
- 5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw. Do not overlap conductors.
- 6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
- 7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
- 8. Tighten unused terminal screws on the device.
- 9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.
- F. Receptacle Orientation:
  - 1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.
- G. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
- H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multi-gang wall plates.
- I. Identify each receptacle with panelboard identification and circuit number.
- J. Confirm correct wiring using a digital wiring analyzer.

## 3.13 IDENTIFICATION INSTALLATION

- A. Self-Adhesive Identification Products: Before applying identification product, prepare and clean attachment surface with manufacturer recommended product to allow for effective bond.
- B. Verify and coordinate identification names and other features.
- C. Nameplate Attachment:
  - 1. Screw mounted for NEMA 1 enclosures.
  - 2. Epoxy or similar waterproof adhesive for all other enclosure types.
- D. Install identification and power source nameplates for electrical equipment. Refer to Part 2 "Identification" Article for requirements.

- E. Install circuit identification labels for cables and conductors at each termination location and within pull boxes and handholes. Refer to PART 2 "Identification" Article for color code and additional requirements.
- F. Install device identification labels for receptacles, light switches, etc. Refer to Part 2 "Identification" Article for requirements.
- G. Install underground warning tape during backfilling of trenches for underground conduits and duct banks in accordance with details on the Drawings.
- H. Panelboard Identification:
  - 1. Provide equipment and power source nameplates as previously described.
  - 2. Label branch circuit phase and neutral wires with associated pole number.
  - 3. Install typed as built circuit directory giving location and nature of load served.

### 3.14 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections for conductors and cables.
  - 1. Visually inspect for correct installation.
  - 2. Perform continuity test.
  - 3. Perform insulation-resistance test for power and control conductors in accordance with NETA standards.
  - 4. Verify uniform resistance of parallel conductors.
- B. Cable will be considered defective if it does not pass tests and inspections.
- C. Conduct fall-of-potential grounding electrode system test in accordance with IEEE 81.
- D. Prepare test and inspection reports.

### 3.15 CLEANING / PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration. Repair damage as recommended by manufacturer.
- B. Remove all rubbish and construction debris from inside electrical equipment and enclosures.

## 3.16 APPENDICES

## A. Table 260510-1: Raceway Application Guidelines

Table 260510-1			
Raceway Application Guidelines			
Raceway Type	Location / Application		
Aluminum Rigid Conduit	All indoor and outdoor applications, except where other types are listed.		
(ARC)	All exposed, non-corrosive areas.		
	All concealed, non-corrosive areas.		
	Under slabs in slab on grade construction.		
	Stub-ups through slabs.		
	Use LFMC for flexible connections.		
	When installed underground or in contact with concrete, paint with two		
	coats of bitumastic paint.		
Electrical Metallic Tubing (EMT)	Not used on this project.		
PVC Schedule 40	Not used on this project.		
PVC Schedule 80	Direct buried.		
	Corrosive areas.		
	Protection of grounding electrode conductors.		
	Protection of lightning conductors.		
	Where exposed, use LFNC for flexible connections.		
	Use ARC elbows for underground applications.		

# END OF SECTION 260510

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### SECTION 260573 - POWER SYSTEM STUDIES

### PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

- A. Section includes a computer-based study for:
  - 1. Short circuit report.
  - 2. Protective device coordination report.
  - 3. Arc flash report.
- B. Study encompasses the power distribution system of the Collier County NRO Well 117 and Well 119 located in Collier County, Florida.
- C. Study includes the electric utility company's protective devices, portable emergency generators, service entrance equipment and distribution. All power distribution to that point whether existing or new is included. Equipment included, but not limited to:
  - 1. Main distribution panelboards.
  - 2. Motor control centers.
  - 3. Variable frequency controllers.
  - 4. Disconnect switches.
  - 5. Transfer switches.
  - 6. 480V control panels.
  - 7. Transformer panel assemblies.
- D. The local electric utility is Florida Power and Light (FPL).
- E. Obtain all data necessary to perform the study. Data included, but not limited to:
  - 1. Up to date one-line diagrams.
  - 2. Equipment data.
  - 3. Cable sizes and lengths.
  - 4. Existing protective device settings.
  - 5. Electric utility information: available fault current, protective device equipment information and settings, X/R ratios, transformer impedances and ratings.

#### 1.3 DEFINITIONS

A. Boundary, Arc Flash: When an arc flash hazard exists, an approach limit from an arc source at which the incident energy equals 1.2 cal/cm<sup>2</sup>.

- B. Boundary, Limited Approach: An approach limit at a distance from an exposed energized electrical conductor or circuit part within which a shock hazard exists.
- C. Boundary, Restricted Approach: An approach limit at a distance from an exposed energized electrical conductor or circuit part within which there is an increased likelihood of electric shock, due to electrical arc-over combined with inadvertent movement.
- D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed and salvaged, or removed and reinstalled. Existing to remain items shall remain functional throughout the construction period.
- E. Field Adjusting Agency: An independent electrical testing agency with full-time employees and the capability to adjust devices and conduct testing indicated and that is a member company of NETA.
- F. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- G. Power System Analysis Software Developer: An entity that commercially develops, maintains, and distributes computer software used for power system studies.
- H. Power Systems Analysis Specialist: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located.
- I. Preliminary Short Circuit Report: Report that includes the maximum available utility fault current, proposed equipment, and existing equipment to determine if new equipment may be released for manufacturing and existing equipment is adequate for the calculated short circuit levels.
- J. Protective Device: A device that senses when an abnormal condition or current flow exists and then removes the affected portion of the circuit from the system.
- K. SCCR: Short-circuit current rating.
- L. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.
- M. Single-Line Diagram: See "One-Line Diagram."
- N. Supplier: The person, firm or corporation identified as such to provide the power system study and means the Supplier or its authorized agent. See also Power Systems Analysis Specialist.
- O. VFD: Variable frequency drive. Interchangeable with variable frequency controller.

## 1.4 ACTION SUBMITTALS

A. Supplier qualifications per Quality Assurance paragraph. Submit prior to starting study. Include the following:

- 1. Brief description of each qualifying study.
- 2. Name of owner of installation on which study was performed with address, telephone number, and contact person.
- 3. Date of study.
- 4. Any other information indicating the firm's experiences and ability to perform the work and business status.
- B. Final Power System Study Report. Report must be approved prior to energization of new major electrical equipment. Revise study as required for changes during construction.

### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data:
  - 1. For Power Systems Analysis Software Developer.
  - 2. For Power System Analysis Specialist.
  - 3. For Field Adjusting Agency.
- B. If requested, Product Certificates: For power system study software, certifying compliance with IEEE 399, IEEE 1584 and NFPA 70E.
- C. Field quality-control reports.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Final power system study updated with any changes made after equipment start-up.
- B. Digital computer files with full read-write access of the complete power system model and library.

#### 1.7 QUALITY ASSURANCE

- A. Perform Study using commercially developed and distributed software designed specifically for power system analysis.
- B. Software algorithms shall comply with requirements of standards and guides specified in this Section.
- C. Manual calculations are unacceptable.
- D. Power System Analysis Software Qualifications:
  - 1. Design computer program to perform short-circuit studies or have a function, component, or add-on module designed to perform short-circuit studies.
  - 2. Develop computer program under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.
  - 3. Complies with IEEE 399, IEEE 141, IEEE 242, IEEE 519, IEEE 1015, and IEEE 1584 as applicable to the project scope.

- E. Power Systems Analysis Specialist Qualifications: Professional engineer licensed in the state where Project is located and has regularly engaged in this electrical engineering study specialty for minimum of five years and has performed at least three projects of similar complexity to this project within the last three years. Perform all elements of the study under the direct supervision and control of this professional engineer.
- F. Power System Study Certification: Report shall be signed and sealed by Power Systems Analysis Specialist.
- G. Field Adjusting Agency Qualifications:
  - 1. Employer of NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification responsible for all field adjusting of the Work.
  - 2. A member company of NETA.
  - 3. Acceptable to authorities having jurisdiction.

### PART 2 - PRODUCTS

## 2.1 POWER SYSTEM ANALYSIS SOFTWARE DEVELOPERS

- A. Acceptable Software:
  - 1. SKM System Analysis, Inc.: Power\*Tools.
  - 2. Operation Technology, Inc.: ETAP (Electrical Transient Analyzer Program).
  - 3. EasyPower, Inc.: EasyPower.
  - 4. Or equal.

### 2.2 POWER SYSTEM STUDY REPORT GENERAL REQUIREMENTS

- A. Except for one-line diagrams, standard 8 1/2-inch by 11-inch pages, with total pages numbered.
- B. Electronic PDF format copy with electronic bookmarks for each section.
- C. Signed and sealed by a professional engineer registered in the state in which the project is located.
- D. Organized in the following order:
  - 1. Executive Summary.
  - 2. Short Circuit Analysis.
  - 3. Short Circuit Computer Printout.
  - 4. Protective Device Coordination.
  - 5. Arc Flash Hazard Analysis.
  - 6. Utility Data.
  - 7. Modeled One Line Diagrams.
- E. Information on one-line diagrams, legible when printed at 11-inch x 17-inch. Show the following:

- 1. Protective device designations and ampere ratings.
- 2. Conductor types, sizes, and lengths.
- 3. Transformer kilovolt ampere (kVA), impedance, and voltage ratings.
- 4. Motor and generator designations and kVA ratings.
- 5. Switchgear, switchboard, motor-control center, and panelboard designations and ratings.
- 6. Derating factors and environmental conditions.
- 7. Any revisions to electrical equipment required by the study.
- F. Identifiers between the one-line diagram, short circuit study, coordination study, and arc flash study to be the same.
- G. Include copies of correspondence with electric utility under utility data section of report. Correspondence to include names and contact information.

#### 2.3 EXECUTIVE SUMMARY

A. Include summary of distribution system, information received from electric utility, major assumptions, adequacy of equipment to safely clear or close on any fault, identify problem areas and recommendations for resolving problem areas.

### 2.4 SHORT CIRCUIT

- A. Comply with IEEE 399 and IEEE 551 (new 3002 series).
- B. Include normal utility powered configuration, on-site generation configuration, and alternate modes of operation (i.e. alternate utility configuration, bus ties closed).
- C. Include minimum and maximum possible fault conditions. Address three-phase bolted as well as ground fault conditions.
- D. Consider the fault contribution of all motors operating during the maximum demand condition of the motors.
- E. Calculate short-circuit momentary duties and interrupting duties based on an assumed bolted three-phase short circuit at each high and medium voltage switchgear bus and controller, low voltage switchgear bus, switchboard, motor control center, distribution panelboard, pertinent branch circuit panelboard and other significant locations throughout the systems. Include the X/R ratios, asymmetry factors, KVA and symmetrical fault-current in the short circuit tabulations. Provide a ground fault current study for the same system areas. Include in tabulations fault impedance, X/R ratios, asymmetry factors, motor contribution, short circuit KVA, and symmetrical and asymmetrical fault-currents.
- F. Include representation of the site power system, the base quantities selected, impedance source data, calculation methods and tabulations, one-line diagrams, conclusions and recommendations.
- G. Identify available fault current at each bus and evaluate system elements including but not limited to equipment, protective devices, and cables.

- H. Base current transformers' ratio and burden calculations on a 10 percent maximum ratio error per IEEE C57.13. Identify current transformers that will not allow the protective devices to operate within acceptable IEEE error margins and recommend corrective action.
- I. List momentary, interrupting, and/or withstand rating of all key elements of the distribution system along with the maximum available fault current in tabular form and clearly indicate the adequacy of the element with PASS / FAIL designation.
- J. Short Circuit Computer Printout:
  - 1. Calculations shall be in sufficient detail for easy review.
  - 2. Back up calculations shall become part of the final report.

### 2.5 PROTECTIVE DEVICE COORDINATION

- A. Comply with IEEE 242 (new 3004 series).
- B. Utilize results from the short circuit study and balance the competing objectives of protection and continuity of service for the system specified, considering the basic factors of sensitivity, selectivity and speed. Include all system protective devices in the coordination analysis, not just overcurrent protective devices. This includes, but is not limited to under and over voltage protective relays, frequency relays, differential relays and reverse power relays.
- C. Show graphic indication of coordination between protective devices in the form of full color time-current coordination (TCC) plots with each protective device curve in a unique color for easy review.
- D. Provide separate TCC plots for each mode of operation. Provide separate TCC plots for "normal" and "stand by" operation. Show maximum fault values in each case. Both power sources shown on one plot is unacceptable.
- E. Provide separate TCC for phase over-current and ground fault.
- F. Show no more than six devices on one TCC. Of these six curves, two (the largest upstream device and the smallest downstream device) shall repeat curves shown on other coordination plots to provide cross-reference. Designate each TCC with a unique identifier and include each TCC identifier and descriptive title in the study's table of contents.
- G. Include in each TCC the following as applicable:
  - 1. TCC name and description.
  - 2. One-line diagram.
  - 3. Identifiers on one-line diagram and curves.
  - 4. Significant motor starting characteristics.
  - 5. Appropriate NEC protection points.
  - 6. Appropriate ANSI/IEEE protection points.
  - 7. Magnetizing inrush points of transformers.
  - 8. Transformer damage curves.
  - 9. Complete operating bands for low voltage circuit breaker trip devices and fuses.
  - 10. Relay coil taps, time-dial settings and pickup settings.

- 11. Significant symmetrical and asymmetrical fault currents.
- 12. Power cable withstand curves.
- 13. Generator short circuit decrement and thermal limit curves.
- H. Terminate device characteristic curve on TCC at a point reflecting the maximum symmetrical or asymmetrical fault current to which that device is exposed, based on the short circuit study.
- I. Select each primary protective device for a delta-to-wye-connected transformer so the characteristic or operating band is within the transformer parameters; where feasible, include a parameter equivalent to 58 percent of the ANSI C37.91 withstand curve to afford protection for secondary line-to-ground faults.
- J. Separate low voltage power circuit breakers from each other and the associated primary protective device, by a 16 percent current margin for coordination and protection in the event of line-to-line faults.
- K. Separate protective relays by a 0.3-second time margin for the maximum 3 phase fault conditions to assure proper selectivity.
- L. Optimize settings for breakers and relays to provide the most effective protection practicable for all modes and power sources.
- M. Include at least all devices down to largest branch circuit and largest feeder circuit breaker in each motor control center and/or power distribution panelboard. Include all adjustable setting ground fault protective devices.
- N. Provide tabulations of recommended settings for all protective devices. Where devices are existing, highlight any changes from the existing setting to the proposed recommended setting.
- O. Provide all information required to program/set multifunction solid state relays.

#### 2.6 ARC FLASH HAZARD

- A. Comply with IEEE 1584, NFPA 70, and NFPA 70E as applicable.
- B. Utilize short circuit and protective device coordination results to provide arc flash hazard analysis. Perform calculations in accordance with IEEE 1584 or NFPA 70E with the method identified within the report.
- C. Calculate the incident energy levels at each faulted bus for each mode of operation and for both maximum and minimum fault currents.
- D. Include calculations at line side and load side of main breakers, where applicable.
- E. Provide tabular report for all modes and conditions and include "worst case" summary. Use the "worst case" to generate the arc flash labels. Include:
  - 1. Fault location.
  - 2. Arcing fault magnitude.
  - 3. Protective device clearing time.
  - 4. Duration of the arc.

- 5. Arc flash boundary.
- 6. Working distance.
- 7. Incident energy.
- 8. Electrode configuration.
- F. Highlight any available incident energy over 40 cal/cm<sup>2</sup> and provide recommendations to mitigate the hazard.
- G. Arc Flash Labels:
  - 1. Machine printed, 4-inches x 4-inches (nominal), thermal transfer, high adhesion polyester.
  - 2. Provide UV resistant laminate for outdoor labels.
- H. Arc Flash Label Information:
  - 1. Equipment name.
  - 2. Identifier LINE or LOAD where equipment has potential different energy levels.
  - 3. Arc flash hazard information: arc flash boundary and incident energy in cal/cm<sup>2</sup>.
  - 4. Shock hazard information: limited approach and restricted approach boundaries.
  - 5. Personal Protective Equipment (PPE) requirements.
  - 6. Study Supplier, project number, and date.
- I. Provide arc flash label sample with preliminary report.
- J. Do not be print the labels until equipment is energized and protective devices set according to the approved final protective device coordination study.

## PART 3 - EXECUTION

### 3.1 POWER SYSTEM DATA

- A. Obtain all data necessary for conduct of the study.
  - 1. Verify completeness of data supplied on one-line diagram. Call any discrepancies to Engineer's attention.
  - 2. For equipment included as Work of this Project, use characteristics submitted under provisions of action submittals and information submittals for this Project.
- B. Gather and tabulate the required input data to support the power system study.
- C. Field data gathering for existing systems shall be under direct supervision and control of the engineer in charge of performing the study and shall be by the engineer or its representative who holds NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification.
- D. Data included, but are not limited to, the following:
  - 1. Product data for overcurrent protective devices and existing settings.
  - 2. Electrical power utility impedance at the service and upstream protective device data.

- 3. Power sources and ties.
- 4. For switchgear, switchboards, panelboards, and motor control centers, ampacity and SCCR in amperes RMS symmetrical.
- 5. For transformers, kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
- 6. For reactors, manufacturer and model designation, voltage rating, and impedance.
- 7. For circuit breakers, trip units, and fuses, manufacturer and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.
- 8. For generators, short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
- 9. For busways, manufacturer and model designation, current rating, impedance, lengths, and conductor material.
- 10. For motors, horsepower and NEMA MG 1 code letter designation.
- 11. Conductor sizes, lengths, number, conductor material, shield parameters for medium voltage cable, and conduit material (magnetic or nonmagnetic).
- 12. For relays, manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
- 13. For transfer switches, withstand and closing ratings (WCR) with time duration.
- 14. Derating factors.

### 3.2 FIELD QUALITY CONTROL

- A. Do all testing and adjustment prior to the energization of new equipment.
- B. Test existing adjustable protective devices in accordance with NETA MTS.
- C. Test new adjustable protective devices in accordance with NETA ATS.
- D. Adjust existing and new protective devices according to approved coordination study.
- E. Testing and adjusting shall be by a full-time employee of the Field Adjusting Agency, who holds NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification.
- F. After successful testing and adjustment, install calibration sticker with Field Adjusting Agency name, employee initials, and date of calibration at each relay or protective device.
- G. After energization, minor adjustments to settings may be required to commission the equipment.
- H. Submit field report and list any changes made during field adjustment or commissioning for update for record submittal of study.
- I. For adjustable breakers, install sticker listing final adjusted settings, i.e. LTPU, LTD, STPU, STD, INST, GFPU, and GFD.

### 3.3 ARC FLASH LABELING

A. After the field adjustment of relays and protective devices, apply arc flash study labels.

- B. Apply arc flash labels on the front covers of the following equipment:
  - 1. Main distribution panelboards.
  - 2. Motor control centers.
  - 3. Variable frequency controllers.
  - 4. Disconnect switches.
  - 5. Transfer switches.
  - 6. 480V control panels.
  - 7. Transformer panel assemblies
- C. Apply arc-flash labels at each section for large equipment such as switchgear and motor control centers.
- D. Install LINE and LOAD arc-flash labels as applicable.
- E. Remove any previous arc flash study labels as applicable and install new labels under the direction of the Power System Analysis Specialist.

END OF SECTION 260573

### SECTION 262213 - LOW-VOLTAGE DISTRIBUTION TRANSFORMERS

### PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

- A. Section includes:
  - 1. Drive isolation dry-type transformers.
  - 2. Transformer panel assemblies.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type and size of transformer.
  - 2. Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer.
- B. Shop Drawings:
  - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment.
  - 3. Include diagrams for power, signal, and control wiring.

### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Source quality-control reports.
- C. Field quality-control reports.

#### 1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: On receipt, inspect for and note any shipping damage to packaging and transformer.
  - 1. If manufacturer packaging is removed for inspection, and transformer will be stored after inspection, re-package transformer using original or new packaging materials that provide protection equivalent to manufacturer's packaging.
- B. Storage: Store in warm, dry, and temperature-stable location in original shipping packaging.
- C. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.
- D. Handling: Follow manufacturer's instructions for lifting and transporting transformers.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. ABB, Electrification Business (General Electric).
  - 2. Eaton.
  - 3. Square D; Schneider Electric USA.
- B. Source Limitations: Obtain each transformer type from single source from single manufacturer.

#### 2.2 DRIVE ISOLATION TRANSFORMERS

- A. Comply with the following Standards:
  - 1. NEMA ST 20.
  - 2. UL 1561.
  - 3. US Department of Energy Efficiency Standards for Low Voltage Distribution Transformers.
- B. General Description:
  - 1. Dry type, two winding. Configuration, kVA, and voltage shown on Drawings.
  - 2. Windings: Copper.
  - 3. Temperature Rise: 80 degrees C.

- C. Taps for transformers 15 kVA and larger: Full capacity, two 2.5 percent above and four 2.5 percent below.
- D. Grounding: Provide ground-bar kit or a ground bar installed on the inside of the transformer enclosure.
- E. Enclosures:
  - 1. Indoor: NEMA 250, Type 1 or 2, ventilated. Standard enclosure type.
  - 2. Outdoor Enclosure or identified for NEMA 4X enclosures on Drawings: TENV, stainless steel enclosure. All stainless steel hardware.

## 2.3 TRANSFORMER PANEL ASSEMBLY (TPA)

- A. Comply with UL 1062 for unit substations.
- B. General Description: Unit assembly with combination of two winding dry type transformer and panel. Includes main primary circuit breaker and secondary panel section with main circuit breaker. Configuration, kVA, and voltage shown on Drawings. Also referred to on the Drawings as MPZ (Mini-Power-Zone).
  - 1. Windings: Copper, epoxy-resin encapsulated.
  - 2. Temperature Rise: 115 degrees C.
  - 3. Taps: Full capacity, two 5 percent below.
- C. Grounding: Include provisions for connection to grounding electrode system. Include copper equipment ground bar in panel distribution section.
- D. Provide ground-bar kit or a ground bar installed on the inside of the transformer enclosure.
- E. Enclosures:
  - 1. Indoor: Standard enclosure type NEMA 3R, painted steel.
  - 2. Outdoor Enclosure or identified for NEMA 4X enclosures on Drawings: NEMA 3R, stainless steel.
- F. Circuit Breakers and Panel Section:
  - 1. Copper bus.
  - 2. Plug-on type circuit breakers.
  - 3. Main primary breaker sized per manufacturer's standard, minimum 18kA interrupting rating at 480V.
  - 4. Secondary main breaker sized per manufacturer's standard, minimum 10kA interrupting rating at 240V.

### 2.4 IDENTIFICATION

A. Nameplates: Engraved, laminated-acrylic or melamine plastic signs for each distribution transformer, mounted with corrosion-resistant screws.

#### 2.5 SOURCE QUALITY CONTROL

- A. Test and inspect transformers according to IEEE C57.12.01 and IEEE C57.12.91.
  - 1. Resistance measurements of all windings at rated voltage connections and at all tap connections.
  - 2. Ratio tests at rated voltage connections and at all tap connections.
  - 3. Phase relation and polarity tests at rated voltage connections.
  - 4. No load losses, and excitation current and rated voltage at rated voltage connections.
  - 5. Impedance and load losses at rated current and rated frequency at rated voltage connections.
  - 6. Applied and induced tensile tests.
  - 7. Regulation and efficiency at rated load and voltage.
  - 8. Insulation-Resistance Tests:
    - a. High-voltage to ground.
    - b. Low-voltage to ground.
    - c. High-voltage to low-voltage.
  - 9. Temperature tests.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.
- B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.
- C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.
- D. Verify that ground connections are in place and requirements in Section 260510 "Limited Electrical for Small Projects" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.
- E. Environment: Enclosures shall be rated for the environment in which they are located. Covers for NEMA 250, Type 4X enclosures shall not cause accessibility problems.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 INSTALLATION

A. Install wall-mounted transformers level and plumb with wall brackets fabricated by transformer manufacturer.

- 1. Coordinate installation of wall-mounted and structure-hanging supports with actual transformer provided.
- B. Install transformers level and plumb on a concrete base with vibration-dampening supports. Locate transformers away from corners and not parallel to adjacent wall surface.
- C. Construct concrete bases and anchor floor-mounted transformers according to manufacturer's written instructions.
  - 1. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
- D. Secure transformer to concrete base according to manufacturer's written instructions.
- E. Secure covers to enclosure and tighten all bolts to manufacturer-recommended torques to reduce noise generation.
- F. Remove shipping bolts, blocking, and wedges.

### 3.3 CONNECTIONS

- A. Ground equipment in accordance with the National Electric Code and as indicated on the Drawings.
- B. Tighten electrical connectors and terminals according to manufacturer's published torquetightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- C. Provide flexible connections at all conduit and conductor terminations and supports to eliminate sound and vibration transmission to the building structure.

### 3.4 IDENTIFICATION

- A. Identify equipment by name designation and fed from source with nameplates.
- B. Color code wiring.
- C. Identify panel branch circuit numbers at TPA at circuit breakers and neutral terminals.
- D. Provide as built typed panel directory at TPA.

## 3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections.

- B. Dry-Type Transformer Field Tests:
  - 1. Visual and Mechanical Inspection.
    - a. Inspect physical and mechanical condition.
    - b. Inspect anchorage, alignment, and grounding.
    - c. Verify that resilient mounts are free and that any shipping brackets have been removed.
    - d. Verify the unit is clean.
    - e. Perform specific inspections and mechanical tests recommended by manufacturer.
    - f. Verify that as-left tap connections are as specified.
  - 2. Electrical Tests:
    - a. Measure resistance at each winding, tap, and bolted connection.
    - b. Perform insulation-resistance tests winding-to-winding and each winding-toground. Apply voltage according to manufacturer's published data. In the absence of manufacturer's published data, comply with NETA ATS, Table 100.5.
    - c. Verify correct secondary voltage, phase-to-phase and phase-to-neutral, after energization and prior to loading.
- C. Remove and replace units that do not pass tests or inspections and retest as specified above.
- D. Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of transformer connections.
  - 1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
  - 2. Perform follow-up infrared scans of transformers at 11 months after Substantial Completion.
  - 3. Prepare certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.
- E. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

### 3.6 ADJUSTING

- A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 5 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.
- B. Output Settings Report: Prepare a written report recording output voltages and tap settings.

## 3.7 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 262213

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### SECTION 262505 – 480V CONTROL PANELS

### PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

- A. Section includes well pump control panels (PCP) with the following features:
  - 1. Enclosure.
  - 2. Main circuit breaker.
  - 3. Motor controllers.
  - 4. Control and monitoring devices.
  - 5. Accessories.
  - 6. Identification.
- B. Related Requirements:
  - 1. Section 262213 "Low-Voltage Distribution Transformers" for drive isolation transformers.
  - 2. Division 40 for process automation requirements.

#### 1.3 DEFINITIONS

- A. CPT: Control power transformer.
- B. GFCI: Ground-fault circuit interrupter.
- C. MCCB: Molded-case circuit breaker.
- D. MCP: Motor circuit protector.
- E. NEC: National Electrical Code.
- F. RVSS: Reduced voltage soft start.
- G. RVAT: Reduced voltage autotransformer start.
- H. SCCR: Short-circuit current rating.
- I. SPD: Surge protective device.
- J. UL: Underwriter's Laboratories.

- K. VFC: Variable frequency motor controller. See VFD.
- L. VFD: Variable frequency drive. Used interchangeably with the term VFC.

### 1.4 ACTION SUBMITTALS

- A. Product Data: For each control panel.
  - 1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
  - 2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each control panel. Submit in PDF and AutoCAD format.
  - 1. Include dimensioned plans, elevations, sections, and details.
  - 2. Bill of materials with part numbers, cross-referenced to plans.
  - 3. Nameplate schedule.
  - 4. Conduit entrance locations and mounting details.
  - 5. Power and control schematics.
  - 6. Certification for compliance with UL 508A.
  - 7. Identification per NEC 409.110.

### 1.5 INFORMATIONAL SUBMITTALS

A. Startup reports.

### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: include the following if applicable:
  - 1. Manufacturer's written instructions for testing and adjusting thermal-magnetic circuit breaker and motor-circuit protector trip settings.
  - 2. Manufacturer's written instructions for setting field-adjustable overload relays.
  - 3. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
  - 4. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.
  - 5. Load-Current and Overload-Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate, full-load currents.
  - 6. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that switch settings for motor-running overload protection suit actual motors to be protected.

#### 1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Control fuses: Equal to 10 percent of total quantity installed for each size and type, but no fewer than two of each size and type.
  - 2. Power fuses: Equal to 10 percent of total quantity installed for each size and type, but no fewer than three of each size and type.
  - 3. Corrosion Inhibitor: Equal to 100 percent of total number of control panels. (One spare per panel.)

#### 1.8 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Accredited by NETA.
  - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

#### 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store control panels indoors in clean, dry space with uniform temperature to prevent condensation. Protect control panels from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- B. If stored in space that is not permanently enclosed and air conditioned, remove loose packing and flammable materials from inside enclosures and install temporary electric heating, with at least 50 W per enclosure.

#### 1.10 FIELD CONDITIONS

- A. Ambient Environment Ratings: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
  - 1. Ambient Temperature: Not less than 23 degrees F and not exceeding 104 degrees F.
  - 2. Altitude: Not exceeding 6600 feet for electromagnetic and manual devices.

#### 1.11 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace control panels that fail in materials or workmanship within specified warranty period.
- B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace SPD that fails in materials or workmanship within specified warranty period.
  - 1. SPD Warranty Period: Five years from date of Substantial Completion.

#### PART 2 - PRODUCTS

### 2.1 GENERAL REQUIREMENTS

- A. Product Selection for Restricted Space: Drawings indicate maximum dimensions for control panels clearances between control panels and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA 250: Enclosures for Electrical Equipment (1000 Volts Maximum).
- D. Comply with NEMA ICS 6: Industrial Control and Systems: Enclosures.
- E. Comply with NFPA 70.
- F. Comply with UL 508A.
- G. Complete and fully functional control to manually or automatically operate the control system as specified herein and in other applicable sections of these specifications. Include manufacturer's recommended safety devices to protect operators. All control devices, unless specified otherwise, mounted in the Control Panel.
- H. The control panel shall operate on a power supply of 480 volts, 3-phase, 60 hertz unless otherwise noted.
- I. Control panel consists of a main circuit breaker, motor circuit protector (MCP) and motor controller for each motor, and a 120-volt control power transformer (fused on primary and secondary) along with other devices specified. Mount all control components in one common enclosure.
- J. All electronic control equipment (i.e. controllers, isolators, signal boosters, transmitters, PLC's, etc.) shall be as specified in Division 40.
- K. Control panels containing PLC's shall contain UPS or battery ride-through for the PLC in accordance with Division 40 specifications.
- L. SCCR: Control panels shall have a minimum SCCR of 42kA, unless specifically noted elsewhere.

#### 2.2 ENCLOSURES

- A. Enclosures: Surface-mounted, dead-front cabinets rated for environmental conditions at installed location. Unless noted elsewhere, NEMA rating shall be NEMA 4X, Type 316 stainless steel, minimum 14-gauge, factory painted white with water shield.
- B. Construction: The door shall be mounted via continuous stainless steel hinged and provided with a pad-lockable vault type 3-point latch. The enclosure shall be equipped with a door and shall incorporate a removable back panel on which control components shall be mounted. Back panel shall be secured to enclosure with collar studs. Door(s) shall be interlocked with main circuit breaker and provided with pad-locking provision. All hardware shall be stainless steel.

- C. All motor branch circuit breakers, motor starters and control relays shall be of highest industrial quality, securely fastened to the removable back panels with screws and lock washers. Back panels shall be tapped to accept all mounting screws. Self-tapping screws shall not be used to mount any component.
- D. Operating handle for main circuit breaker: flange mounted.
- E. Outdoor enclosures shall be provided with sun shields where indicated in the Drawings.
- F. Provide additional temperature control if required to meet UL temperature rating of internal components. If forced air ventilation is required, the enclosure shall be pressurized. Air filters shall be of commercially available types and sizes.
- G. All operating control and instruments shall be securely mounted on the exterior door. All controls and instruments shall be clearly labeled to indicate function. All exterior mounted equipment shall be NEMA 4X.
- H. Print storage pockets shall be provided on the inside of each panel. Pocket shall be of sufficient size as required to hold all prints necessary to service the equipment.

### 2.3 COMPONENTS

- A. Comply with Collier County approved product list as shown on the Drawings.
- B. Main Breaker: Thermal-magnetic air circuit breaker, Schneider Electric/Square D PowerPact Type JJ (250 amp frame, 65 kAIC) or equal.
- C. MCP: Molded case motor circuit protector with adjustable magnetic trip only, Schneider Electric/Square D "Mag-Gard" or equal.
  - 1. Reduced voltage motor starting: VFD, refer to VFD Article for requirements.
- D. Overload relays shall be self-powered solid-state type and provide the following features: tamper guard over trip adjustment setting, ambient insensitive, harmonic immunity, phase loss and phase unbalance protection, manual reset, and push-to-test.
- E. Overload reset buttons shall be mounted on dead front door.
- F. Normally open and normally closed auxiliary motor overload contacts wired to terminal blocks shall be provided for each motor starter within the control panel.
- G. SPD: The control panel shall be provided with a surge protective device (SPD) rated for 200kA per mode for the incoming power. SPD shall be mounted within the control panel enclosure. Lead lengths shall not be longer than 12 inches from the main circuit breaker.
- H. Control Power Transformer: 480-120V CPT, fused on primary and secondary sides, capacity as required.

#### 2.4 CONTROL DEVICES AND ACCESSORIES

- A. Control Operators and Indictors:
  - 1. Heavy duty type, full size (30.5mm), NEMA 4X or 7 as required.
  - 2. Each motor shall include HAND-OFF-AUTO selector switches to permit override of automatic control and manual actuation of shutdown.
- B. Indicating Lights:
  - 1. LED, full size (30.5mm), full voltage and push-to-test type.
  - 2. Indicators shall be provided for individual motor run and an indicator for each failure condition.
- C. Elapsed Time Meters (ETM):
  - 1. Six (6) digit, non-reset elapsed time meter to indicate the total running time of each motor in "hours" and "tenth of hours". Series T50 as manufactured by the ENM Company or equal.
  - 2. Provide an ETM for each motor.
- D. Relays:
  - 1. Control relays shall be 10 amp rated contacts (minimum), 11 pin with mounting base, 3PDT (minimum), with LED indicators to show relay status, relays shall be manufactured by Potter Brumfield or equal.
  - 2. Timing relays shall be solid state, with pin (octal) and bases, relays shall be T-series as manufactured by Diversified Electronics Inc. or equal.
- E. An interior enclosure light shall be provided for the control panel, the light shall be model Panelite LED24V15 as manufactured by nVent Hoffman, or equal.
- F. MCCB for MPZ: Include a molded case circuit breaker of the same manufacturer and type as the control panel main circuit breaker. The circuit breaker shall be sized per the Mini-Power-Zone (MPZ) manufacturer's standard.
- G. A duplex GFCI utility receptacle (circuit breaker protected) providing 120 volts, 60 Hertz, single phase current shall be mounted on the side of the enclosure.
- H. Auxiliary contacts shall be provided for remote run indication and indication of each status and alarm condition. Additional controls shall be provided as specified herein and as required by Divisions 40, 26 and as shown on the Drawings.
- I. A phase monitor shall be provided for the control panel, monitors shall be model SUA-440-ASA as manufactured by Diversified Electronics Inc., or equal.
- J. Corrosion Inhibitor Emitter: Inclusion of an industrial corrosion inhibitor emitter, selected by the manufacturer, to protect internal components of control panel from corrosion for up to one year.
- K. Breather assemblies, to maintain interior pressure and release condensation in Type 4X enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.

L. Space heaters, with NC auxiliary contacts, to mitigate condensation in Type 4X enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.

### 2.5 VFD AND ACCESSORIES

- A. VFD:
  - 1. Allen Bradley Power Flex 753, six pulse drive, no exceptions.
  - 2. Input Voltage: 480V, 3 phase.
  - 3. Output Current: As indicated on Drawings.
  - 4. EMC Filtered.
  - 5. Control and interface to SCADA system via Ethernet cable using Ethernet/IP communications protocol.
- B. DV/DT Output Filter:
  - 1. Comprised of passive components only.
  - 2. Limits peak voltage at motor terminals to 150 percent or less of VFD's DC bus voltage for motor leads of 1000 feet or shorter.
  - 3. Maximum dV/dT waveform pulses at motor terminal of 200 volts per microsecond.
  - 4. Insertion loss of 3 percent of rated voltage maximum.
  - 5. UL listed.
  - 6. MTE Series A dV/dT Filter or equivalent.
- C. Input Drive Isolation Transformer:
  - 1. Separate enclosure, not mounted within pump control panel.
  - 2. Refer to specification Section 262213 "Low-Voltage Distribution Transformers".

### 2.6 WIRING

- A. Power and control wire shall be 600 Volt class, Type MTW insulated stranded copper and shall be of the sizes required for the current to be carried, but not smaller than No. 14 AWG. All wiring shall be enclosed in PVC wire trough with slotted side openings and removable cover.
- B. Wiring shall be stranded copper, minimum size #14 AWG (except for shielded instrumentation cable), with 600 Volt, 90 degree C, flame retardant, Type MTW thermoplastic insulation.
- C. Provide clear shock protection barriers over any exposed terminal with over 120-volts to ground potential voltage.
- D. All interconnecting wires between panel mounted equipment and external equipment shall be terminated at numbered terminal blocks.
- E. Terminal blocks shall be 600 Volt heavy duty rated, tubular clamp type. Terminal strips shall be Allen Bradley catalog #1492-CA-1 or equal.
- F. A copper ground bar with sufficient terminals for all field and panel ground connections shall be provided.

- G. All signal wiring entering and exiting the control panel shall be provided with surge protection. Surge protection shall be as specified in Division 40.
- H. An 8-inch (minimum) clear space within the enclosure shall be provided horizontally along the entire top and bottom of the control panel. A 4-inch (minimum) clear space within the enclosure shall be provided vertically along the entire sides of the control panel. No devices, terminals, etc. shall be installed within this space, the space shall be provided for field conduit and wiring access only.

### 2.7 IDENTIFICATION

- A. All control panel wiring shall be numbered at both ends with type written heat shrinkable wire markers.
- B. The control diagrams and overload tables shall be laminated to the inside of the door except where door space is limited the laminated documents shall be in the print storage pocket.
- C. The control panel shall be provided with nameplates identifying each component, selector switches, pilot lights, etc. Nameplates shall be permanently affixed using an epoxy process (inner door nameplates shall be fastened with stainless steel screws). Nameplates shall be laminated plastic, engraved black letters with a white background.
- D. All control panels shall be provided with two nameplates located on the exterior door. The first nameplate shall identify the control panel name. The second nameplate shall identify the power source.
- E. Where applicable provide a nameplate which reads as follows "CAUTION THIS PANEL CONTAINS A VOLTAGE FROM AN EXTERNAL SOURCE." Letters shall be black on a high visibility yellow background.
- F. Each terminal at terminal blocks shall be individually labeled.
- G. Incoming phase conductor terminals shall be clearly identified. All wiring within the control panel shall be color coded or coded using electrical tape in sizes where colored insulation is not available. The following coding shall be used.

System	Wire	Color
Incoming line voltage	Phase conductors	Black
	Ground	Green
	Neutral (as required)	Gray
Internal control voltage	AC	Red
Internal control voltage	DC	Blue
External source	All	Yellow

#### 2.8 FACTORY TESTS

A. Inspect and test control panel for correct operation. Test each circuit for continuity, short circuits, and ground faults.

### PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Inspect anchorage, alignment, grounding, and clearances.
- C. Compare equipment nameplate data for compliance with Drawings and Specifications.
- D. Verify that electrical wiring installation complies with manufacturer's written installation requirements.
- E. Motor Overload Relays: Select and set overloads on the basis of full-load current rating as shown on motor nameplate. Adjust setting value for special motors as required by NFPA 70 for motors that are high-torque, high-efficiency, and so on.
- F. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260510 "Limited Electrical for Small Projects."
- G. Arc Flash Labels: Install as specified in Section 260573 "Power System Studies."

### 3.2 STARTUP SERVICE

- A. Complete startup checks according to manufacturer's written instructions.
- B. Verify motor running protection is appropriate for actual motors installed.
- C. Test control panel with all field wiring connected. Set adjustable set points and time delays for proper operation of equipment. Adjust as required.
- D. Perform infrared inspection of panel interior during periods of maximum possible loading. Remove all necessary covers prior to the inspection. Comply with the recommendations of NFPA 70B, "Testing and Test Methods" Chapter, "Infrared Inspection" Article.
- E. Prepare test and inspection reports.
- F. Install a set of legible "as built" laminated control panel drawings (11 x 17 or 8.5 x 11), in the storage pocket.

#### 3.3 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain equipment.

END OF SECTION 262505

### SECTION 263600 - TRANSFER SWITCHES

### PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. Section includes nonautomatic transfer switches rated 600 V and less, including the following:

### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for transfer switches.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and accessories.

### 1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

### 1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

### 1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications:
  - 1. Member company of NETA.
    - a. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

#### 1.7 FIELD CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service:
  - 1. Notify Owner no fewer than two days in advance of proposed interruption of electrical service.
  - 2. Do not proceed with interruption of electrical service without Owner's written permission.

#### 1.8 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of transfer switch or transfer switch components that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: 18 months from date of Substantial Completion.

### PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NEMA ICS 1.
- C. Comply with NFPA 110.
- D. Comply with UL 1008 unless requirements of these Specifications are stricter.
- E. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.
- F. Neutral Switching: Where four-pole switches are indicated, provide neutral pole switched simultaneously with phase poles.
- G. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, by color-code or by numbered or lettered wire and cable shrinkable sleeve markers at terminations.
  - 1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
  - 2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
  - 3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.
  - 4. Accessible via front access.

H. Enclosures: General-purpose NEMA 250, Type 4X, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

### 2.2 NONAUTOMATIC TRANSFER SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. ASCO Power Technologies.
  - 2. Russ Electric, Inc.
- B. Electrically Operated: Electrically actuated by push buttons designated "Normal Source" and "Alternative Source." Switch shall be capable of transferring load in either direction with either or both sources energized.
- C. Manual and Electrically Operated: Electrically actuated by push buttons designated "Normal Source" and "Alternative Source." Manual handle provides quick-make, quick-break manual-switching action. Switch shall be capable of electrically or manually transferring load in either direction with either or both sources energized. Control circuit disconnects from electrical operator during manual operation.
- D. Double-Throw Switching Arrangement: Incapable of pauses or intermediate position stops during switching sequence.
- E. Pilot Lights: Indicate source to which load is connected.
- F. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and alternative-source sensing circuits.
  - 1. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
  - 2. Emergency Power Supervision: Red light with nameplate engraved "Alternative Source Available."
- G. Unassigned Auxiliary Contacts: Switch shall have one set of normally closed contacts for each switch position, rated 10 A at 240-V ac.
- H. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
  - 1. Switch Action: Double throw; mechanically held in both directions.
  - 2. Contacts: Silver composition or silver alloy for load-current switching.
  - 3. Conductor Connectors: Suitable for use with conductor material and sizes.
  - 4. Material: Hard-drawn copper, 98 percent conductivity.
  - 5. Main and Neutral Lugs: Mechanical type.
  - 6. Ground Lugs and Bus-Configured Terminators: Mechanical type.
  - 7. Ground bar.
  - 8. Connectors shall be marked for conductor size and type according to UL 1008.

#### 2.3 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect components, assembled switches, and associated equipment according to UL 1008. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.
- B. Prepare test and inspection reports.
  - 1. For each of the tests required by UL 1008, performed on representative devices, for emergency systems. Include results of test for the following conditions:
    - a. Overvoltage.
    - b. Undervoltage.
    - c. Loss of supply voltage.
    - d. Reduction of supply voltage.
    - e. Alternative supply voltage or frequency is at minimum acceptable values.
    - f. Temperature rise.
    - g. Dielectric voltage-withstand; before and after short-circuit test.
    - h. Overload.
    - i. Contact opening.
    - j. Endurance.
    - k. Short circuit.
    - 1. Short-time current capability.
    - m. Receptacle withstand capability.
    - n. Insulating base and supports damage.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Floor-Mounting Switch: Anchor to floor by bolting.
  - 1. Install transfer switches on cast-in-place concrete equipment base(s).
  - 2. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.
  - 3. Provide workspace and clearances required by NFPA 70.
- B. Annunciator and Control Panel Mounting: Flush in wall unless otherwise indicated.
- C. Identify components according to Section 260510 "Limited Electrical for Small Projects."
- D. Set field-adjustable intervals and delays, relays, and engine exerciser clock.
- E. Comply with NECA 1.

#### 3.2 CONNECTIONS

A. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
- B. Ground equipment according to Section 260510 "Limited Electrical for Small Projects."
- C. Final connections to equipment shall be made with liquidtight, flexible metallic conduit no more than 18 inches (457 mm) in length.

# 3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Engage qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections:
  - 1. After installing equipment, test for compliance with requirements according to NETA ATS.
  - 2. Visual and Mechanical Inspection:
    - a. Compare equipment nameplate data with Drawings and Specifications.
    - b. Inspect physical and mechanical condition.
    - c. Inspect anchorage, alignment, grounding, and required clearances.
    - d. Verify that the unit is clean.
    - e. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
    - f. Verify that manual transfer warnings are attached and visible.
    - g. Verify tightness of all control connections.
    - h. Inspect bolted electrical connections for high resistance using one of the following methods, or both:
      - 1) Use of low-resistance ohmmeter.
      - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data.
    - i. Perform manual transfer operation.
    - j. Verify positive mechanical interlocking between normal and alternate sources.
    - k. Perform visual and mechanical inspection of surge arresters.
  - 3. Electrical Tests:
    - a. Perform insulation-resistance tests on all control wiring with respect to ground.
    - b. Perform contact/pole-resistance test. Compare measured values with manufacturer's acceptable values.
    - c. Verify settings and operation of control devices.
    - d. Calibrate and set all relays and timers.
    - e. Verify phase rotation, phasing, and synchronized operation.
    - f. Perform automatic transfer tests.
    - g. Verify correct operation and timing of the following functions:
      - 1) Normal source voltage-sensing and frequency-sensing relays.
      - 2) Engine start sequence.

- 3) Time delay on transfer.
- 4) Alternative source voltage-sensing and frequency-sensing relays.
- 5) Automatic transfer operation.
- 6) Interlocks and limit switch function.
- 7) Time delay and retransfer on normal power restoration.
- 8) Engine cool-down and shutdown feature.
- 4. Measure insulation resistance phase-to-phase and phase-to-ground with insulationresistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
  - a. Check for electrical continuity of circuits and for short circuits.
  - b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
  - c. Verify that manual transfer warnings are properly placed.
  - d. Perform manual transfer operation.
- 5. After energizing circuits, perform each electrical test for transfer switches stated in NETA ATS and demonstrate interlocking sequence and operational function for each switch at least three times.
  - a. Simulate power failures of normal source to automatic transfer switches and retransfer from emergency source with normal source available.
  - b. Simulate loss of phase-to-ground voltage for each phase of normal source.
  - c. Verify time-delay settings.
  - d. Verify pickup and dropout voltages by data readout or inspection of control settings.
  - e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
  - f. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for one pole deviating by more than 50 percent from other poles.
  - g. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cooldown and shutdown.
- 6. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.
  - a. Verify grounding connections and locations and ratings of sensors.
- D. Coordinate tests with tests of generator and run them concurrently.
- E. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.
- F. Transfer switches will be considered defective if they do not pass tests and inspections.
- G. Remove and replace malfunctioning units and retest as specified above.

- H. Prepare test and inspection reports.
- I. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.
  - 1. Instrument: Use infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
  - 2. Record of Infrared Scanning: Prepare certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
  - 3. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.

END OF SECTION 263600

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# SECTION 264113 - LIGHTNING PROTECTION FOR STRUCTURES

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. Provide new lighting protection system (LPS) at the NRO Well 119N located in Collier County, Florida.
- B. LPS consists of conductors, air terminals, and accessories bonded together and grounded to the system ground grid at regular intervals. Submittal of alternate methods of lightning protection must provide equal or greater lightning protection than specified.
- C. Employ a licensed LPS engineering company to design and install the LPS in compliance with NFPA 780 and UL 96. Design to include detailed installation drawings and material specification.
- D. Provide for UL field inspection upon completed installation and UL Master label. Make all corrections and additions required by UL inspector. Pay all costs for UL inspection and any subsequent re-inspections. If structure is not eligible upon the standards of UL 96A, provide a Letter of Findings for the installation at completion of work.
- E. Related Requirements:
  - 1. Section 260510 "Limited Electrical for Small Projects" for grounding and bonding materials and PVC conduit.

## 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
  - 1. Include layouts of the lightning protection system, with details of the components to be used in the installation.
  - 2. Include raceway locations needed for the installation of conductors.
  - 3. Details of air terminals, ground rods, ground rings, conductor supports, splices, and terminations, including concealment requirements.
  - 4. Include roof attachment details, coordinated with roof installation.
  - 5. Calculations required by NFPA 780 for bonding of metal bodies.

### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For each type of roof adhesive for attaching the roof-mounted air terminal assemblies, approved by the roofing-material manufacturer.
- C. Field quality-control reports.

### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For lightning protection system to include in maintenance manuals.
  - 1. Include the following:
    - a. Dimensioned site plan showing dimensioned route of the ground loop conductor and the ground rod locations.
    - b. A system testing and inspection record, listing the results of inspections and ground resistance tests, as recommended by NFPA 780, Annex D.
- B. Completion Certificate:
  - 1. UL Master Label Certificate.

#### 1.6 QUALITY ASSURANCE

A. Installer Qualifications: UL-listed installer, category OWAY or LPI Master Installer.

## PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. NFPA Lightning Protection Standard: Comply with NFPA 780 requirements for Class I buildings.
- B. UL Lightning Protection Standard: Comply with UL 96A requirements for Class I buildings.
- C. Lightning Protection Components, Devices, and Accessories: Listed and labeled by a qualified testing agency as complying with UL 96, and marked for intended location and application.

# 2.2 MATERIALS

- A. General:
  - 1. Use new materials.
  - 2. Comply with minimum weight, size, and composition requirements of UL and NFPA unless higher standard is included herein.

- 3. Comply with Section 260510 "Limited Electrical for Small Projects" for grounding materials and methods.
- 4. Comply with Section 260510 "Limited Electrical for Small Projects" for PVC conduit. Use PVC schedule 80.
- B. Static Dissipator Type Air Terminals:
  - 1. Static dissipator / streamer delaying type as manufactured by Lightning Master Corp.
  - 2. High quality solid stainless steel electrode material, 300 series stainless preferred.
  - 3. Minimum of five hundred (500) dissipator electrode wires, none of which exceed 0.010inch diameter.
  - 4. Cast bronze base with stainless steel bolt pressure connectors. Provide base specific to the attachment surface. Adhesive type for flat roof areas.
- C. Class 1 Main Conductors (Structures 75 Feet and Less):
  - 1. Aluminum: 14 AWG, 28 strand (weighing 105 lbs per 1,000 feet).
  - 2. Copper: Tinned, 17 AWG, 32 strand (weighting 220 lbs per 1,000 feet).
- D. Secondary Conductors Fasteners: Non-corrosive metal, rated to support conductors.
- E. Conductor Splices and Connectors:
  - 1. Compression fittings that are installed with hydraulically operated tools, or exothermic welds, approved for use with the class type.
  - 2. Bronze when joining dissimilar metals. Stainless steel bolts and nuts.
  - 3. Exothermic type at buried and non-accessible locations.

# PART 3 - EXECUTION

## 3.1 INSTALLATION

- A. Coordinate work with electrical contractor and other trade contractors.
- B. Install materials by a UL listing lightning protection contractor and in accordance with the approved shop drawings, and UL 96A and NFPA 780 recommended practices.
- C. LPS engineering company to provide assistance and supervision of the installation as required and be present during the UL inspection.
- D. Install in a neat and inconspicuous manner.
- E. Coordinate mounting and penetration of roof surface with roofing contractor to assure maximum roofing guarantee. Through-roof penetration flashings shall be furnished, sealed, and guaranteed by a licensed roofing contractor.
- F. Excavate and backfill as required. Finish grade and restore to original condition.
- G. Bond metal bodies within 6 feet of the LPS conductor to the LPS with approved fittings and conductors. Use approved bimetallic connectors for connections between dissimilar metals.

- H. Legibly record field changes on a set of project contract drawings as work progresses. Furnish a complete set of reproducible "As-built" drawings for the Project Record Documents when work is complete.
- I. Air Terminals:
  - 1. Space air terminals so as not to exceed 20 feet apart around the outside perimeter of the roof or ridge and not over 50 feet apart through the center of flat roof areas.
  - 2. Do not project air terminals more than 24 inches nor less than 10 inches above the protected object.
- J. Conductor Routing:
  - 1. Maintain a downward or horizontal course on main conductors, free from "U" or "V" pockets.
  - 2. Do not form conductors with an angle of less than 90 degrees nor less than an 8 inch radius bend.
  - 3. Do not use metal roofing and siding, eave downspouts or other metal parts subject to displacement as part of the lightning conductor system.
  - 4. Space fasteners not more than 3 feet horizontally or vertically.
  - 5. Use fasteners of the same material as the conductor.
  - 6. Use bimetallic fittings for connections between dissimilar metals.
- K. Down Conductors:
  - 1. Follow the most direct patch possible between roof conductors and ground terminals.
  - 2. Provide a minimum of two down conductors installed at the diagonally opposed corners of the building for buildings with a ground perimeter less than 250 feet.
  - 3. Provide down conductors as required so the distance between the conductors does not exceed 100 feet for all buildings with a ground perimeter in excess of 250 feet.
  - 4. Conceal down conductors to greatest extent possible.
  - 5. Use Schedule 80 PVC conduit for any required physical protection of down conductors.
  - 6. Install down conductors within a building within the wall and provide physical protection within the wall.
  - 7. Where down conductors are installed on the exterior of structures, provide physical protection of the conductor from grade level to a height of at least 6 feet.
  - 8. Make connections through roof with through-roof connectors.
  - 9. Splices are not permitted on conductors embedded in concrete.
  - 10. Do not route conductors through any chemical spill containment area.
- L. Roof Conductors:
  - 1. Interconnect and provide a two-way path from air terminals.
  - 2. Bond together air terminals and installed exposed except where connections are made to equipment located under roof.
  - 3. Form closed loops on perimeters of flat roofs.
  - 4. Dead end air terminals are not permitted.
  - 5. Interconnecting cables from air terminals to roof conductors or metal roof decks shall be similar to roof conductor.
- M. Roof Penetrations and Pitch Pockets: By a qualified roofing contractor.

- N. Grounding System:
  - 1. Provide ground rods at each down conductor, a minimum of 3 feet away from the foundation walls.
  - 2. Provide LPS ground rods in addition to the ground rods provide for the system grounding grid as required.
  - 3. Interconnect ground terminals with the electric system grounding grid and all grounding mediums. This includes electric and telephone service grounds and underground metallic piping systems.
  - 4. Use an exothermic weld process to bond down conductors to ground rods and any bonds or splices in concealed locations.
  - 5. Notify design Engineer prior to concealment for Engineer's inspection.
- O. Identification:
  - 1. Attach corrosion resistant stamped metal tags to, or adjacent to, each down conductor indicating in feet the exact vertical depth in the ground of each ground terminal.
  - 2. Indicate location of down leads connected to water pipes.
  - 3. Place tags at a height of 5 feet above finished grade.

## 3.2 CONNECTIONS

- A. Aboveground concealed connections, and connections in earth or concrete, shall be done by exothermic welds or by high-compression fittings listed for the purpose.
- B. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
  - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
  - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.

### 3.3 CORROSION PROTECTION

- A. Do not install copper lightning protection materials on aluminum roofing, siding or other aluminum surfaces.
- B. Do not embed aluminum lightning protection materials in concrete, masonry, or on or below copper surfaces.
- C. Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture unless moisture is permanently excluded from junction of such materials.
- D. Use conductors with protective coatings where conditions would cause deterioration or corrosion of conductors.

## 3.4 FIELD QUALITY CONTROL

- A. Special Inspections: Engage qualified special inspector to perform the following special inspections:
  - 1. Perform inspections as required to obtain a UL Master Label for system.
  - 2. Test the LPS for continuity of all conductors and air terminals.
  - 3. Do not exceed system resistance of five ohms, unless otherwise specified or scheduled.
- B. Prepare test and inspection reports and certificates.

END OF SECTION 264113

# SECTION 271523 - COMMUNICATIONS OPTICAL FIBER HORIZONTAL CABLING

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. Section Includes:
  - 1. 9/125 micrometer, single-mode, indoor-outdoor optical fiber cable (OS2).
  - 2. Optical fiber cable connecting hardware, patch panels, and cross-connects.
  - 3. Grounding.
  - 4. Cabling identification products.

### 1.3 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- C. RCDD: Registered Communications Distribution Designer.

## 1.4 OPTICAL FIBER HORIZONTAL CABLING DESCRIPTION

- A. Optical fiber horizontal cabling system shall provide interconnections between Distributor A, Distributor B, or Distributor C and the equipment outlet, otherwise known as "Cabling Subsystem 1" in the telecommunications cabling system structure. Cabling system consists of horizontal cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for horizontal-to-horizontal cross-connection.
  - 1. TIA-568-C.1 requires that a minimum of two equipment outlets be installed for each work area.
  - 2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the equipment outlet.
  - 3. Bridged taps and splices shall not be installed in the horizontal cabling.
- B. Maximum allowable horizontal cable length is 295 feet. This maximum allowable length does not include an allowance for the length of 16 feet to the workstation equipment or in the horizontal cross-connect.

### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Reviewed and stamped by RCDD.
  - 1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
  - 2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
  - 3. Cabling administration Drawings and printouts.
  - 4. Wiring diagrams and installation details of telecommunications equipment, to show location and layout of telecommunications equipment, including the following:
    - a. Telecommunications rooms plans and elevations.
    - b. Telecommunications pathways.
    - c. Telecommunications system access points.
    - d. Telecommunications grounding system.
    - e. Telecommunications conductor drop locations.
    - f. Typical telecommunications details.
    - g. Mechanical, electrical, and plumbing systems.
- C. Fiber optic cable testing plan.

### 1.6 CLOSEOUT SUBMITTALS

- A. Software and Firmware Operational Documentation:
  - 1. Software operating and upgrade manuals.
  - 2. Program Software Backup: On USB media or compact disk, complete with data files.
  - 3. Device address list.
  - 4. Printout of software application and graphic screens.
- B. Maintenance Data: For optical fiber cable, splices, and connectors to include in maintenance manuals.

## 1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Connecting Blocks: One of each type.
  - 2. Jacks: Ten of each type.
  - 3. Plugs: Ten of each type.

### 1.8 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
  - 1. Installation Supervision: Installation shall be under the direct supervision of Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.
  - 2. Testing Supervisor: Currently certified by BICSI as a RCDD.
- B. Testing Agency Qualifications: Testing agency must have personnel certified by BICSI on staff.
  - 1. Testing Agency's Field Supervisor: Currently certified by BICSI as a RCDD to supervise on-site testing.

### 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
  - 1. Test optical fiber cable to determine the continuity of the strand end to end. Use optical loss test set.
  - 2. Test optical fiber cable while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector, including the loss value of each. Retain test data and include the record in maintenance data.

## 1.10 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

## 1.11 COORDINATION

A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications equipment and service suppliers.

## PART 2 - PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.
- B. Telecommunications Pathways and Spaces: Comply with TIA-569-D.
- C. Grounding: Comply with TIA-607-B.

- 2.2 9/125 MICROMETER, SINGLE-MODE, INDOOR-OUTDOOR OPTICAL FIBER CABLE (OS2)
  - A. Description: Single mode, 9/125-micrometer, tight buffered, nonconductive optical fiber cable.
  - B. Maximum Attenuation: 0.5 dB/km at 1310 nm; 0.5 dB/km at 1550 nm.
  - C. Jacket:
    - 1. Jacket Color: Yellow stripe along entire length of cable and shall be marked "Collier County BCC IT" at three-foot intervals.
    - 2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-D.
    - 3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches.
  - D. Standards:
    - 1. Comply with TIA-492CAAB for detailed specifications.
    - 2. Comply with TIA-568-C.3 for performance specifications.
    - 3. Comply with ICEA S-104-696 for mechanical properties.
  - E. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
    - 1. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
    - 2. Plenum Rated, Nonconductive: Type OFNP in listed plenum communications raceway.
    - 3. Plenum Rated, Nonconductive: Type OFNP or Type OFNR in metallic conduit.
    - 4. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262; Type OFNP in listed plenum communications raceway; or Type OFN, Type OFNG, Type OFNP, or Type OFNR in metallic conduit.
    - 5. Plenum Rated, Conductive: Type OFCP, complying with NFPA 262.
    - 6. Plenum Rated, Conductive: Type OFCP or Type OFNP in listed plenum communications raceway.
    - 7. Plenum Rated, Conductive: Type OFCP, Type OFNP, Type OFCR, or Type OFNR in metallic conduit installed per NFPA 70, Article 300.22, "Wiring in Ducts, Plenums, and Other Air-Handling Spaces."

## 2.3 OPTICAL FIBER CABLE HARDWARE

- A. Standards:
  - 1. Comply with Fiber Optic Connector Intermateability Standard (FOCIS) specifications of the TIA-604 series.
  - 2. Comply with TIA-568-C.3.
- B. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.
  - 1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.

- C. Patch Cords: Factory-made, single-fiber cables in 36-inch lengths.
- D. Connector Type: Type SC complying with TIA-604-10-B connectors.
- E. Plugs and Plug Assemblies:
  - 1. Male: Color-coded modular telecommunications connector designed for termination of a single optical fiber cable.
  - 2. Insertion loss not more than 0.25 dB.
  - 3. Marked to indicate transmission performance.
- F. Jacks and Jack Assemblies:
  - 1. Female; quick-connect, simplex and duplex; fixed telecommunications connector designed for termination of a single optical fiber cable.
  - 2. Insertion loss not more than 0.25 dB.
  - 3. Marked to indicate transmission performance.
  - 4. Designed to snap-in to a patch panel or faceplate.
- G. Faceplate:
  - 1. Two-port, vertical single-gang faceplates designed to mount to single-gang wall boxes.
  - 2. Eight-port, vertical double-gang faceplates designed to mount to double-gang wall boxes.
  - 3. Plastic Faceplate: High-impact plastic.
  - 4. Metal Faceplate: Stainless steel.
  - 5. For use with snap-in jacks accommodating any combination of twisted pair, optical fiber, and coaxial work area cords.
    - a. Flush mounting jacks, positioning the cord at a 45-degree angle.

#### 2.4 IDENTIFICATION PRODUCTS

A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

#### 2.5 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test multimode optical fiber cables according to TIA-526-14-B and TIA-568-C.3.
- C. Factory test preterminated optical fiber cable assemblies according to TIA-526-14-B and TIA-568-C.3.
- D. Cable will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

# PART 3 - EXECUTION

## 3.1 WIRING METHODS

- A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces, in attics, and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.
  - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

# 3.2 INSTALLATION OF OPTICAL FIBER BACKBONE CABLES

- A. Comply with NECA 1, NECA 301 and NECA/BICSI 568.
- B. General Requirements for Optical Fiber Cabling Installation:
  - 1. Comply with TIA-568-C.1 and TIA-568-C.3.
  - 2. Comply with BICSI ITSIMM, Ch. 6, "Cable Termination Practices."
  - 3. Terminate all cables; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
  - 4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
  - 5. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
  - 6. Bundle, lace, and train cable to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified by the manufacturer. Use lacing bars and distribution spools.
  - 7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
  - 8. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
  - 9. In the communications equipment room, provide a 10-foot- long service loop on each end of cable.
  - 10. Pulling Cable: Comply with manufacturer recommendations. Monitor cable pull tensions.
  - 11. Cable may be terminated on connecting hardware that is rack or cabinet mounted.

### C. Open-Cable Installation:

- 1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
- 2. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
- D. Installation of Cable Routed Exposed under Raised Floors:
  - 1. Install plenum-rated cable only.
  - 2. Install cabling after the flooring system has been installed in raised floor areas.
  - 3. Coil cable 6 feet long not less than 12 inches in diameter below each feed point.
- E. Group connecting hardware for cables into separate logical fields.

### 3.3 FIRESTOPPING

- A. Comply with TIA-569-D, Annex A, "Firestopping."
- B. Comply with BICSI ITSIMM, "Firestopping" Chapter.

### 3.4 GROUNDING

- A. Install grounding according to BICSI ITSIMM, "Grounding (Earthing), Bonding, and Electrical Protection" Chapter.
- B. Comply with TIA-607-B and NECA/BICSI-607.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

#### 3.5 IDENTIFICATION

- A. Paint and label colors for equipment identification shall comply with TIA-606-B for Class 2 level of administration including optional identification requirements of this standard.
- B. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- C. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, terminal

hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.

- D. Cable and Wire Identification:
  - 1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
  - 2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
  - 3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.
  - 4. Label each unit and field within distribution racks and frames.
  - 5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
- E. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA 606-B, for the following:
  - 1. Flexible vinyl or polyester that flexes as cables are bent.

## 3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Tests and Inspections:
  - 1. Visually inspect optical fiber jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments and inspect cabling connections for compliance with TIA-568-C.1.
  - 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
  - 3. Optical Fiber Cable Tests:
    - a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
    - b. Link End-to-End Attenuation Tests:

- 1) Horizontal and Multimode Horizontal Link Measurements: Test at 850 or 1300 nm in one direction according to TIA-526-14-B, Method B, One Reference Jumper.
- 2) Attenuation test results for horizontal links shall be less than 2.0 dB. Attenuation test results shall be less than those calculated according to equation in TIA-568-C.1.
- E. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.
- F. Remove and replace cabling where test results indicate that it does not comply with specified requirements.
- G. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- H. Prepare test and inspection reports.

END OF SECTION 271523

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# SECTION 400506 - COUPLINGS, ADAPTERS, AND SPECIALS FOR PROCESS PIPING

# PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. Section Includes:
  - 1. Pipe penetrations.
  - 2. Restrained joints.
  - 3. Flexible connections.
  - 4. Expansion joints.
  - 5. Expansion loops.
  - 6. Sleeve-type couplings.
- B. Related Requirements:
  - 1. Section 400507 "Hangers and Supports for Process Piping for hangers, anchors, sleeves, and sealing of piping to adjacent structures.
  - 2. Section 400523 "Stainless Steel Process Pipe and Tubing" for stainless steel piping materials and appurtenances.
  - 3. Section 400551 "Common Requirements for Process Valves" for common product requirements for valves for placement by this Section.

## 1.3 DEFINITIONS

- A. FM: Factory Mutual Insurance Company; FM Global is the communicative name of the company.
- B. WH: Warnock Hersey; indicates compliance to relevant building codes, association criteria, and product safety and performance standards.

# 1.4 COORDINATION

A. Coordinate Work of this Section with installation of piping, valves and equipment connections specified in other Sections and indicated on Drawings.

### 1.5 ACTION SUBMITTALS

- A. Product Data:
  - 1. Submit manufacturer catalog information for each specified product, including installation instructions.
  - 2. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-toface length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
  - 3. Expansion Joints: Indicate maximum temperature, pressure rating, and expansion compensation.
- B. Shop Drawings:
  - 1. Identification:
    - a. Submit list of wording, symbols, letter size, and color coding for pipe identification.
    - b. Comply with ASME A13.1.
  - 2. Indicate restrained joint details and materials.
  - 3. Submit layout drawings showing piece numbers and location, indicating restrained joint locations.
  - 4. Indicate layout of piping systems, including flexible connectors, expansion joints and compensators, loops, offsets, and swing joints.

## 1.6 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- B. Welder Certificates: Certify welders and welding procedures employed on Work, verifying AWS or ASME qualification within previous 12 months.
- C. Manufacturer Instructions: Submit special procedures and setting dimensions.
- D. Source Quality-Control Submittals: Indicate results of factory tests and inspections.
- E. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- F. Qualifications Statements:
  - 1. Submit qualifications for manufacturer, installer, and licensed professional.
  - 2. Submit manufacturer's approval of installer.
  - 3. Welders: Qualify procedures and personnel according to ASME BPVC-IX or AWS D1.1/D1.1M.

# 1.7 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of piping appurtenances.

B. Identify and describe unexpected variations to pipe routing or discovery of uncharted utilities.

## 1.8 QUALITY ASSURANCE

- A. Materials in Contact with Potable Water: Certified to NSF Standards 61 and 372.
- B. Perform Work according to ASME B31.9 for installation of piping systems and according to ASME BPVC-IX or AWS D1.1/D1.1M for welding materials and procedures.
- C. Perform Work according to ASME B31.3 for installation of piping systems.

### 1.9 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' documented experience.
- B. Installer: Company specializing in performing Work of this Section with minimum five years' documented experience.
- C. Welders: AWS or ASME qualified within previous 12 months for employed weld types.

### 1.10 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- B. Store materials according to manufacturer instructions.
- C. Protection:
  - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
  - 2. Furnish temporary end caps and closures on piping and fittings and maintain in place until installation.
  - 3. Provide additional protection according to manufacturer instructions.

### 1.11 EXISTING CONDITIONS

- A. Field Measurements:
  - 1. Verify field measurements prior to fabrication.
  - 2. Indicate field measurements on Shop Drawings.

# 1.12 WARRANTY

A. Furnish two-year manufacturer's warranty for products specified within this section.

## PART 2 - PRODUCTS

### 2.1 DISASSEMBLY JOINTS

- A. Manufacturers:
  - 1. Victaulic Style 489 rigid coupling.
  - 2. Or approved equal.
- B. Description:
  - 1. Housing: Type 316 stainless steel, conforming to ASTM A351, A743 and A744, Grade CF8M.
  - 2. Gaskets:
    - a. Material: Grade "E" EPDM, Compatible with service conditions.
    - b. ANSI/NSF 61 compliant.
  - 3. Hardware: Stainless steel oval neck track bolts meeting mechanical property requirements of ASTM F593, Group 2 (Type 316 stainless steel), condition CW. Stainless steel heavy nuts meeting mechanical property requirements of ASTM F594, Group 2 (Type 316 stainless steel), condition CW, with galling reducing coating.
  - 4. Connecting piping: Type 316 stainless steel with ends formed with Victaulic OGS groove profile or equal.

## 2.2 FINISHES

A. Prepare piping appurtenances for field finishes.

## 2.3 SOURCE QUALITY CONTROL

- A. Provide shop inspection and testing of completed assemblies.
- B. Certificate of Compliance:
  - 1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.
  - 2. Specified shop tests are not required for Work performed by approved manufacturer.

## PART 3 - EXECUTION

## 3.1 EXAMINATION

A. Verify that field dimensions are as indicated on Shop Drawings.

- B. Inspect existing flanges for nonstandard bolthole configurations or design and verify that new pipe and flanges mate properly.
- C. Verify that pipe grooved ends conforms to coupling manufacturer's requirements.

## 3.2 PREPARATION

- A. Cleaning: Thoroughly clean end connections before installation.
- B. Close pipe and equipment openings with caps or plugs during installation.
- C. Surface Preparation: Clean surfaces to remove foreign substances.

## 3.3 INSTALLATION

- A. According to ASME B31.3.
- B. Coating: Finish piping appurtenances as specified for service conditions.
- C. Disinfection: Disinfect raw and potable water piping as specified.

# 3.4 FIELD QUALITY CONTROL

- A. After installation, inspect for proper supports and interferences.
- B. Repair damaged coatings with material equal to original coating.

## 3.5 CLEANING

A. Keep equipment interior clean as installation progresses.

END OF SECTION 400506

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# SECTION 400507 - HANGERS AND SUPPORTS FOR PROCESS PIPING

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. Section includes:
  - 1. Hangers and supports for piping.
  - 2. Delegated Design.
- B. Related Requirements:
  - 1. Section 400506 "Couplings, Adapters, and Specials for Process Piping".
  - 2. Section 400523 "Stainless Steel Process Pipe and Tubing".

### 1.3 DEFINITIONS

- A. Ferrous Metal: Iron, steel, stainless steel, and alloys with iron as principal component.
- B. Wetted or submerged: Submerged, less than 1-foot above liquid surface, below top of channel or tank wall, under cover or slab of channel or tank, or in other damp locations.
- C. "Pipe" or "Piping": Piping, piping system(s), hose, tube, fittings, joints, valves, and similar appurtenances.
- D. Supports: Wherever the word "supports" or "pipe supports" are used, pipe supports, hangers, structural connections, concrete inserts (if allowed), anchors, guides, bolts, expansion units, restraints and all restraint, hanging, supporting, allowing controlled expansion, or other means of attaching piping along with the necessary appurtenances.

## 1.4 ACTION SUBMITTALS

- A. Product Data: Submit manufacturer's catalog data including load capacity.
- B. Shop Drawings: Submit scaled piping layouts for each system. Indicate flow stream, pipe size(s) material(s), schedule(s), lining(s), critical dimensions between pipes, equipment and building features. Indicate by schedule pipe hanger/support type and locations. Provide detail of each type of hangers, supports, anchors, and guides.

### 1.5 DELEGATED DESIGN SUBMITTALS

- A. Delegated Design Submittal: For hangers and supports for piping.
  - 1. Where the Drawings show support types and/or locations, analyze them for adequacy to support loads and stresses, modify if required, install generally where shown, and integrate with the pipe support system design.
  - 2. Engage the services of an independent registered professional engineer licensed in the State of Florida ordinarily engaged in the business of pipe support systems analysis and design, to analyze system piping and service conditions, and to develop a detailed support system design, specific to the piping material, pipe joints, valves, and piping appurtenances proposed for use.
    - a. Support system engineering groups include the following:
      - 1) SAC Incorporated https://www.sacincorporated.com/contact-us/
      - 2) Fenny Engineering http://www.fennyengineering.com/contact/
      - 3) Piping Solutions and Energy Associates <u>https://www.pseassoc.com/request-for-service/</u>
      - 4) Newman Associates https://newmanassoc.com/
  - 3. The support system design shall include:
    - a. Criteria by piping system.
    - b. Summary of Contractor-selected related components including joints, class, valves, appurtenances, etc., and commercial supports and especially including pipe materials.
    - c. Dead weight and dynamic analysis, including system thermal effects and pressure thrusts. Computer-based software system equivalent to Bentley Systems AutoPIPE or SST Systems CAEPIPE.
      - 1) Present each system in an isometric graphic and show the resolved and resultant force and moment systems, as well as all recommended hangers, supports, anchors, restraints, and expansion/flexible joints.
    - d. Submit support system design to the Engineer for review. The submittal needs to be stamped by a professional engineer registered in State of Florida.
    - e. All aspects of the analysis and design to comply with the provisions of ANSI B31.1 and the referenced standards.
  - 4. Coordinate support arrangements to eliminate interference with similar systems to be installed under Electrical, to account for structural expansion joints and to maintain access for both personnel and for the removal of equipment.
- B. Manufacturers' Instructions: Submit special procedures and assembly of components.
- C. Qualifications Statement: Submit qualifications for licensed professional.

#### 1.6 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- B. Welders' Certificate: Submit welders' certification of compliance with ASME Section IX or AWS D1.1, verifying qualification within previous 12 months.
- C. Qualifications Statements:
  - 1. Submit qualifications for manufacturer, fabricator, installer, and licensed professional.
  - 2. Submit manufacturer's approval of installer.

### 1.7 DELIVERY, STORAGE AND HANDLING

- A. All supports and hangers shall be crated, delivered and uncrated so as to protect against any damage.
- B. All parts shall be properly protected so that no damage or deterioration shall occur during a prolonged delay from the time of shipment until installation is completed.
- C. Finished metal surfaces not galvanized, that are not of stainless-steel construction, or that are not coated, shall be grease coated, to prevent rust and corrosion.

### 1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this Section with minimum three years' documented experience.
- B. Fabricator: Company specializing in fabricating products specified in this Section with minimum three years' documented experience.
- C. Installer: Company specializing in performing Work of this Section with minimum three years' documented experience and approved by manufacturer.
- D. Licensed Professional: Professional engineer experienced in design of specified Work and licensed in State of Florida.
  - 1. Have at least 5 years of experience in the analysis and design of similar systems, including the use of commercial and custom pipe supports and in the use of commercial pipe stress software programs.

#### 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept materials on-Site in original factory packaging, labeled with manufacturer's identification.
- B. Protect products from weather and construction traffic, dirt, water, chemical, and damage by storing in original packaging.

### 1.10 EXISTING CONDITIONS

A. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

### 1.11 WARRANTY

A. Furnish two-year manufacturer's warranty for pipe hangers and supports.

## PART 2 - PRODUCTS

## 2.1 GENERAL

- A. Support pipe and appurtenances connected to equipment to prevent any strain being imposed on the equipment. Comply with manufacturer's requirements regarding piping loads being or not being transmitted to their equipment. Submit certification stating that such requirements have been met.
- B. Support and secure all pipe and tubing in the intended position and alignment to prevent significant stresses in the pipe or tubing material, valves, fittings, and other pipe appurtenances. Design all supports to adequately secure the pipe against excessive dislocation due to thermal expansion and contraction, internal flow forces, and all probable external forces such as equipment, pipe, and personnel contact. Any structural steel members required to brace any piping from excessive dislocation and shall be furnished and installed under this Section.
- C. Contractor may propose minor adjustments to the piping arrangements in order to simplify the supports, or in order to resolve minor conflicts in the work. Such an adjustment might involve minor change to a pipe centerline elevation so that a single trapeze support may be used.
- D. Where flexible sleeve, split ring, vibration, or other couplings are required at equipment, tanks, etc., the end opposite to the piece of equipment, tank, etc., shall be rigidly supported to prevent transfer of force systems to the equipment. Do not install fixed or restraining supports between a flexible coupling and the piece of equipment.
- E. Pipe Supports:
  - 1. Shall not induce point loadings but shall distribute pipe loads evenly along the pipe circumference.
  - 2. Provide supports at changes in direction and elsewhere as shown in the Drawings or as specified herein.
  - 3. No piping shall be supported from other piping or from metal stairs, ladders, and walkways, unless specifically directed or authorized by the Engineer.
  - 4. Provide pipe supports to minimize lateral forces through valves, both sides of flexible split ring type couplings and sleeve type couplings, and to minimize all pipe forces on pump housings. Pump housings shall not be utilized to support connecting pipes.
  - 5. Effects of thermal expansion and contraction of the pipe to be accounted for in the pipe support selection and installation.

- F. Insofar as is possible, floor supports shall be given preference. Where specifically indicated, concrete supports, as shown on the Drawings, may be used. Base elbow and base tees shall be supported on concrete pedestals.
- G. Restraints, flexible connections, expansion items, and related items as included in other specifications (especially Section 400506 "Couplings, Adapters, and Specials for Process Piping" and other individual pipe sections) and shown on the Drawings.

# 2.2 PERFORMANCE REQUIREMENTS/DESIGN CRITERIA

- A. Delegated Design: Engage a qualified professional engineer to design hangers and supports for piping.
- B. All supports and appurtenances shall be standard products from approved manufacturers wherever possible and shall be adequate to maintain the supported load in proper position under all operating conditions. Any reference to a specific figure number of a specific manufacturer is for the purpose of establishing a type and quality of product and shall not be considered as proprietary. Note that different materials required, as specified in Part 2 MATERIALS, may require different figures or model numbers than those shown.
  - 1. The minimum working factor of safety for all items, with the exception of springs, shall be five times the ultimate tensile strength of the material, assuming 10 feet of water-filled pipe being supported and normal test pressures.
  - 2. Design for all loads using a safety factor of 5.
- C. Piping schedule is included in the contract drawings.
- D. All items shall be designed with strength and stiffness to support, restrain, and allow expansion of the respective pipes under the maximum combination of peak loading conditions to include pipe weight, liquid weight, liquid movement and pressure forces, thermal expansion and contraction, vibrations, and all probable externally applied forces.
- E. Support spacing shall be per ASME B31.1.
- F. Complete design details of the pipe system components shall be submitted for review and approval as specified in Part 1. No support shall be installed without approved support system Drawings.
- G. The pipe support system shall not impose loads on the supporting structures in excess of the loads for which the supporting structure is designed.
- H. Seismic Design and restraint requirements, in accordance with the Structural Design criteria.

# 2.3 MATERIALS

- A. Metallic Pipe Support:
  - 1. Submerged, buried, or within outdoor structures (vaults, etc.): Type 316 stainless steel (SS).

- 2. Within chemical areas: Vinyl ester fiberglass reinforced plastic (FRP) for pipe size up to 2 inch, epoxy coated steel for 2-1/2 inches size and larger.
- 3. Other locations: steel with galvanizing where noted.
- 4. Additional requirements (including dielectric insulation) in ACCESSORIES Article.
- B. Non-Metallic Pipe Support:
  - 1. Submerged, buried, or within vaults: Type 316 stainless steel or FRP.
  - 2. Within chemical areas: vinyl ester FRP.
  - 3. Other locations: steel with galvanizing where noted; all with local stress protection shields.
  - 4. Additional requirements (including stress protection shields) in ACCESSORIES Article.
- C. Wherever stainless steel is noted, it shall be Type 316 unless noted otherwise.

# 2.4 SUPPORT AND RESTRAINT SYSTEMS

- A. Steel or Ductile Iron Piping:
  - 1. Cast iron and ductile iron, steel, and stainless steel piping shall be supported at a maximum support spacing of 10 feet with a minimum of one support per pipe section at the joints.
  - 2. Support spacing for ductile iron, steel, and stainless steel piping 2-inch and smaller diameter shall not exceed 5 feet.
- B. Copper Piping:
  - 1. Supports for copper pipe shall be copper plated or shall have a 1/16 inch plastic coating.
  - 2. Support spacing for copper piping and tubing 2 inch and smaller diameter shall not exceed 5 feet and greater than 2 inch diameter shall not exceed 8 feet.
  - 3. Where pipe supports come in contact with copper piping, provide protection from galvanic corrosion by: wrapping pipe with 1/16 inch thick neoprene sheet material and galvanized protection shield; isolators similar to Cooper B-Line B3195CT; or copper-plated or PVC-coated hangers and supports.
- C. Non-Metallic Piping:
  - 1. All uninsulated non-metallic piping such as PVC, CPVC, HDPE, PVDF, etc., shall be protected from local stress concentrations at each support point. Protection shall be provided by non-metallic protection shields or other method as approved by the Engineer.
    - a. Where pipes are bottom supported 180 degrees, arc shields shall be furnished. Where 360-degree arc support is required, such as U-bolts, protection shields shall be provided for the entire pipe circumference. All U-bolts or clamps for nonmetallic pipes shall be plastic coated.
    - b. Protection shields shall have an 18-gauge minimum thickness, not be less than 12 inches in length and be securely fastened to pipe with Type 316 stainless steel straps not less than 1/2 inch wide.

- 2. Individually supported PVC pipes shall be supported as recommended by the pipe manufacturer except that support-spacing shall be manufacturers recommendation minus 2-feet down to 5 feet spacing recommendation, then spacing shall be 3 feet.
- 3. Supports for horizontal multiple PVC plastic piping:
  - a. Shall be continuous wherever possible.
  - b. Multiple, suspended, horizontal plastic PVC pipe runs, where possible, shall be supported by ladder type cable trays such as: Husky Ladder Flange Out by MPHusky; or equal.
  - c. Rung spacing shall be 12 inches. Tray width shall be approximately 6 inch for single runs and 12 inchesfor double runs.
  - d. Ladder type cable trays shall be furnished complete with all hanger rods, rod couplings, concrete inserts, hanger clips, etc., required for a complete support system. Individual plastic pipes shall be secured to the rungs of the cable tray by strap clamps or fasteners similar to: Globe, Series 600; Unistrut Pipe/Conduit Clamps and Hangers; or equal.
  - e. Spacing between clamps shall not exceed 9 feet. The cable trays shall provide continuous support along the length of the pipe. Individual clamps, hangers, and supports in contact with plastic PVC pipe shall provide firm support but not so firm as to prevent longitudinal movement due to thermal expansion and contraction.
- D. Framing Support System:
  - 1. See Part 2 MATERIALS for materials of construction.
  - 2. Beams: Size such that beam stress does not exceed 25,000 psi and maximum deflection does not exceed 1/240 of span.
  - 3. Column Members: Size in accordance with manufacturer's recommended method.
  - 4. Support Loads: Calculate using weight of pipes filled with water.
  - 5. Maximum Spans:
    - a. Steel and ductile iron pipe 3 inch diameter and larger: 10 foot centers, unless otherwise shown.
    - b. Other pipelines and special situations: Same as noted in previous paragraphs. Supplementary hangers and supports may be required.
- E. All vertical pipes shall be supported at each floor or at intervals of not more than 12 feet by approved pipe collars, clamps, brackets, or wall rests and at all points necessary to ensure rigid construction. All vertical pipes passing through pipe sleeves shall be secured using a pipe collar.

## 2.5 ANCHOR BOLTS/SYSTEMS

A. Anchoring Devices: Design, size, and space support anchoring devices, including anchor bolts, inserts, and other devices used to anchor support, to withstand shear, and pullout loads imposed by loading and spacing on each particular support. DO NOTE USE ADHESIVE ANCHOR BOLTS ON ANY PIPE SUPPORT HUNG FROM A ROOF OR CEILING, unless specifically noted otherwise.

- B. All post-installed anchors in concrete shall have current published ICC-ES Evaluation Report indicating the anchor is approved for installation in cracked concrete.
- C. The latest edition of the following specification and recommended practices shall become part of this specification as if written herein. Wherever requirements conflict, the more stringent shall govern.
  - 1. ACI 318, Appendix D.
  - 2. ACI 355.2, Mechanical Anchors "Qualification of Post-Installed Mechanical Anchors in Concrete".
  - 3. Anchor manufacturer's published installation requirements.
- D. Expansion Anchors:
  - 1. The length of expansion bolts shall be sufficient to place the wedge portion of the bolt a minimum of 1 inch behind the steel reinforcement.
  - 2. Manufacturers:
    - a. Power-Stud+ SD4 and Power-Stud+ SD6 by Powers Fasteners, Brewster, NY.
    - b. Kwik Bolt as manufactured by Hilti USA, Tulsa, Oklahoma.
    - c. Wej-it by Wej-it Expansion Products, Inc., Broomfield, Colorado.
- E. Unless otherwise noted: use Type 304 stainless steel anchoring parts/bolts and hardware for non-submerged supports, Type 316 stainless steel for submerged anchors.
- F. Size of anchor bolts as designed by manufacturer, 1/2 inch minimum diameter, or as shown on the Drawings.
- G. Anchors to concrete in chemical areas shall be epoxy secured vinyl ester FRP all thread, insertion depth and size as required by the manufacturer for the design loads. Nuts, bolts and hardware shall all be vinyl ester FRP construction.

## 2.6

## 2.6 SINGLE PIPE SUPPORTS FROM BELOW

- A. Single pipes located in a horizontal plane close to the floor shall be Pedestal type: Schedule 40 pipe stanchion, saddle, and anchoring flange.
  - 1. Nonadjustable Saddle: MSS SP 58, Type 37 with U-Bolt.
    - a. Anvil, Figure 259.
    - b. Cooper B-Line, Figure B3090.
  - 2. Adjustable Saddle: MSS SP 58, Type 38 without clamp.
    - a. Anvil, Figure 264.
    - b. Cooper B-Line, Figure B3093.

- B. Pipes less than 3 inch in diameter:
  - 1. Hold in position by supports fabricated from steel C channel, welded post base similar to Unistrut, Figure P2072A, where use of steel is allowed; and pipe clamps similar to Unistrut, Figures P1109 through 26.
  - 2. Where required to assure adequate support, fabricate supports using two vertical members and post bases connected by horizontal member of sufficient load capacity to support pipe.
  - 3. Fasten supports to nearby walls or other structural member to provide horizontal rigidity.
  - 4. More than one pipe may be supported from a common fabricated support.
- C. Pipes 3 inch in diameter and larger:
  - 1. Support by adjustable stanchions.
  - 2. Provide at least 4 inch adjustment.
  - 3. Flange mount to floor.
- D. Use yoked saddles for piping whose centerline elevation is 18 inches or greater above the floor and for all exterior installations.
- E. Pipe roller type supports shall be used where required to accommodate thermal movement in conjunction with axial supports.

#### 2.7 BASE ANCHOR SUPPORT

- A. Bend Support: Where pipes change direction from horizontal to vertical via a bend, install a welded or cast base bend support to carry the load. Fasten to the floor, pipe stanchion, or concrete pedestal using expansion anchors or other method as approved by the Engineer.
- B. Concrete Supports: Where indicated, securely fasten pipe bends to concrete supports with suitable metal bands as required and approved by the Engineer. Isolate piping from poured concrete with a neoprene insert.

### 2.8 SHOP FACTORY FINISHING

A. Prepare and prime metallic (except stainless steel) supports.

#### 2.9 ACCESSORIES

- A. Insulation Shield: Install on insulated non-steel piping. Oversize the rollers and supports, as required. Manufacturers:
  - 1. Anvil, Figure 167.
  - 2. Cooper B-Line, Series B3151.
- B. Welding Insulation Saddle: Install on insulated metal pipe. Oversize the rollers and supports, as required. Manufacturers:

- 1. Anvil, Figure 160.
- 2. Cooper B-Line, Series B3160.
- C. Vibration Isolation Pad: Install under base flange of pedestal type pipe supports adjacent to equipment, and where required to isolate vibration.
  - 1. Isolation pads to be neoprene, waffle type.
  - 2. Manufacturers:
    - a. Mason Industries, Type W.
    - b. Korfund.
- D. Dielectric Barrier:
  - 1. Install between carbon steel members and copper or stainless steel pipe.
  - 2. Install between stainless steel supports and non-stainless steel ferrous metal piping.
  - 3. All stainless steel piping shall be isolated from all ferrous materials, including galvanized steel by use of neoprene sheet material and protection shields.
- E. Electrical Isolation: Install 1/4 by 3 inch neoprene rubber wrap between submerged metal pipe and oversized clamps.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. Verify field dimensions as indicated on Shop Drawings.

## 3.2 INSTALLATION

- A. Obtain permission from Engineer before using powder-actuated anchors.
- B. Obtain permission from Engineer before drilling or cutting structural members.
- C. Inserts:
  - 1. Install inserts for placement in concrete forms. Before setting inserts, all drawings and figures shall be checked that have a direct bearing on the pipe location. Responsibility for the proper location of pipe supports is included under this Section.
  - 2. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 in and larger.
  - 3. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
  - 4. Where inserts are omitted, drill through concrete slab from below and provide throughbolt with recessed square steel plate and nut above slab.
- D. Pipe Hangers and Supports:
  - 1. Install according to: ASME B31.1.
  - 2. Support horizontal piping as indicated on Shop Drawings, depending upon pipe size.
- 3. Support horizontal cast iron pipe adjacent to each hub, with 5 foot maximum spacing between hangers.
- 4. Support riser piping independently of connected horizontal piping.
- 5. Support piping independently so that equipment is not stressed by piping weight or expansion in piping system.
- 6. Support large or heavy valves, fittings, and appurtenances independently of connected piping.
- 7. Proceed with installation of piping and supports only after any building structural work has been completed and new concrete has reached its 28-day compressive strength.
- 8. The installation of pipe support systems shall not interfere with the operation of any overhead bridge cranes, monorails, access hatches, etc. No piping shall be supported from stairs, other pipes, ladders, and walkways unless authorized by the Engineer.
- 9. Repair mounting surfaces to original condition after attachments are made.
- 10. Brace horizontal pipe movements by both longitudinal and lateral sway bracing.
- 11. Where supports are required in areas to receive chemical resistant seamless flooring, install supports prior to application of flooring system.
- E. Equipment Bases and Supports:
  - 1. Provide housekeeping pads as detailed on Drawings.
  - 2. Using templates furnished with equipment, install anchor bolts and accessories for mounting and anchoring equipment.
  - 3. Construct supports of steel pipe and fittings. Brace and fasten with flanges bolted to structure.
  - 4. Provide rigid anchors for pipes after vibration isolation components are installed.
- F. Prime Coat:
  - 1. Prime coat exposed steel hangers and supports.
  - 2. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

## 3.3 FIELD QUALITY CONTROL

- A. All pipe support systems shall be tested after installation in conjunction with the respective piping pressure tests. If any part of the pipe support system proves to be defective or inadequate, it shall be repaired, augmented or replaced to the satisfaction of the Engineer.
- B. After the work is installed, but before it is filled for start-up and testing, the Support System Design Engineer shall inspect the work and shall certify its complete adequacy. Each system shall be inspected and certified in the same way.
- C. Submit a report, including all field modifications and including all certificates.
  - 1. Insert state where project is located.
  - 2. The report shall bear the stamp of a professional engineer registered in State of Florida and shall be subject to the review of the Engineer.

## END OF SECTION 400507

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# SECTION 400523 - STAINLESS STEEL PROCESS PIPE AND TUBING

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Stainless steel pipe and fittings.
  - 2. Stainless steel tube and fittings.
  - 3. Accessories.
- B. Related Requirements:
  - 1. Section 400506 "Couplings, Adaptors, and Specials for Process Piping" for pipe penetrations, restrained joints, flexible connections, expansion joints and loops, and sleeve-type couplings.
  - 2. Section 400551 "Common Requirements for Process Valves" for common product requirements for valves for placement by this Section.
  - 3. Section 400507 "Hangers and Supports for Process Piping" for hangers, anchors, sleeves and sealing of piping to adjacent structures.

## 1.3 ACTION SUBMITTALS

- A. Product Data: Submit manufacturer information on pipe materials, tube materials, and fittings.
- B. Shop Drawings:
  - 1. Indicate piping layouts and schedules, with dimensions, fittings, expansion joints, locations of valves and appurtenances, joint details, wall penetration details, methods, types and locations of hangers and supports, and pertinent technical specifications for piping to be furnished.
  - 2. Include data and information required for complete piping systems. Base dimensions on actual equipment to be furnished. Show types and locations of pipe hangers and/or supports on layouts for each pipe submittal. Since not all dimensions will be checked by Engineer, nor will every detail be reviewed by Engineer, Contractor will be responsible for accurate dimensioning of piping systems.
- C. Cleaning Methods:
  - 1. Include pre-cleaning, descaling, chemicals to be used, or mechanical descaling method, post-weld cleaning to restore corrosion resistance and final cleaning/passivation/pickling.

- 2. Include method and schedule for drying pipe so that it is ready for service as part of proposed cleaning method.
- 3. Include name and qualifications of firm that will be doing cleaning.
- 4. Include name and qualifications of independent firm that will be doing inspection of cleaned pipe.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Welder Certificates: Submit welders' certification of compliance with ASME BPVC, Section IX or AWS D1.1/D1.1M, verifying qualification within previous 12 months.

## 1.4 INFORMATIONAL SUBMITTALS

- A. Source Quality-Control Submittals: Indicate results of shop tests and inspections.
- B. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- C. Qualifications Statements:
  - 1. Submit qualifications for manufacturer, installer, and licensed professional.
  - 2. Submit manufacturer's approval of installer.

## 1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of valves, fittings, and appurtenances, connections, and centerline elevations.
- B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

## 1.6 QUALITY ASSURANCE

- A. Furnish stainless steel pipe and fittings by a single manufacturer who is fully experienced, reputable, qualified and regularly engaged for the last 5 years in manufacture of materials to be furnished.
- B. Permanently mark each length of pipe with manufacturer's name or trademark, and compliance with standards.
- C. Materials in Contact with Raw Water: In Conformance to NSF 61 and NSF 372.
- D. Fabricator Qualifications: Factories, including mills, foundries, factories and machine shops, which hold a current ISO 9001 Certificate of Quality System Registration. Furnish documentation necessary to verify Supplier's certification and registration.
- E. Furnish work in new and unused condition. Include products and services from Suppliers having a successful record of manufacturing and servicing Work specified herein for a minimum of 10 years prior to Effective Date of Agreement.

- F. Perform and document quality control (QC) and quality assurance (QA) procedures performed during manufacturing at factory; during loading of Work for transport at factory; during transport to Site; during unloading and storage of Work at Site; and during installation and startup at Site, all part of Work specified herein.
- G. Design, manufacture, deliver and install products in accordance with requirements of specified herein. Provide new and unused products specified herein from Suppliers having a successful record of manufacturing and servicing products specified herein for a minimum of 5 years.
- H. Submit to Engineer, four copies of certified mill test reports (MTRs) for chemical analysis, mechanical properties including tensile, impact, and bend test results for materials used in manufacture of products specified herein. Verify MTRs identify products, for which material will be used, and information necessary to verify compliance with requirements specified herein.
- I. If there are difficulties in operation of systems included under this Contract due to defective Work, provide additional services to correct defective Work and meet acceptance testing requirements.
- J. Inspection by Owner or Engineer or failure to inspect does not relieve Contractor of his responsibility to provide materials and perform Work in accordance with Contract Documents.

# 1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' documented experience.
- B. Installer: Company specializing in performing Work of this Section with minimum five years' documented experience and approved by manufacturer.
- C. Welders: AWS or ASME qualified within previous 12 months for employed weld types.
- D. Welding Qualifications: Qualify procedures according to AWS D1.1/D1.1M, "Structural Welding Code – Steel."
- E. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- B. Store materials according to manufacturer instructions.
- C. Protection:
  - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.

- 2. Protect piping and appurtenances by storing off ground.
- 3. Provide additional protection according to manufacturer instructions.

#### 1.9 AMBIENT CONDITIONS

A. Minimum Conditions: Do not store or handle uninstalled lined pipes or fittings at temperatures below zero degrees F.

#### 1.10 EXISTING CONDITIONS

- A. Field Measurements:
  - 1. Verify field measurements prior to fabrication.
  - 2. Indicate field measurements on Shop Drawings.

#### 1.11 WARRANTY

- A. Manufacturer and Installer agree to repair or replace components of stainless steel process piping and tubing that fail(s) in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Two years from date of Substantial Completion.

## PART 2 - PRODUCTS

## 2.1 STAINLESS STEEL PIPE AND FITTINGS

- A. General Service Piping:
  - 1. Type:
    - a) Welded; comply with ASTM A813/A813M.
    - b) Class: SW; comply with ASTM A814/A814M.
  - 2. Schedule: 40S.
  - 3. Grade: Type 316L.
  - 4. Dimensions: Comply with ASTM A312/A312M.
- B. Seamless Stainless Steel Alloy Pipe:
  - Type: Billet-pierce and manufacture seamless (SMLS) stainless steel alloy pipe, 1/4 inch to 48 inch diameter to ASME B36.19 from the following alloys ("L" suffix stands for low alloy, suitable for welding). Furnish SMLS stainless steel pipe in one of the following alloys as designated on Drawings. Specific material designation indicated on Drawings is indicated in parentheses. P-Numbers for base metal classification in ASME BPVC Section IX are also provided below:
    - a) ASTM A312, Grade TP316L (316L) austenitic stainless steel; ASME P-8.

- 2. Provide 2D factory finish on SMLS stainless steel pipe, having a wall thickness of 0.010 inch or less.
- 3. Provide a 2E factory finish on seamless stainless steel pipe, having a wall thickness 0.010 inch to 0.25 inch when delivered to mill.
- 4. Provide a 1D factory finish on seamless stainless steel pipe, having a wall thickness greater in 0.25.
- C. Electric-Resistance-Welded Stainless Steel Alloy Pipe:
  - 1. Type: Install electric-resistance-welded (ERW) stainless steel alloy pipe, 1/4 inch to 48 inch diameter, manufactured to ASME B36.19, where scheduled and indicated on Drawings. ("L" suffix stands for low alloy, suitable for welding). Furnish ERW stainless steel pipe in one of the following alloys as designated on Drawings. specific material designation indicated on Drawings is indicated in parentheses. P-Numbers for base metal classification in ASME BPVC Section IX are also provided below.
  - 2. Provide a 2D factory finish on ERW pipe, having a wall thickness of 0.010 inch or less.
  - 3. Provide a 2E factory finish on ERW pipe, having a wall thickness 0.010 inch to 0.25 inch when delivered to mill.
  - 4. Provide a 1D factory finish on welded pipe, having a wall thickness greater than 0.25 inch or less.
  - 5. Provide cold drawn ERW pipe manufactured from the following alloys (P-Numbers for base metal classification in ASME BPVC Section IX are included in parenthesis):
    - a) ASTM A312, Grade TP316L (316L) austenitic stainless steel; ASME P-8.
- D. Fittings:
  - 1. Type:
    - a) Piping 2 inches and Smaller: Socket welding.
    - b) Piping 2-1/2 inches and Larger: Butt welding.
  - 2. Dimensions: Comply with ASTM A312/A312M.
  - 3. Threaded Fittings:
    - a) Comply with ASME B16.11 and ASTM A182/A182M.
    - b) Grade: Type 316.
    - c) Threads: Comply with ASME B1.20.1.
  - 4. Butt-Welding Fittings:
    - a) Comply with ASTM A403/A403M.
    - b) Grade: Type 316L.
    - c) Class: CR; comply with ASME B16.9.
  - 5. Socket-Welding Fittings:
    - a) Comply with ASTM A403/A403M.
    - b) Grade: Type 316L.
    - c) Class: WP-S; comply with ASME B16.11.

- 6. Flanged Fittings:
  - a) Type: Welding neck.
  - b) Class: 150.
  - c) Comply with ASTM A182/A182M.
  - d) Grade: Type 316L.
  - e) Facing and Drilling: Comply with ASME B16.5 and matching mating flange.
  - f) Backing Flanges:
    - 1) Material: Stainless steel.
    - 2) Class: 150.
    - 3) Comply with ASTM A351/A351M.
    - 4) Grade: Type 316L.
    - 5) Type: Van stone.
    - 6) Drilling: Comply with ASME B16.5.
- 7. Low-Pressure Cast Stainless Steel Threaded Fittings:
  - a) Provide castings of one of the following alloys for fittings for use with ERW stainless steel pipe, 1/4 inch to 2 1/2 inch:
    - 1) ASTM A351 Grade CF8M for pipe manufactured from ASTM A312, Grade TP316L austenitic stainless steel.
  - b) Provide low-pressure stainless steel threaded fittings meeting requirements of ASME B16.3 for dimensional, material, and pressure Class 150 in accordance with scheduled piping system pressure requirements. Provide bushings and plugs meeting requirements of ASME B16.14. Provide thread form meeting ASME B1.20.1.
- 8. Wrought Stainless Steel Butt-Welding Fittings:
  - a) Provide wrought carbon steel buttwelding fittings, 2 inch to 48 inch diameter for use with ERW and seamless carbon steel pipe where butt-welding fittings are indicated on Contract Drawings and approved Shop Drawings.
  - Provide buttwelding fittings having a minimum wall thickness corresponding to wall schedule specified for connecting Piping; meeting requirements of ASME B16.9.
  - c) Provide wrought stainless steel buttwelding fittings for pipe 1/4 inch to 60 inch diameter conforming to ASME B16.9.
  - d) Provide fittings manufactured from the following alloys in accordance with designated ASTM standard:
    - 1) ASTM A403, Grade WP316L (ASME P-8) for pipes manufactured from ASTM A312 Type 316/316L austenitic stainless steel; and ASTM A778 Type 316L extra-low carbon austenitic stainless steel.
- E. Flanged Connections: As required to connect stainless-steel piping to fittings and equipment, fittings, and valves as required.

- 1. Forged Stainless Steel Pipe Flanges:
  - a) Provide forged stainless steel flanges for pipe 1/2 inch to 60 inch diameter and larger of raised-face type in weld-neck, slip-on or stub-end configuration, as indicated on Drawings.
  - b) Provide forged flange dimensions and tolerances manufactured in accordance with ASME B16.5 and ASME B16.47.
  - c) Cut flange gaskets from sheet stock in flat ring configuration in accordance with ASME B16.21, in non-insulating and insulating materials specified below.
  - d) Construct forged flanges of the following alloys:
    - 1) ASTM A182, Grade F316L (ASME P-8) for pipes manufactured from ASTM A312 Type 316L austenitic stainless steel.
- F. Unions:
  - 1. Low-Pressure Cast Stainless Steel Threaded Unions:
    - a) Manufacture low-pressure stainless steel threaded unions for use with ERW stainless steel pipe, 1/4 inch to 2 1/2 inch diameter, to requirements of MSS SP-114 for heat treating, material thickness, dimensions and marking.
    - b) Provide low-pressure threaded unions of castings of one of the following alloys:
      - 1) ASTM A351 Grade CF8M for pipe manufactured from ASTM A312, Grade TP316L austenitic stainless steel.
    - c) Provide low-pressure stainless steel threaded unions meeting requirements of ASME B16.39 for dimensional, material, and pressure Class 150 in accordance with scheduled piping system pressure requirements; thread form meeting ASME B1.20.1.

## 2.2 STAINLESS STEEL TUBE AND FITTINGS

- A. Tube:
  - 1. Type: Seamless or Welded.
  - 2. Comply with ASTM A269/A269M.
  - 3. Grade: Type 316L.
- B. Seamless Stainless Steel Alloy Tube:
  - 1. Install seamless stainless steel alloy tube, 1/4-inch to 2 1/2-inch diameter in designated size and wall thickness as scheduled and indicated on Drawings.
  - 2. Provide seamless tube manufactured from the following alloys in accordance with designated ASTM standard:
    - a) ASTM A269, Grade S31603, (316L) austenitic stainless steel (ASME P-8), ID and OD: mechanically polished to a No. 2B finish, as a minimum.
    - b) Provide seamless annealed stainless steel alloy tube manufactured and/or distributed by:

- 1) Tioga Pipe Supply Company, Philadelphia, Pennsylvania.
- 2) Outokumpu Piping Products, Wildwood, Florida.
- 3) Rath Gibson, Janesville, Wisconsin.
- 4) Swagelok, Solon, Ohio.
- 5) Plymouth Tube, Warrenville, Illinois.
- 6) Bristol Metals (Brismet), Bristol, Tennessee.
- 7) Alaskan Copper Works, Seattle, Washington.

## C. Fittings:

- 1. Threaded:
  - a) Comply with ASTM A182 and ASME B16.11.
  - b) Grade: Type 316.
  - c) Threads: Comply with ASME B1.20.1.
- 2. Butt-Welding Fittings:
  - a) Comply with ASTM A403.
  - b) Grade: Type 316L.
  - c) Class: CR.
- 3. Socket-Welding Fittings:
  - a) Comply with ASTM A403.
  - b) Grade: Type 316L.
  - c) Class: WP-S.
- 4. Flanged Fittings:
  - a) Type: Welding neck.
  - b) Class: 150.
  - c) Comply with ASTM A182.
  - d) Grade: Type 316L.
  - e) Facing and Drilling: Comply with ASME B16.5.
  - f) Backing Flanges:
    - 1) Material: Stainless steel.
    - 2) Class: 150.
    - 3) Comply with ASTM A351/A351M.
    - 4) Grade: Type 316L.
    - 5) Type: Van stone.
    - 6) Drilling: Comply with ASME B16.5.
  - g) Bolting:
    - 1) Bolts: Comply with ASTM A193/A193M, Grade B5; hex head.
    - 2) Nuts: ASTM A194, Grade 316; hex head.

- h) Cast-Iron Mating Flange on Valves or Equipment:
  - 1) Bolts: Comply with ASTM A193/A193M, Grade 316; hex head.
  - 2) Washers: Same material as bolts.
- 5. Crimp Fittings:
  - a) Material: Cold-drawn stainless steel.
  - b) Grade: Type 316L.
- 6. Compression Fittings:
  - a) Material: Stainless steel.
  - b) Comply with ASTM A479/A479M.
  - c) Grade: Type 316.
  - d) Pressure Rating:150 psig.
- 7. Welded Stainless Steel Tube Fittings:
  - a) Only use welded stainless steel tube fittings, 3 inch to 12 inch diameter with ASTM A778 light-wall extra-low-carbon stainless steel pipe; designed and manufactured in accordance with ASTM A774; fitting dimensions in accordance with MSS SP-43.
  - b) Provide welded stainless steel tube fittings manufactured from the following alloys in accordance with designated ASTM standard:
    - 1) ASTM A774, Grade TP316L (extra low carbon (<0.03 percent) alloy for welded fabrication) for pipes manufactured from ASTM A778 Type 316L extra-low carbon light-wall austenitic stainless steel.
  - c) Provide low-pressure light-wall fittings for stainless steel pipe manufactured and/or distributed by one of the following:
    - 1) Felker Brothers, Marshfield, Wisconsin.
    - 2) Douglass Brothers, Portland, Maine.
    - 3) Swepco Tube, Clifton, New Jersey.
- 8. Compression Tube Fittings and Adapters:
  - a) Use compression fittings and adapters constructed of same material as connecting tube, 1/4-inch to 2 1/2-inch diameter, on stainless steel tube where specified and indicated on drawings.
  - b) Provide all threaded joints for medium pressure oil hydraulic tube fittings of SAE straight-thread O-ring end-seal type.
  - c) Provide compression type couplings between tubes, bends and adapters for oil hydraulics.
  - d) Provide one of the following compression fittings for stainless steel tube:
    - 1) Tube fittings and adapters manufactured by Swagelok, Solon, Ohio.
    - 2) Gyrolok fittings manufactured by Hoke, Spartanburg, South Carolina.

- 3) Tube fittings manufacture by Tube Fittings Division, Parker Hannifin Corporation, Columbus, Ohio.
- 4) Tube fittings manufactured by Brennan Industries, Solon, Ohio.
- 9. Flared 37 Degree Tube Fittings and Adapters:
  - a) Use flared 37 degree fittings and adapters 1/4-inch to 2-inch diameter on tube fittings where indicated on Drawings. Do not used on oil hydraulic systems. Provide dimensions in accordance with SAE J514 and threads in accordance with ASME B1.20.1.
  - b) Meet the following material standards:
    - 1) ASTM A182, Grade F316/F316L (ASME P-8) (L low alloy for welded fabrication) Austenitic for tubes manufactured from ASTM A269, Type 316/316L.
  - c) Provide flared fittings manufactured by one of the following:
    - 1) Parker Hannifin Corporation, Columbus, Ohio.
    - 2) Brennan Industries, Solon, Ohio.
    - 3) Swagelok, Solon, Ohio.
- 10. Flared 45 Degree Tube Fittings and Adapters:
  - a) Use f fittings and adapters 1/4-inch to 2-inch diameter where specified and indicated on Drawings. Provide dimensions in accordance with SAE J513 or SAE J512 with threads in accordance with ASME B1.20.1 and bodies forged to ASTM A182.
  - b) Meet the following material standards:
    - 1) ASTM A182, Grade F316/F316L (ASME P-8) (L low alloy for welded fabrication) Austenitic for tubes manufactured from ASTM A269, Type 316/316L.
  - c) Provide flared 45 degree fittings from one of the following manufacturers:
    - 1) Parker Hannifin Corporation, Columbus, Ohio.
    - 2) Brennan Industries, Solon, Ohio.
    - 3) Mueller Industries, Covington, Tennessee.

#### 2.3 ACCESSORIES

- A. Pipe-Thread Tape:
  - 1. Material: PTFE.
  - 2. Comply with ASTM D3308.
- B. O-Ring Seals: EPDM.

- C. Flange Gaskets:
  - 1. Comply with ASME B16.5.
  - 2. Nonmetallic Gaskets:
    - a) Material: Chloroprene rubber.
    - b) Comply with ASME B16.21.
  - 3. Type:
    - a) Flat-Face Flanges: Full face.
- D. Anti-seize Bolting Lubricants:
  - 1. Install flange bolts using a nickel anti-seize lubricant capable of achieving required bolt torque and sealing stress and permitting future disassembly with minimal manual input.
  - 2. Remove excess anti-seize compound by degreasing solvent prior to finish painting piping.
  - 3. Anti-Seize Compound:
    - a) Never-Seez Pure Nickel Special Lubricant manufactured by Bostik, Wauwatosa, Wisconsin.
    - b) Loctite Heavy Duty Anti-Seize Lubricant Manufactured by Henkel Technologies, Rocky Hill, Connecticut.
    - c) Chesterton 772 Premium Nickel Anti-Seize Compound manufactured by Chesterton Technical Products, Stoneham, Massachusetts.
  - 4. Flange Bolts: Adequately degreased of all corrosion inhibiting slush oil and excess antiseize lubricant prior to field application of prime and finish coatings.

# 2.4 SOURCE QUALITY CONTROL

A. Provide shop inspection and testing of completed assembly.

# PART 3 - EXECUTION

# 3.1 EXAMINATION

- A. Verify that field dimensions are as indicated on Shop Drawings.
- B. Inspect existing flanges for nonstandard bolt hole configurations or design, and verify that new pipe and flange mate properly.

# 3.2 PREPARATION

- A. Ream pipe and tube ends and remove burrs.
- B. Bevel plain-end pipe.

C. Thoroughly clean pipe and fittings before installation.

## 3.3 INSTALLATION

- A. Comply with ASME B31.3. Install pipe, fittings and specials true to alignment and rigidly supported. Do not exceed deflection at pipe joints recommended by *Supplier*. Support all pipe and appurtenances connected to equipment to prevent any strain on equipment and valves nozzles, and adjoining pipe flanges.
- B. Run piping straight along alignment as indicated on Shop Drawings, with minimum number of joints.
- C. Fittings:
  - 1. Clean gasket seats thoroughly, and wipe gaskets clean prior to installation.
  - 2. Install according to manufacturer instructions.
  - 3. Bolting:
    - a) Tighten bolts progressively, drawing up bolts on opposite sides until bolts are uniformly tight.
    - b) Use torque wrench to tighten bolts to manufacturer instructions.
- D. Concrete encase pipe under concrete slabs. Wrap stainless steel pipe in a protective material, such as a petrolatum tape or coat pie as needed, prior to encasement.
- E. Provide required upstream and downstream clearances from devices as indicated on Shop Drawings.
- F. Install piping with sufficient slopes for venting or drainage of liquids and condensate to low points.
- G. Provide expansion joints as specified in Section 400506 "Couplings, Adaptors, and Specials for Process Piping" to compensate for pipe expansion due to temperature differences.
- H. Disinfection: Disinfect raw water piping.
- I. Dielectric Fittings: Provide between dissimilar metals.
- J. Field Cuts: According to pipe manufacturer instructions.
- K. Field welding of stainless steel is not permitted.
- L. Provide cathodic protection for all buried ferrous piping systems as recommended by the Manufacturer.
- M. Joining preparation and finished welds: Under no circumstances may permanent backer-rings or other consumable inserts be used for field or shop welding of steel pipe. Non-consumable refractory inserts are allowed with Engineer's approval.
- N. Assemble joints between straight lengths of carbon steel pipe with full-penetration groove welds. Make full-penetration butt-welded field joints for pipe larger than 8 inch diameter using

line-up clamps. Submit alternative methods to line-up clamps proposed with welding submittals for Engineer's approval.

- O. Join socket-welded fittings, used with seamless mill grade stainless steel piping, by fillet welding as indicated on Drawings. Use socket welded fittings only on oil fluid power system piping.
- P. Prepare pipe joints by a machining process without damage to pipe exterior. Cut ends smooth and at a right angle to axis of pipe and beveled where required in accordance with approved welding procedure specifications. Deburr pipe and tube as part of preparation of all joint configurations.
- Q. Rust spots and corrosion pits on new stainless steel pipe and fittings are not allowed. Verify pipe, tube and fittings are inspected by the Engineer and Contractor upon delivery and stored in a location that will prevent entry of contaminants prior to installation.
- R. Protect pipe, tube, fittings and valves, and adhere to the following mandatory requirements, and others specified in paragraphs below:
  - 1. Protect stainless steel materials from contact with carbon steel including but not limited to hoisting and rigging equipment, steel tables, storage racks and hand tools.
  - 2. Do not bundle pipe and fittings using ferrous metal banding at factory or Supplier's facility.
  - 3. Do not allow contact between wear surfaces of tools used for carbon steel fabrication and surfaces of stainless steel pipe, tubes and fittings. These tools include abrasive grinding and cutting wheels, wheel cutters and rollers, threading taps and dies, tube bending equipment and all other bearing edge tools.
  - 4. Use manual or powered wire brush tools for surface repair and joint preparation manufactured from stainless steel. Brushes with carbon steel wire cannot be used for fabrication of stainless steel.
  - 5. Shield stainless steel pipe, tube and fittings from all on-site carbon steel pipe and structural steel cutting and blasting operations.
  - 6. Remove all exterior surface scratches; surface contamination by ferrous metal grinding kerf; contamination by paint markers and crayons etc.; and labels after installation.
- S. Verify engineer examines exterior surfaces of pipe, tube and fittings at Site for free iron contamination by ferroxyl test or other method. Clean all contaminated surfaces at Site by pickling using a lean spray-applied pickling cleaner suitable for large surfaces system. Follow pickling with passivation of entire treated surface by a neutralizing rinse. Provide one of the following spray-applied pickling solutions:
  - 1. Avesta Classic Cleaner 401<sup>®</sup>, manufactured by Avesta Finishing Chemicals, Orchard Park, New York.
  - 2. Antox® 75E Pickling Cleaner, manufactured by Chemetall US, New Providence, New Jersey.
  - 3. Kytex® Brightener 123, manufactured/distributed by Harvard Chemical Research, Atlanta, Georgia.
- T. Perform field cutting of stainless-steel pipe by mechanical wheel cutter or abrasive saw, leaving a smooth cut at right angles to axis of pipe. Use new abrasive cutting wheels for stainless steel pipe and tube designed to prevent iron, sulfur or chlorine contamination to surface under

preparation or repair, and surfaces of adjacent piping. Deburr pipe and tube as part of preparation for all joint configurations. Abrasive cutting wheels acceptable for use on stainless steel pipe and tube as follows:

- 1. Charger® cutting wheels manufactured by Norton/Saint-Gobain Abrasives, Worcester, Massachusetts.
- 2. Saitech Z-Tech® cutting wheels manufactured by United Abrasives/SAIT, Windham, Connecticut.
- 3. pecialist® cutting wheels manufactured by Flexovite, Angola, New York.
- U. Perform field grinding of stainless-steel pipe and tube, including root pass and enter-pass weld grinding using new grinding wheels. Use grinding wheels designed to prevent iron, sulfur or chlorine contamination to surface under repair or surfaces of adjacent piping. Abrasive grinding wheels acceptable for use on stainless steel pipe and tube as follows:
  - 1. Norzon Plus® grinding wheels manufactured by Norton/Saint-Gobain Abrasives, Worcester, Massachusetts.
  - 2. Saitech Pipeline® grinding wheels manufactured by United Abrasives/SAIT, Windham, Connecticut.
  - 3. Flexon® ZA24S grinding wheels manufactured by Flexovite, Angola, New York.
- V. Use wire wheels, to remove defects on pipe surface after installation, constructed of same material as pipe wall or Type 316 stainless steel for super austenitic and duplex stainless-steel piping. Verify surface finish on pipe meets specified mill-applied surface finish or better.
- W. Installation of Grooved Joint Couplings and Fittings:
  - 1. Assemble steel grooved-joint couplings on piping systems in accordance with latest version of Manual I-100 "Field Installation Handbook" published by Victaulic Company, Easton, Pennsylvania.
  - 2. Install coupling gaskets using Supplier's standard lubricant compatible with elastomer gaskets. Complete lubrication of gasket exterior, gasket sealing lips, housings, and pipe ends prior to joining to prevent gasket pinching.
  - 3. Tighten coupling nuts evenly by alternating sides until metal-to-metal contact occurs at bolt pads. For angle-bolt-pad couplings, even offsets must be present at bolt pads to obtain pipe-joint rigidity.
- X. Bolting Procedure for Flanged Joints:
  - 1. Assemble flanged pipe joints in accordance with gasket Supplier's instructions and as specified herein. Utilize calibrated bolting equipment capable of applying a measured torque to flange bolts during assembly. Submit bolting patterns, procedures and bolting equipment data to Engineer prior to pipe fitting and bolting.
  - 2. Use hydraulic cassette wrenches for assembly of flanged pipe joints requiring greater than 900 ft-lbs of assembly torque. Document each flanged joint assembly included in Work using "Flange Bolting Worksheet" at end of this Section. Do not use torque multipliers. Engineer reserves right to require documentation of any flange joint requiring less than 900 ft-lbs of bolt torque.
  - 3. Calculate clamping forces and target assembly torque for assembly of all flanged pipe joints included in Work. Verify calculations take into consideration pipe diameter, gasket Supplier's recommended assembly stress; bolt material tensile and yield stress; gasket Supplier's recommended bolt stress; pipe service, design and test pressures. Verify calculations are stamped by a professional engineer.

- 4. Visually inspect and clean flange bolts, stud-bolts, nuts and washers prior to bolting. Lubricate bolts and nuts; if hardened washers are not used, lubricate flange surface around bolt holes. Remove excess lubricant on surfaces to receive protective coatings by cleaning and degreasing solvent prior to applying a coating system.
- 5. Hand-tighten all nuts and bolts, then tighten them to 10 to 20 percent of target torque. Do not exceed 20 percent of target torque, for initial torque. Tightened bolts according to pattern recommended by gasket Supplier. Do not reuse nuts removed during disassembly of existing or newly assembled joints. Dispose of used nuts in presence of Engineer.
- 6. Perform three rounds of bolt tightening on flanges having 4 to 8 bolts following hand tightening, first to 30 percent; then 60 percent; and finally, 100 percent of target torque calculated by Contractor.
- 7. Perform four rounds of bolt tightening for flanges having 12 bolts or more, following hand tightening, first to 20 percent; then 40 percent; then 80 percent, and then 100 percent of target torque calculated by Contractor.
- 8. Measure gap between flanges following application of 100 percent of target at every other bolt to confirm uniformity. Perform a final re-tightening to 100 percent of target torque 24-hours after 100 percent tightening at end of initial bolting sequence. Verify every bolt and stud-bolt has a minimum of three full threads exposed beyond nut following final tightening.
- 9. Fill out "Flange Bolting Worksheet", located at end of this Section, for all flanged joints on project. Identify joints in accordance with designation included in approved laying schedule. Submit form to Engineer at end of each workday, after 24-hour re-tightening sequence, for filing in project records.
- Y. Installation of Stainless Steel Tube:
  - 1. Install tubing using compression fittings and adapters or by welding.
    - a) Tubing to be Used with Compression Fittings: Bright annealed and electropolished as specified above and protected from scratches and deformation during shipping, storage on site and assembly.
  - 2. Minimize use of fittings by tube bending. Perform tube bending using manual or mechanized dies designed for use with annealed stainless steel tube.
  - 3. Cut stainless steel tube to length using cutter-wheel type tube cutters. Debur cut tube ends prior to swaging or welding. For all edge tool components used for installation of stainless steel tube use only new or dedicated for use with stainless steel equipment.
- Z. Installation of Compression Tube Fittings:
  - 1. Install compression fittings for annealed stainless steel tubing in accordance with manufacturer's instructions. Remove all markings applied to tube and fittings during assembly by solvent cleaning after installation. General installation requirements below are based upon use of Swagelok tubing and serve as minimum requirement. Adhere to manufacturer's instructions during installation. Do not mix nuts and ferrules from different tube fitting manufacturers.
  - 2. Swage compression fittings 1-inch diameter and smaller manually. Hand-tighten nut, and then turn another 1 and 1/4 turns by a manual wrench to engage ferrule to tube wall. Compression ferrules for fittings larger than 1 inch diameter hydraulically swaged to tube by a hydraulic swaging tool in accordance with manufacturer's instructions. Apply manufacturer's standard lubricant to body threads and back of ferrule prior to swaging.

Verify Engineer inspects fittings after initial assembly for proper pull-up with gap inspection gauges.

- 3. Install adapter fittings in accordance with requirements below for type of connecting joint, including SAE straight thread O-ring joints, standard tapered threaded joints, SAE hydraulic flanges and welded joints.
- 4. Do not use thread sealant with SAE straight O-ring threaded joints.
- 5. Do not use standard tapered threaded joints adapters or liquid thread sealants used for oil operated hydraulic fluid lines. In addition, do not use NPTF Dryseal threads for any adapters for use with any service.
- 6. Disassemble welded adapters prior to tack welding and re-lubricate prior to hydraulic swaging after welding. Remove all adjacent O-rings and other heat sensitive materials prior to welding and/or protected with heat sinks during welding.
- 7. Avoid disassembly of compression fittings after initial assembly as much as possible. If a compression joint must be disassembled, mark nut and fitting nut flats to use as a guide for proper pull-up after reassembly.

# 3.4 TOLERANCES

A. Piping Laying Tolerance: 5/8 inch.

# 3.5 FIELD QUALITY CONTROL

- A. After installation, clean completed lines with Oakite deoxidizer or similar deoxidizer as recommended by manufacturer to remove all foreign matter, construction stains or shop markings. Rinse cleaned lines with steam or hot water. Verify all cleaning chemicals are NSF 60 approved.
- B. Inspection:
  - 1. Inspect for damage to piping or tubing that may be detrimental as determined by Engineer.
  - 2. Repair damaged piping, or provide new, undamaged pipe.
  - 3. After installation, inspect for required supports and anchoring, interferences, and damage to pipe, tube, or fittings.
- C. Pressure Testing:
  - 1. Test Pressure: Not less than 200 psig or 50 psi in excess of maximum static pressure, whichever is greater.
  - 2. Conduct hydrostatic test for minimum two hours.
  - 3. Filling:
    - a) Fill section to be tested with water slowly and expel air from piping at high points.
    - b) Install corporation cocks at high points.
    - c) Close air vents and corporation cocks after air is expelled.
    - d) Raise pressure to specified test pressure.
  - 4. Observe joints, fittings, and valves under test.

- 5. Remove and renew cracked pipe, joints, fittings, and valves showing visible leakage and retest.
- 6. Leakage:
  - a) Correct visible deficiencies and continue testing at same test pressure for additional two hours to determine leakage rate.
  - b) Maintain pressure within plus or minus 5 psi of test pressure.
  - c) Leakage is defined as quantity of water supplied to piping necessary to maintain test pressure during period of test.
  - d) Compute maximum allowable leakage by following formula:
  - e) L = SD x sqrt(P)/C:
    - 1) L = testing allowance, in gallons per hour.
    - 2) S =length of pipe tested, in feet.
    - 3) D = nominal diameter of pipe, in inches.
    - 4) P = average test pressure during hydrostatic test, in psig.
    - 5) C = 148,000.
  - f) When pipe under test contains sections of various diameters, calculate allowable leakage from sum of computed leakage for each size.
  - g) If test of pipe indicates leakage greater than allowed, locate source of leakage, make corrections, and retest until leakage is within allowable limits.
  - h) Correct visible leaks regardless of quantity of leakage.
- D. Replace pipe or fittings with mortar cracks wider than 1/16 inch.

#### 3.6 ADJUSTING

A. Adjust hardware and moving parts to function smoothly, and lubricate as recommended by manufacturer.

#### 3.7 **PROTECTION**

A. Remove and replace piping or tubing that are wet, moisture damaged, or mold damaged.

#### 3.8 CLEANING

- A. Keep pipe interior clean as installation progresses.
- B. After installation, clean pipe interior of soil, grit, and other debris.

#### END OF SECTION 400523

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# SECTION 400551 - COMMON REQUIREMENTS FOR PROCESS VALVES

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Common requirements for valves.
  - 2. Common requirements for valve actuators.
- B. Related Requirements:
  - 1. Section 400507 "Hangers and Supports for Process Piping" for product and execution requirements for valve supports specified by this Section.
  - 2. Section 400557 "Actuators for Process Valves and Gates."

## 1.3 ACTION SUBMITTALS

- A. Valve Schedule:
  - 1. Submit valve schedule populated with all Division 40 process valves specified for this project. Include all information shown on the Sample Valve Schedule included in this project.
  - 2. Approval of valve schedule submittal to precede all individual valve submittals. All subsequent individual valve submittals to include the approved valve tag number or group on the submittal cover sheet.
- B. Valve Tags:
  - 1. Materials, dimensions and thickness of tags, materials and gauge of cable and splicing hardware.
  - 2. Color palate for Owner selection.
  - 3. Full scale drawing of sample with lettering dimensions and scribe depth.
  - 4. Valve tag lettering provided with Valve Schedule above.
- C. Shop Drawings: Valve and actuator model number and size, valve parts list, materials of each part including material standard designation (ASTM or other), position indicators, limit switches, actuator mounting.
- D. Provide certified hydrostatic test data, per manufacturer's standard procedure or MSS-SP-61 for all valves.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Manufacturer Instructions: Submit installation and operation instructions for each component including valve, actuator, gearbox, and any included instrumentation.
- B. Source Quality-Control Submittals: Indicate results of integrators facility tests and manufacturers factory tests and inspections.
- C. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- D. Manufacturer Certification of Installation: Certify that equipment has been installed according to manufacturer instructions.
- E. Qualifications Statement:
  - 1. Submit qualifications for manufacturer and licensed professional.

# 1.5 QUALITY ASSURANCE

- A. Maintain clearances as indicated on Drawings and Shop Drawings.
- B. Ensure that materials of construction of wetted parts are compatible with process liquid.
- C. Mate valves to actuators at manufacturer's or integrator's facility. Fully test assembled product and certify ready for installation prior to shipment to the job site.
  - 1. Only in special cases for extremely large assemblies where installation requires disassembly, may actuators be mounted to the valves in the field.
- D. Materials in Contact with Potable Water: Certified to NSF 61 and NSF 372.
- E. Furnish affidavit of compliance with testing and manufacturing standards referred in this specification and the individual valve specifications.
- F.
- F. Obtain Manufacturer's Certification of Proper Installation for Specified valves and valve assemblies.

# 1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing valves and actuators with minimum ten years' documented experience.

# 1.7 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

- B. Deliver factory mated power actuated valves on rigid wooden skids, fully braced and strapped to prevent damage to valve, actuator or coupling system.
- C. Store materials according to manufacturer instructions.
- D. Protection:
  - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
  - 2. Protect valve ends from entry of foreign materials by providing temporary covers and plugs.
  - 3. Provide additional protection according to manufacturer instructions.

## 1.8 EXISTING CONDITIONS

- A. Field Measurements:
  - 1. Verify field measurements prior to materials ordering or any fabrication.
  - 2. Indicate field measurements on Shop Drawings.

## 1.9 WARRANTY

A. Furnish two-year manufacturer's warranty for valves and actuators.

## PART 2 - PRODUCTS

## 2.1 VALVES

- A. Description: Valves, operator, actuator, handwheel, chainwheel, extension stem, floor stand, worm and gear operator, operating nut, chain, wrench, and other accessories as required.
- B. Provide all valves of the same type by same manufacturer.
- C. Valve Ends: Compatible with adjacent piping system and as indicated on valve schedule.
- D. Operation:
  - 1. Close by turning clockwise. Coordinate with Owner prior to shipment.
  - 2. Cast directional arrow on valve or actuator with OPEN and CLOSE cast on valve in appropriate location.
- E. Valve Marking and Labeling:
  - 1. Marking: Comply with MSS SP-25.
  - 2. Labeling (valve tags):
    - a. Fiberglass reinforced plastic, ASTM D709, 70 mil thick, 2 1/2-inch diameter or 2 1/2-inch by 1 1/4-inch.

- b. Lettering 1/16-inch thick of silk screening or other permanent embedment of subsurface printed graphics, permanently sealed.
- c. Colors of lettering and backing as selected by Owner.
- d. Two, 1/4-inch clear opening Type 316 stainless steel grommets at each end, center of hole 3/8-inch from tag edge.
- e. 3/32-inch Type 316 SS cable and splice hardware.
- F. Valve Construction: As Specified in Valve Sections.
- G. Do not use Van Stone flanges with pinch valves, industrial butterfly valves; elastomer bellows style expansion joints or other piping system components having an elastomer liner (rubber seat) that is used as a gasket.

## 2.2 VALVE ACTUATORS

- A. Provide mechanical position indicators for power actuated and gearbox actuated valves.
- B. Gear and Power actuators as specified in Section 400557 "Actuators for Process Valves and Gates".

#### 2.3 FINISHES

- A. Valve Coating: Comply with AWWA C550.
- B. Factory finishes are included in individual valve sections.
- C. Exposed Valves: As specified.
- D. Stainless Body Valves: Do not coat.
- E. Do not coat flange faces of valves unless otherwise specified.

#### 2.4 SOURCE QUALITY CONTROL

A. Testing: Test valves according to manufacturer's standard testing protocol, including hydrostatic, seal, and performance testing.

## PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Verify that piping system is ready for valve installation.
- B. Fully examine valves for debris, damage and interior finish blemishes prior to installation. Do not install valves with soiled interior or any visible damage to seats, discs or interior finish.

C. Identify any piping, plant or equipment clearance issues prior to installation, bring to Engineer's attention via job meetings, submittal process or request for information process.

# 3.2 INSTALLATION

- A. Install valves, actuators, extensions, valve boxes, and accessories according to manufacturer instructions.
- B. Inspect valve interiors before line closure for the presence of debris. At the option of the Engineer, internal inspection of valve and appurtenances may be required any time that the likelihood of debris is a possibility. Clean connecting pipes prior to installation, testing, disinfection and final acceptance.
- C. Disinfect valves installed in potable water lines with approved pipeline disinfection process.
- D. Rigidly support valves to avoid stresses on piping.
- E. Coat studs, bolts and nuts with anti-seizing lubricant.
- F. Dielectric Fittings: Provide between dissimilar metals.
- G. Clean field welds of slag and splatter to provide a smooth surface.
- H. Mate, adjust and fully test gearboxes, electric, hydraulic and pneumatic actuators to valves at manufacturer's or integrator's facility.
  - 1. Only in special cases for extremely large assemblies where installation requires disassembly may actuators be mounted to the valves in the field. These circumstances require preinstallation meetings.
- I. Do not install stems vertically downward.
- J. Unless otherwise indicated on the Drawings:
  - 1. Install Gate, Globe, Ball valves with stem vertical in the 12 o'clock position.
  - 2. Install Plug valves with stem horizontal and plug opening to the top of the body unless position will not allow proper actuator access, in which case stem may be vertical in the 12 o'clock position.
  - 3. Install Butterfly valves 12 inch and smaller with stem horizontal or vertical in the 12 o'clock position.
  - 4. Install Butterfly valves 14 inch and larger with the stem horizontal unless position will not allow proper actuator access, in which case stem may be vertical in the 12 o'clock position.
  - 5. Install Control valves in horizontal pipelines with top works vertically upward.
- K. Install all brackets, extension rods, guides, the various types of operators and appurtenances as indicated. Before properly setting these items, check all drawings and figures which have a direct bearing on their location.
- L. Inspect all materials for defects in construction and materials. Clean debris and foreign material out of openings, etc. Verify valve flange covers remain in place until connected piping is in

place. Verify operability of all operating mechanisms for proper functioning. Check all nuts and bolts for tightness. Repaired or replace valves and other equipment which do not operate easily or are otherwise defective.

- M. Where installation is covered by a referenced standard, install and certify in accordance with that standard, except as herein modified. Also note additional requirements in other parts of this Section.
- N. Unless otherwise noted, provide joints for valves and appurtenances utilizing the same procedures as specified under the applicable type connecting pipe joint. Install valves and other items as recommended by the manufacturer. Verify manufacturers' torqueing requirements for all valves.
- O. Coordinate direction of flow through offset type and shaped butterfly valve discs with the mated actuator torque capacity.
- P. Rotate valve operators and indicators to display toward normal operation locations. Consult with Engineer prior to installing valves with handwheels to confirm final position of handwheel.
- Q. Vertically center floor boxes, valve boxes, extension stems, and low floor stands over the operating nut, with couplings as required.
  - 1. Adjust elevation of the box top to conform to the elevation of the finished floor surface or grade at the completion of the Contract.
  - 2. Support boxes and stem guides during concrete placement to maintain vertical alignment.
- R. Install brass male adapters on each side of valves in copper-piped system and solder adapters to pipe.
- S. Install 1-inch gate valves with cap for drains at main shutoff valves, low points of piping, bases of vertical risers, and equipment.
- T. Install valves with clearance for installation of insulation and to allow access.
- U. Provide access where valves and fittings are not accessible.
- V. Pipe Hangers and Supports: As specified in Section 400507 "Hangers and Supports for Process Piping".
- W. Comply with Division 40 Process Interconnections for piping materials applying to various system types.

# 3.3 FIELD QUALITY CONTROL

- A. Valve Field Testing:
  - 1. Test for proper alignment.
  - 2. If specified by valve Section, field test equipment to demonstrate operation without undue noise, vibration, or overheating.
  - 3. Engineer will witness field testing.
  - 4. Functional Test:

- a. Prior to system startup, inspect valves and actuators for proper alignment, quiet operation, proper connection and satisfactory performance.
- b. After installation, open and close all manual valves in the presence of the Engineer to show the valve operates smoothly from full open to full close and without leakage.
- c. Operate pressure control and pressure relief valves in the presence of the Engineer to show they perform their specified function at some time prior to placing the piping system in operation and as agreed during construction coordination meetings.
- 5. Field test pipelines in which the valves and appurtenances are to be installed. During these tests, adjust, remove or replace defective valve or appurtenance, or otherwise make acceptable to the Engineer. Test regulating valves, strainers, or other appurtenances to demonstrate conformance with the specified operational capabilities. Correct deficiencies, replace device or otherwise made acceptable to the Engineer.

END OF SECTION 400551

Sample Valve Schedule											
Valve Designation	Tag Type	Size	End Connectio n	Pressure Rating (psi)	Service Pressure (psi) /Velocity (fps)	Service Fluid	viscosity(cP )/Temp (Deg F.)	Actuator Type	Drawing Located	Remarks	
5941B-5947B	BV2	4	RF	150	80/15	EW Feed	1.3/ 50-90	E			
5941C-5947C	BFV4	6	L	150	45/5	LPOL Feed	200- 1000/50-90	Р			
5941D-5947D	GV1	8	w	50	10/5	POLS Discharge	700- 3000/50-90	HC			
5941E-5947E	BV1	4	FPT	150	10/10	Tank Drain	700- 3000/50-90	L			
User Notes		Fxpl	anation								
Valve Designation		Originates from P&ID, this is often Owner defined or may be contractor defined if 400551 requires the contractor to prepare the									
	The designation can be the tag number, however coordinate with valve tag required information with Owner							ation with Owner			
Tag Type	pe Is defined in the individual Valve Specification Sections. Engineer is encouraged to include the Tag Type on the drawing c								the Tag Type on the drawing callouts		
		For instance, there are four types of butterfly valves in 400564, BFV1, BFV2, BFV3, BFV4.									
Size		Refe	Refers to the diameter at the piping connection. Ball valves and pinch valves may have reduced ports for instance, and would re								
End Connecti	FF-fla	FF-flat faced flange, RF-raised face flange, MJ-mechanical joint, FPT-female pipe thread, MPT-male pipe thread, SW-socket weld									
SW is applicable to steel and PVC piping systems, and will be obvious due to the piping system where valve is located										em where valve is located	
Service press	ure/vel	ls rec	s required when a valve is fitted with a power actuator, it allows the valve torque to be determined								
Service Fluid		Is op	tional								
Vis/Temp		Is optional, include when extreme									
Actuator Type		H-handwheel, L-lever, AN-AWWA nut, G-gear w/handwheel, E- electric, P-pneumatic, HC- hydraulic cylinder O- other, use Rem									
Drawing Located		Is op	tional								
Remarks		Could be used to alert contractor for special testing or installation requirements, etc.									
	Could also indicate floorstand or other accessory										

# SECTION 400553 - IDENTIFICATION FOR PROCESS PIPING

# PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. Section Includes:
  - 1. Nameplates.
  - 2. Tags.
  - 3. Stencils.
  - 4. Pipe markers.
  - 5. Ceiling tacks.
  - 6. Labels.
  - 7. Lockout devices.
- B. Related Requirements:
  - 1. Section 400551 "Common Requirements for Process Valves" for basic materials and methods for valves.

# 1.3 ACTION SUBMITTALS

- A. Product Data: Submit manufacturer's catalog literature for each specified product.
- B. Shop Drawings:
  - 1. Indicate list of wording, symbols, letter size, spacing of labels, and color-coding for mechanical identification and valve chart and schedule.
  - 2. Indicate valve tag number, location, function, and valve manufacturer's name and model number.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

# 1.4 INFORMATIONAL SUBMITTALS

A. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.

- B. Qualifications Statement:
  - 1. Submit qualifications for manufacturer.

#### 1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

#### 1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Tools: Furnish special crimpers and other devices required for Owner to reinstall tags.

## 1.7 QUALITY ASSURANCE

- A. Piping Color Scheme and Lettering Size: Comply with ASME A13.1.
- B. Perform Work according to Collier County standards and preferences.
- C. Comply with recommended water treatment plant color coding from the latest version of Ten State Standards unless otherwise requested by Owner.

#### 1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

# 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- B. Store materials according to manufacturer instructions.
- C. Protection:
  - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
  - 2. Provide additional protection according to manufacturer instructions.

## PART 2 - PRODUCTS

#### 2.1 NAMEPLATES

- A. Manufacturers:
  - 1. Craftmark Pipe Markers.
  - 2. Kolbi Pipe Marker Co.
  - 3. Pipemarker.com (Brimar Industries, Inc.)
  - 4. Seton Identification Products.
- B. Description: Laminated three-layer plastic with engraved black letters on light, contrasting background color.
- 2.2 TAGS
  - A. Plastic Tags:
    - 1. Manufacturers:
      - a. Brady ID.
      - b. Craftmark Pipe Markers.
      - c. Kolbi Pipe Marker Co.
      - d. Marking Services, Inc.
      - e. R&R Identification Co.
      - f. Seton Identification Products.
    - 2. Description:
      - a. Laminated three-layer plastic with engraved black letters on light, contrasting background color.
      - b. Minimum Tag Size and Configuration: 2 inches; square.
      - c. Provide with brass hooks suitable for attaching the tag to the valve operator.
      - d. Stamp or etch tags with the valve number and information on the valve schedule coded in a system provided by the Owner.
  - B. Metal Tags:
    - 1. Manufacturers:
      - a. Brady ID.
      - b. Craftmark Pipe Markers.
      - c. Kolbi Pipe Marker Co.
      - d. Marking Services, Inc.
      - e. Pipemarker.com (Brimar Industries, Inc.).
      - f. R&R Identification Co.
      - g. Seton Identification Products.

- 2. Description:
  - a. Brass, Aluminum, or Stainless steel construction; stamped letters.
  - b. Minimum Tag Size and Configuration: 2 inches; diameter or square with finished edges.
  - c. Provide with brass hooks suitable for attaching the tag to the valve operator.
  - d. Stamp or etch tags with the valve number and information on the valve schedule coded in a system provided by the Owner.
- C. Information Tags:
  - 1. Manufacturers:
    - a. Brady ID.
    - b. Seton Identification Products.
  - 2. Description:
    - a. Clear plastic with printed text CAUTION.
    - b. Minimum Tag Size: 3-1/4 by 5-5/8 inches.
    - c. Furnish grommet and self-locking nylon ties.
  - 3. Tag Chart: Typewritten, letter-size list of applied tags and location, plastic laminated.

# 2.3 STENCILS

- A. Manufacturers:
  - 1. Kolbi Pipe Marker Co.
  - 2. Marking Services, Inc.
  - 3. Pipemarker.com (Brimar Industries, Inc.)
  - 4. R&R Identification Co.
  - 5. Seton Identification Products.
- B. Description:
  - 1. Quality: Clean-cut symbols.
  - 2. Letters:

## OUTSIDE DIAMETER OF PIPE

# SIZE OF LETTERS

3/4-inch to 1-1/4-inches 1-1/2-inches to 2-inches 2-1/2-inches to 6-inches 8-inches to 10-inches Over 10-inches 1/2-inch 3/4-inch 1-1/2-inches 2-1/2-inches 3-inches

- C. Stencil Paint:
  - 1. Description: Semigloss enamel.
  - 2. As specified.

## 2.4 PIPE MARKERS

- A. Plastic Pipe Markers:
  - 1. Manufacturers:
    - a. Brady ID.
    - b. Craftmark Pipe Markers.
    - c. Marking Services, Inc.
    - d. R&R Identification Co.
    - e. Seton Identification Products.
  - 2. Description:
    - a. Factory-fabricated, flexible, and semi-rigid plastic.
    - b. Preformed to fit around pipe or pipe covering.
    - c. Larger sizes may be of maximum sheet size, with spring fastener.
    - d. Letter sizes per Paragraph 2.3B.
    - e. Color shall be white or black depending on background color.
- B. Plastic Tape Pipe Markers:
  - 1. Manufacturers:
    - a. Brady ID.
    - b. Craftmark Pipe Markers.
    - c. Kolbi Pipe Marker Co.
    - d. Marking Services, Inc.
    - e. Pipemarker.com (Brimar Industries, Inc.)
    - f. Seton Identification Products.
  - 2. Description:
    - a. Flexible, 3.5 mil vinyl film tape with pressure-sensitive adhesive backing and printed markings.
    - b. Letter sizes per Paragraph 2.3B.
    - c. Color shall be white or black depending on background color.
- C. Plastic Underground Pipe Markers:
  - 1. Manufacturers:
    - a. Kolbi Pipe Marker Co.
    - b. Marking Services, Inc.
    - c. Pipemarker.com (Brimar Industries, Inc.)

- d. Rhino Marking and Protection System.
- e. Seton Identification Products.
- 2. Description:
  - a. Brightly colored, continuously printed plastic ribbon tape.
  - b. Minimum Size: 6 inches wide by 4 mils thick.
  - c. Manufactured for direct burial service.
  - d. Letter sizes per Paragraph 2.3B.

## 2.5 CEILING TACKS

- A. Manufacturers:
  - 1. Marking Services, Inc.
  - 2. R&R Identification Co.
  - 3. Seton Identification Products.
- B. Description:
  - 1. Material: Steel.
  - 2. Head:
    - a. Color-coded.
    - b. Diameter: 3/4 inch.

## 2.6 LABELS

- A. Manufacturers:
  - 1. Brady ID.
  - 2. Seton Identification Products.
- B. Description:
  - 1. Material: Aluminum.
  - 2. Minimum Size: 1.9 by 0.75 inches.
  - 3. Adhesive backed, with printed identification.

# 2.7 LOCKOUT DEVICES

- A. Lockout Hasps:
  - 1. Manufacturers:
    - a. Brady ID.
    - b. Master Lock Company, LLC.

- 2. Description:
  - a. Material: Anodized aluminum.
  - b. Furnish hasp with erasable label surface.
  - c. Minimum Size: 7-1/4 by 3 inches.
- B. Valve Lockout Devices:
  - 1. Manufacturers:
    - a. Brady ID.
    - b. Master Lock Company, LLC.
  - 2. Description:
    - a. Material: Nylon or Steel.
    - b. Furnish device to restrict access to valve operator and to accept lock shackle.

# PART 3 - EXECUTION

## 3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Stencil Painting: Prepare surfaces as specified.

## 3.2 INSTALLATION

- A. According to manufacturer instructions.
- B. Apply stencil painting as specified.
- C. Install identifying devices after completion of coverings and painting.
- D. Install plastic nameplates with corrosion-resistant mechanical fasteners or adhesive.
- E. Labels:
  - 1. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer.
  - 2. For unfinished covering, apply paint primer before applying labels.
  - 3. Titles:
    - a. Locate a maximum 26 feet apart.
    - b. Locate directly adjacent to pipeline breaches on each side wall.
    - c. Locate adjacent to each side of the valve regulator, flow meter, strainer, cleanout and all pieces of equipment.
    - d. Identify the contents by complete name at least once in each room or space and thereafter may be labeled by generally recognized abbreviations.

- F. Tags:
  - 1. Identify valves in main and branch piping with tags.
  - 2. Install tags using corrosion-resistant chain.
  - 3. Number tags as indicated on drawings. Submit in writing to Engineer for any valves that does not have a tag indicated on the drawings.
- G. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.
- H. Piping:
  - 1. Identify piping, concealed or exposed, with plastic pipe markers, plastic tape pipe markers, or stenciled painting.
  - 2. Use tags on piping 3/4-inch diameter and smaller.
  - 3. Identify service, flow direction, and pressure.
  - 4. Install in clear view and align with axis of piping.
  - 5. Locate identification not to exceed 20 feet on straight runs, including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.
- I. Ceiling Tacks:
  - 1. Provide ceiling tacks to locate valves above T-bar-type panel ceilings.
  - 2. Locate in corner of ceiling panel closest to equipment.

# END OF SECTION 400553
# SECTION 400557 - ACTUATORS FOR PROCESS VALVES AND GATES

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. Section Includes: Following types of actuators for linear, multi-turn, and quarter turn valves and gates:
  - 1. Manual actuators.
  - 2. Pneumatic actuators.
    - a. Rotary vane.
    - b. Rack and pinion.
    - c. Pneumatic cylinder.
    - d. Diaphragm.
  - 3. Electric motor actuators.
- B. Related Requirements:
  - 1. Section 400507 "Hangers and Supports for Process Piping" for hangers, anchors, sleeves, and sealing of piping to adjacent structures.
  - 2. Section 400551 "Common Requirements for Process Valves" for common product requirements for valves for placement by this Section.

#### 1.3 DEFINITION

A. Where the term "valve" alone is used in this Section, it applies to both valves and gates as the corresponding text context dictates.

## 1.4 COORDINATION

- A. Section 400551 "Common Requirements for Process Valves" for valve schedule requirements.
- B. Coordinate Work of this Section with installation of valves, gates, and accessories.

#### 1.5 ACTION SUBMITTALS

A. Product Data: Manufacturer information for actuator with model number and size indicated.

- B. Shop Drawings:
  - 1. Parts list, materials, sizes, position indicators, limit switches, control system, actuator mounting, wiring diagrams, and control system schematics with external interfaces on assembly drawings.
  - 2. Actuator Shop Drawings with respective valve submittal.
- C. Manufacturer's Certificate: Products meet or exceed specified requirements.

## 1.6 INFORMATIONAL SUBMITTALS

- A. Manufacturer Instructions: Special procedures and placement requirements.
- B. Source Quality-Control Submittals: Results of factory tests and inspections and provide required certifications.
- C. Field Quality-Control Submittals: Results of Contractor-furnished tests and inspections.
- D. Qualifications Statements:
  - 1. Qualifications for manufacturer and installer.
  - 2. Manufacturer's approval of installer.

## 1.7 CLOSEOUT SUBMITTALS

A. Project Record Documents: Documentation of actual locations and types of actuators.

## 1.8 QUALITY ASSURANCE

- A. Minimum NEMA Enclosure Classification:
  - 1. Non-submergence Installations: NEMA 4X.
  - 2. Submergence Installations: NEMA 6P/IP68.
- B. Single Source Requirements:
  - 1. Furnish electric motor actuators in the scope of the project by the same manufacturer. Coordinate this requirement with actuated valves and gates included in scope of vender furnished equipment.
  - 2. Furnish actuators, floor stands, stem guides, stems, extensions, and accessories for slide gate assemblies by slide gate manufacturer.
- C. Mate actuators to equipment at equipment manufacturers or integrators facility.
  - 1. Test assembled product. Certify ready for installation prior to shipment to job site.
  - 2. For extremely large assemblies requiring disassembly for installation, the actuator may be disassembled for shipment and remounted in the field.

#### 1.9 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' documented experience.
- B. Installer: Company specializing in performing Work of this Section with minimum five years' documented experience.

# 1.10 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- B. Store materials according to manufacturer instructions.
- C. Protection:
  - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
  - 2. Furnish temporary end caps and closures on piping and fittings and maintain in place until installation.
  - 3. Provide additional protection according to manufacturer instructions.

#### 1.11 EXISTING CONDITIONS

- A. Field Measurements:
  - 1. Verify field measurements prior to fabrication.
  - 2. Indicate field measurements on Shop Drawings.

#### 1.12 WARRANTY

- A. Manufacturer's Special Warranty: Submit standard written warranty against manufacturing defects for manual and electric-motor actuators.
  - 1. Warranty Period: Five years from date of Substantial Completion.

# PART 2 - PRODUCTS

# 2.1 GENERAL

- A. Refer to valve and gate schedule for actuator type, accessories, and sizing information.
- B. Provide clockwise closed actuation unless otherwise noted on the valve and gate schedule.
- C. Supply chain actuators for manual valves located 7 feet or higher above finished floor.

#### 2.2 ACCESSORIES

- A. Floor Stands:
  - 1. Materials:
    - a. Stand: stainless steel.
    - b. Stem Bushing: Sintered bronze.
    - c. Position Indicator: Bronze.
  - 2. Height to input shaft or handwheel: 36 inch.
  - 3. Base Mounting Requirements:
    - a. Concrete Floor Mounting: Type 316 stainless steel anchor bolts.
    - b. Face of Basin or Offset Mounting: Heavily reinforced, adjustable wall bracket with required anchor hardware using Type 316 stainless steel.
  - 4. Actuator Mounting Requirements:
    - a. Manual Actuator: Cast iron handwheel on top of floor stand with dual ball type thrust bearings, grease fitting on bearing bowl, hardened machined alloy bronze lift nut (for rising stem). Where manual effort is greater than 40 lb rim pull with 2 foot diameter wheel, provide geared actuator with a handwheel or crank.
      - 1) Handwheel casting to include the word "OPEN" and an arrow indicating the direction of operation.
    - b. Gearbox or Direct Powered Actuator: Through bolt holes matched to actuator or gearbox bolting pattern.
  - 5. Non-rising stem position indicator: Mechanical indicator connected to and driven by stem extension and cast position marks on floor stand with the word "OPEN" cast at the top of the travel, and a field mounted aluminum "CLOSED" tag supplied with drive rivets, installed based on number of valve turns.
  - 6. Rising Stem Position Indicator: Permanent markings on transparent stem covers.
- B. Stem Covers: Fracture-resistant clear polycarbonate stem covers for rising stems. Closed top with adhesive type position indicator markings.
- C. Extension Stems and Stem Guides:
  - 1. Extension stems and couplings to actuate recessed, buried, below slab valves and gates via operating nut or floor stand mounted actuator.
  - 2. Stem Extensions and Stem Couplings: Alloy steel, hardware of Type 316 stainless steel unless specified otherwise in the respective slide gate specification.
  - 3. Stem and Stem Couplings: Rated for five times the maximum input torque capacity of the actuator.
  - 4. Adjustable, Cast Iron Wall Bracket Type Stem Guides: Include two-piece bronze bushing.
  - 5. Spacing: 10 feet spacing or at spacing calculated by manufacturer to prevent buckling with a safety factor of 2 based on design thrust, shaft material and shaft size.

- D. Torque Tubes:
  - 1. Supply where shown on the Drawings or Valve and Gate Schedule.
  - 2. Supported by/mated to valve bonnet/yoke.
  - 3. Sized by supplier for the required actuator torque.
  - 4. Drilled specifically for valve and actuator bolt pattern.
  - 5. Internal extension keyed or shaped specifically to mate to valve shaft and fabricated of Type 316 stainless steel.
  - 6. Internal extension designed for axial adjustment for mating purposes.

# 2.3 MANUAL ACTUATORS

- A. Operating Nuts:
  - 1. 2 inch cast iron AWWA design.
    - a. Painted Carbon Steel Tee Handle Operator: 2-inch AWWA nut socket end extension length for nut actuated valves where nuts are recessed in valve boxes.
    - b. Tee Extension Length: Determine based on nut height as shown on Drawings with handle height approximately 3 feet above operating surface.
  - 2. Operating Nuts Recessed on Concrete: Cast iron floor box with cover and tee handle operator with 2 inch AWWA nut socket end.
  - 3. Nut Operated Non-Rising Stem Buried Valves: Cast iron bonnet skirts, extension pipes valve box and cover. Stem extensions with AWWA nut end to elevation shown on the Drawings or scheduled.
  - 4. Two tee handles for every ten buried or encased non-rising stem application with 2 inch AWWA operating nut.
- B. Gear-Assisted Manual Valve Actuators:
  - 1. Provide:
    - a. For manually actuated valves and gates larger than 8 inch nominal diameter and for ball and plug valves 6 inch and larger.
    - b. With power actuators where torque requirements dictate.
  - 2. Comply with AWWA C504.
  - 3. Handwheel Diameter: 8 inches.
  - 4. Maximum Handwheel Pull: 40 lbs maximum.
  - 5. Housings: Cast or ductile iron.
  - 6. Worm or helical gear type.
  - 7. Gears: Hardened steel, machine cut and mated.
  - 8. Bearings: Permanently lubricated bronze.
  - 9. Input and Output Shafts: Sealed with greased, waterproof machine shaft seals.
  - 10. Filled with waterproof grease and designed for submerged service where scheduled.
  - 11. Handwheel: Removable.
    - a. Diameter: 8 inch up to 12 inch valve size.
    - b. Diameter: 12 inch diameter up to 16 inch valve size.

- c. Diameter: 18 inch diameter for larger than 16 inch valve size.
- d. Maximum Diameter: 24 inch diameter.
- 12. Include mechanical top mounted valve position indication, opening direction, and adjustable stops.

# 2.4 ELECTRIC MOTOR ACTUATORS

- A. General:
  - 1. Where specified on the Valve and Gate Schedule.
  - 2. Comply with AWWA C542.
  - 3. Actuators for Valves 3 inches and Smaller: 120 Volt, 1 Phase, 60 Hertz power supply.
    - a. Actuators for Valves Larger than 3 inches and for slide gates and weir gates: 480 Volt, 3 Phase, 60 Hz power supply.
- B. 120 Volt Power Actuators:
  - 1. Actuators to have reversing motor, reduction gearing, local position indicator, position limit switches, provision for manual override, 100 to 1000 in-lbs torque range and motor thermal and electronic control protection.
  - 2. Enclosure:
    - a. Cast aluminum or steel alloy.
    - b. Powder coated or fusion bonded epoxy finish.
    - c. NEMA 4X.
  - 3. Power Train:
    - a. Self-locking planetary epicyclical gear design.
    - b. Hardened bronze alloy gears with bronze bearings.
    - c. Housing Penetrations: Seal with mechanical seals.
    - d. Housing: Equip with space heaters.
    - e. Mounting System: ISO 5211.
  - 4. Actuator for Open/Close/Jog Reversing Service: Proportional/modulating service where required in the equipment specifications or Instrumentation Drawings.
  - 5. Motors:
    - a. Design for valve actuation service.
    - b. Insulation: Class F.
    - c. Split phase capacitor protection.
    - d. Duty Cycle: 40 percent at 100 degrees F for open/close duty, and 100 percent for modulating duty.
    - e. 90-Degree Travel Time: 10 to 20 seconds depending on actuator size.
    - f. Actuator Switches: Have two SPDT 15 Amp rated switches for remote open/close valve position indication.

- 6. Products: Subject to compliance with requirements, provide one of the following or equal:
  - a. Series 92 as manufactured by Asahi/America.
  - b. EPM-6 by Hayward.
  - c. P Series as manufactured by Promation Engineering, Inc.
  - d. Or equal.
- C. 480 Volt Power Actuators:
  - 1. General: 2 phase 60 hz supply rated, self-contained, totally enclosed with motor, integral reversing starters, local controls, reduction gearing, limit switch gearing, limit switches, control power transformer, torque switches, bored and keyed drive sleeve for non-rising stems, declutch lever, auxiliary handwheel, and local position indication.
  - 2. Separately seal motor and control compartments with space heaters in limit switch, motor, and control compartments.
  - 3. Suitable for indoor and outdoor use, fully functional in ambient temperature range from 40 to 140 degrees F at 100 percent relative humidity.
  - 4. Size to guarantee full travel, seating and unseating torque or thrust as specified by the valve or gate manufacturer.
  - 5. Size to provide torque required to operate valve or gate at 90 percent of nominal voltage.
  - 6. Design Travel Rate:
    - a. As indicated on valve and gate schedule, and if not so indicated:
      - 1) Gate Valves and Slide Gates: 12 inches per minute.
      - 2) Globe Valves: 4 inches per minute.
      - 3) Quarter Turn Valves: 30 seconds per 1 foot of throat diameter.
  - 7. Enclosure:
    - a. Cast iron construction.
    - b. NEMA 4X for watertightness from pressure hose.
    - c. NEMA 6 for submergence up to 6 feet for 30 minutes.
    - d. NEMA 6P for submergence up to 15 feet for 72 hours.
    - e. IP 68-8 for submergence up to 26 feet for 96 hours per EN 60529.
    - f. NEMA 7 for Class 1, Division 1 & 2, Groups C & D hazardous environment.
    - g. Operate successfully a minimum of 10 full cycles under submersion.
    - h. External Fasteners: Type 316 stainless steel.
    - i. Include anti-condensation heater, suitable for continuous operation with alarm output to indicate heater failure.
  - 8. Motors:
    - a. High-starting torque; low stall torque, low inertia, designed and built by actuator manufacturer.
    - b. Embed thermistor in each motor winding for thermal protection.
    - c. Insulation: Class F, with a duty rating of at least 15 minutes at 40 degrees F ambient temperature.
    - d. Electrical disconnection by means of plug and socket. Allow motor removal without loss of lubricant.

- e. Hardware to ensure motor runs with correct rotation for required direction of valve travel regardless of power supply connection sequence.
- 9. Motor Protection:
  - a. De-energize without damage in the event of a stall condition when attempting to move a jammed valve.
  - b. De-energize in the event of an over-torque condition.
  - c. Imbed a minimum of three thermal devices in motor windings to de-energize the motor in case of overheating.
  - d. Lost phase protection algorithm.
- 10. Gear Train:
  - a. Grease filled, O-ring sealed in cast or ductile iron gear case.
  - b. Suitable for operation in any orientation.
  - c. Hardened, machine cut steel gears, and precision machined alloy bronze worm gear.
  - d. Reduction gearboxes as specified in Paragraph "Gear-Assisted Manual Valve Actuators."
- 11. Manual Operation:
  - a. Handwheel which does not rotate during motor operation.
  - b. Output contact with declutch mechanism to indicate manual operation.
  - c. Utilize actuator worm shaft/worm wheel to maintain self-locking gearing and to facilitate changeover from motor to manual operation when the actuator is under load. Do not use designs that bypass actuator worm gear or break valve load at worm gear.
  - d. Automatic return from manual to motor operation upon starting motor.
  - e. Manual operation capable with seized motor.
- 12. Position and Torque Calibration:
  - a. Sensing by absolute encoder using hall effect sensors. Incremental encoders requiring batteries to retain settings upon loss of power are not acceptable. Settings stored in permanent non-volatile memory.
  - b. Torque and travel adjustment parameters:
    - 1) Position Setting Range: 1 to 500 turns, with resolution of 2.81 degrees and accuracy to 5.0 degrees of actuator output.
    - 2) Torque Setting: 40 to 100 percent of rated torque.
  - c. Torque switch bypass for the torque sensing system to inhibit torque switch trip during unseating or during starting in mid-travel against high inertia loads.
- 13. Wiring and Terminals:
  - a. Tropical grade insulated stranded cable of appropriate size for the control and 3-phase power.

- b. Include a removable plug and socket head for termination of all external wiring. Include actuators without plug and socket terminal connections having power and control disconnect switches for ease of maintenance and safety.
- 14. Controls:
  - a. Microprocessor: Based with mechanically and electronically interlocked reversing contactors for Open/Close duty and solid-state contactors for modulating duty.
  - b. Local/Off /Remote Selector Switch and Open/Stop/Close Pushbuttons: Mount on actuator face with red and green indication lights for open/close and amber for fault.
  - c. Remote On/Off Service: Actuator to accept one remote signal to open and a second remote signal to close.
  - d. Modulating Service: When in remote mode, actuator to accept a 4 to 20 mA DC position control signal and position valve 0 to 100 percent of travel in proportion to control signal.
  - e. Monitoring Relays: Remotely indicate fault signal for indication of power failure, phase failure, thermal switch tripped, torque switch tripped between travel stops, and Local-Off-Remote selector switch position.
  - f. Gear Actuated Position Transmitter: On modulating duty actuator that is a twowire device, produce 4 to 20 mA DC signal proportional to 0 to 100 percent travel.
  - g. Transmitter: Have easily accessible zero and span adjustment potentiometers.
  - h. DC Power Supply: Integral with operator and powered from 110-volt AC internal transformer. Positioner board to provide repeatable accuracy to 0.25 percent of span and have separate trim pots for zero, span, and dead band adjustment.
- 15. Position Indication: Continuous mechanical dial indication of valve and gate position in step with the actuator at all times in both the hand wheel and motor operation. For modulating applications, graduations on mechanical dial position indicator to be 0 to 100 percent scale.
- 16. Limit Switches:
  - a. Adjustable type to trip at any point between fully opened and fully closed.
  - b. Mid-travel Switches: Provide as noted in valve and gate schedule.
  - c. Do not allow set position to be lost if over travel occurs in either manual or electric modes of operation.
  - d. Two independent and fully adjustable rotary type position limit switches each with 15 Amp DPDT contacts for remote open/close position indication.
- 17. Torque Switches: Actuator with adjustable torque switches and be responsive to load encountered in either direction of travel.
- 18. Terminal Compartment:
  - a. Separate from the inner electrical components of actuator with a watertight seal.
  - b. Three threaded cable entries.
  - c. Stud-type Terminals: Embed in a terminal block of high tracking-resistance compound.
  - d. Three-phase Power Terminals: Shroud from control terminals by means of an insulating cover.

- 19. Remote Control Stations:
  - a. For actuators located below the operating floor or located more than 7 feet above the operating floor, provide a UL Listed remote control station at the operating floor level with the same enclosure rating as the actuator.
  - b. Include a Local/Off/Remote selector switch, Open/Stop/Close pushbuttons and Open/Close indicating lights.
    - 1) Local/Off/Remote selector to include padlock mount for the Off position.
  - c. Include auxiliary contacts for remote indication of switch position.
- 20. Manufacturers: Provide products by one of the following or equal.
  - a. IQ/IQM as manufactured by Rotork, Plc.
  - b. Limitorque QX/MX as manufactured by Flowserve Corporation.
  - c. EIM TEC2000 as manufactured by Allied Valve, Inc.
  - d. AUMA SA/SAR as manufactured by AUMA Riester GmbH & Co. KG.

# 2.5 SOURCE QUALITY CONTROL

- A. Factory Testing:
  - 1. Shop inspect and test completed assemblies.
  - 2. Factory performance test each actuator and supply individual test certificates. Submit test certificates prior to shipment of valve actuators. Test equipment to simulate a typical valve and gate load, and record the following parameters:
    - a. No load current.
    - b. Current at maximum torque setting.
    - c. Stall current.
    - d. Torque at maximum torque setting.
    - e. Stall torque.
    - f. Test voltage and frequency.
    - g. Flash test voltage.
    - h. Actuator output speed.

## PART 3 - EXECUTION

#### 3.1 EXAMINATION

A. Verify field dimensions are as indicated on Shop Drawings.

# 3.2 INSTALLATION

A. Install products plumb, square, and true according to manufacturer's published installation instructions.

B. Securely mount actuators using brackets or hardware specifically designed for attachment to valves/gates.

# 3.3 FIELD QUALITY CONTROL

A. After installation, inspect for proper supports and interferences according to manufacturer's requirements and Section 400551 "Common Requirements for Process Valves".

END OF SECTION 400557

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## SECTION 400564 - BUTTERFLY VALVES

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. Section Includes:
  - 1. Double offset high performance butterfly valves.
- B. Related Requirements:
  - 1. Section 400551 "Common Requirements for Process Valves" for basic materials and methods related to valves commonly used for process systems.
  - 2. Section 400557 "Actuators for Process Valves and Gates".
- C. Van Stone flanges shall not be used with pinch valves, industrial butterfly valves; elastomer bellows style expansion joints or other piping system components having an elastomer liner (rubber seat) that is used as a gasket.

# 1.3 SUBMITTALS

A. As specified in Section 400551 "Common Requirements for Process Valves": Submittal requirements for compliance with this Section.

#### 1.4 QUALITY ASSURANCE

- A. Test valves in accordance with AWWA C504, API 598, MSS SP61 as applicable for types listed herein.
- B. Provide Installation Inspection and Operator Training per Section 400551 "Common Requirements for Process Valves".
- C. Provide testing and inspection certificates.

## PART 2 - PRODUCTS

#### 2.1 HIGH PERFORMANCE BUTTERFLY VALVES- Tag Type BFV

- A. Manufacturers:
  - 1. Cameron WKM DynaCentric.
  - 2. Powell 1572/3072.
  - 3. Jamesbury Model 815L.
  - 4. Crane Flowseal Soft Seat.
  - 5. Tyco K-Lok 360/362 and 370/372.
- B. Description:
  - 1. Comply with MSS SP 25, 44, 55, 61, 67, 68, API 609, ANSI B16.5, 16.34, 16.47, ISO 5211.
  - 2. Minimum Working Pressure:
    - a. Fluid Service (Tag Type BFV) 150 psig.
  - 3. Maximum Process Fluid Temperature:
    - a. Fluid service (Tag Type BFV) 104 degrees F.
  - 4. Body Style: Lugged.
  - 5. Disc: eccentric, single or double offset design.
  - 6. Shaft: single or two-piece design, taper pinned. Capable for mechanical separation from disc without damage to shaft or disc.
  - 7. Bearings: Self-lubricating.
  - 8. Shaft Seals/Packing:
    - a. Multiple square rings.
    - b. Multiple V-rings.
    - c. mechanically retained.
    - d. Blow out proof retainer.
  - 9. Seats:
    - a. Mechanically retained.
    - b. Energized.
    - c. Located in body.
    - d. Resilient and replaceable. Field replaceable.
- C. Actuator:
  - 1. Handwheel.
  - 2. Gear Actuators for Manual Valves: Comply with AWWA C504.

- D. Materials:
  - 1. Body: ASTM A182 Type F316 SS (saline service).
  - 2. Stem: Nitronic 50 (saline service).
  - 3. Disc: Alloy 20 or Alloy 2205 case hardened (saline service).
  - 4. Taper pins: Nitronic 50 (saline service).
  - 5. Seat elastomer: reinforced PTFE with silicone rubber energizer (saline service).
  - 6. Seat retainer: Titanium (saline service).
  - 7. Shaft Bearings: glass-backed PTFE (saline service).
  - 8. Thrust Bearings: Alloy 20 (saline service).
  - 9. Shaft Seals: Teflon Chevron packing (saline service).
  - 10. Seal Retaining rings and thrust washers: Inconel (saline service).
- E. Finishes:
  - 1. As specified in Section 400551 "Common Requirements for Process Valves".
  - 2. Manufacturers standard fusion bonded epoxy.
  - 3. Manufacturers polyester powder coat.
  - 4. No coatings for stainless steel body valves.
- F. NSF 61 compliant for raw water service valves.
- 2.2 SOURCE QUALITY CONTROL
  - A. Testing: Test butterfly valves according to AWWA C504.
  - B. Submit affidavit of compliance stating that the valves have been manufactured and tested in accordance with AWWA C504 and specifically list all exceptions.

# PART 3 - EXECUTION

# 3.1 EXAMINATION

A. As specified in Section 400551 "Common Requirements for Process Valves" for submittal requirements for compliance with this Section.

## 3.2 INSTALLATION

- A. As specified in Section 400551 "Common Requirements for Process Valves".
- B. According to Manufacturer's Instructions.
- C. Van Stone flanges shall not be used with industrial butterfly valves, or other piping system components having an elastomer liner that is used as a gasket.

## END OF SECTION 400564

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# SECTION 400565.35 – GLOBE BODY SILENT CHECK VALVES

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

# 1.2 SUMMARY

- A. Section Includes: Globe body silent check valves, 2.5 through 42 inches in size.
- B. Related Requirements:
  - 1. Section 400551 "Common Requirements for Process Valves" for basic materials and methods related to valves commonly used for process systems.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: Submit catalog information, indicating materials of construction and compliance with indicated standards.
- B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Source Quality-Control Submittals: Indicate results of factory tests and provide required certifications.
- B. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- C. Qualifications Statement:
  - 1. Submit qualifications for manufacturer.

## 1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record the actual locations of piping, valves and other appurtenances, connections, and centerline elevations.

#### 1.6 QUALITY ASSURANCE

- A. Comply with AWWA C518.
- B. Materials in Contact with Potable Water: Certified according to NSF 61 and NSF 372.
- C. Provide Installation Inspection and Operator Training Per Section 400551 "Common Work Requirements for Process Valves."
- D. Provide testing and inspection certificates.

## 1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years documented experience.
- B. Installer: Company specializing in performing Work of this Section with minimum five years' documented experience.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- B. Store materials according to manufacturer instructions.
- C. Protection:
  - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
  - 2. Protect valves and appurtenances by storing off ground.
  - 3. Cover flange faces with 3/4-inch plywood blinds.
  - 4. Provide additional protection according to manufacturer instructions.

## 1.9 EXISTING CONDITIONS

- A. Field Measurements:
  - 1. Verify field measurements prior to fabrication.
  - 2. Indicate field measurements on Shop Drawings.

## 1.10 WARRANTY

A. Furnish two-year manufacturer's warranty for globe body silent check valves.

## PART 2 - PRODUCTS

## 2.1 GLOBE BODY SILENT CHECK VALVES – Tag Type CV

- A. Manufacturers:
  - 1. Bermad, Series 800.
  - 2. Substitutions: Not permitted.
- B. Description:
  - 1. Clean Water Service Tag Type SGCV:
    - a. Type: Globe body, double guided, spring-loaded, poppet check valves.
    - b. Style: Flanged.
    - c. Body: Type 316 stainless steel.
    - d. Cover: Type 316 stainless steel.
    - e. Disk: concave Type CF8M stainless steel.
    - f. Seats: Buna-N or EPDM.
    - g. Disc Pin: Type 316 stainless steel
    - h. Spring: Type 316 stainless steel.
- C. Working Pressure Rating:
  - 1. Valves 2.5 through 12 Inches: 150 psig at 150 degrees F.
- D. Finishes: As specified in Section 400551 "Common Requirements for Process Valves."

#### 2.2 SOURCE QUALITY CONTROL

- A. Testing:
  - 1. Hydrostatically test check valves at twice rated pressure according to AWWA C518.
  - 2. Permitted Leakage at Indicated Working Pressure: None.

## PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Verify that field dimensions are as indicated on Shop Drawings.
- B. Inspect existing flanges for nonstandard bolt-hole configurations or design and verify that new valve and flange mate properly.

#### 3.2 PREPARATION

A. Thoroughly clean valves before installation.

#### B. Surface Preparation:

- 1. Solvent-clean surfaces that are not shop primed.
- 2. Clean surfaces to remove loose rust, mill scale, and other foreign substances by commercial sand blasting; SSPC SP 6.

# 3.3 INSTALLATION

- A. According to AWWA C518 and manufacturer instructions.
- B. Dielectric Fittings: Provide between dissimilar metals.

## 3.4 FIELD QUALITY CONTROL

A. Section 400551 "Common Requirements for Process Valves."

#### B. Inspection:

- 1. Inspect for damage to valve lining or coating and for other defects that may be detrimental as determined by Engineer.
- 2. Repair damaged valve or provide new, undamaged valve.
- 3. After installation, inspect for proper supports and interferences.
- C. Pressure test valves with piping.

## 3.5 CLEANING

A. Keep valve interior clean as installation progresses.

# END OF SECTION 400565.35

# SECTION 400578.19 - COMBINATION AIR VALVES FOR WATER SERVICE

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. Section Includes: Combination air valves for water treatment facilities.
- B. Related Requirements:
  - 1. Section 400507 "Hangers and Supports for Process Piping" for anchors and supports.
  - 2. Section 400551 "Common Requirements for Process Valves" for typical product and installation requirements for valves specified in this Section.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: Submit manufacturer catalog information.
- B. Shop Drawings: Indicate materials, dimensions, weights, and end connections in assembly drawings.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

## 1.4 INFORMATIONAL SUBMITTALS

- A. Manufacturer Instructions: Submit special procedures and setting dimensions.
- B. Source Quality-Control Submittals: Indicate results of factory tests and inspections and provide required certifications.
- C. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- D. Manufacturer Reports: Certify that equipment has been installed according to manufacturer instructions.
- E. Qualifications Statements:
  - 1. Submit qualifications for manufacturer and installer.
  - 2. Submit manufacturer's approval of installer. American Iron and Steel (AIS): Submit certification indicating compliance with AIS requirements.

#### 1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of combination air valves.

#### 1.6 QUALITY ASSURANCE

- A. Materials in Contact with Raw Water: Conforms to NSF 61 and NSF 372.
- B. Manufacturer Quality Management System: Certified to ISO 9001.

#### 1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' documented experience.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- B. Store materials according to manufacturer instructions.
- C. Protection:
  - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
  - 2. Furnish temporary end caps and closures on piping and fittings and maintain in place until installation.
  - 3. Provide additional protection according to manufacturer instructions.

#### 1.9 EXISTING CONDITIONS

- A. Field Measurements:
  - 1. Verify field measurements prior to fabrication.
  - 2. Indicate field measurements on Shop Drawings.

#### 1.10 WARRANTY

A. Furnish two-year manufacturer's warranty for combination air valves.

#### PART 2 - PRODUCTS

## 2.1 COMBINATION AIR VALVES FOR WATER SERVICE – Tag Type CAV

- A. Manufacturers:
  - 1. 2-inch Combination Air Valve Upstream of Check Valve: ARI Model D-040PT02.
  - 2. 2-inch Combination Air Valve with non-slam Downstream of Check Valve: ARI Model D-060CHFNST02.

#### B. Description:

- 1. Type:
  - a. Fully automatic, float operated.
  - b. Body: Single.
- 2. Comply with AWWA C512.
- 3. Size: As indicated on Drawings.
- 4. Suitable for potable or raw water service.
- 5. Minimum Pressure Rating: 150 psig.
- 6. Maximum Operating Temperature: Water to 104 degrees F.
- 7. Combination air valves shall perform the functions of an air/vacuum valve (exhaust large quantities of air on start-up, admits air on shut-down) and air release valves (release air continuously during operation) to maintain system efficiency and prevent pipeline surges.
- C. Materials:
  - 1. Body and Cover: reinforced nylon or Type 316 stainless steel.
  - 2. Float: Type 316 Stainless steel.
  - 3. Seats: Stainless steel.
  - 4. Seals: Buna-N/Nitrile.
  - 5. Trim: Stainless steel.
  - 6. Hardware: Stainless steel.
- D. End Connections:
  - 1. Size 4 Inches and smaller: Threaded, NPT.
  - 2. Size Larger than 4 Inches: Flanged, ASME B16.5.
- E. Accessories:
  - 1. Backwash accessories, including inlet shutoff valve, blowoff valve, rubber supply hose, and quick-disconnect couplings.
  - 2. Throttling device on outlet.

## 2.2 SOURCE QUALITY CONTROL

A. Provide shop inspection and testing of completed assembly.

## PART 3 - EXECUTION

# 3.1 EXAMINATION

- A. Verify that field dimensions are as indicated on Shop Drawings.
- B. Inspect existing flanges for nonstandard bolt hole configurations or design and verify that new pipe and flanges mate properly.

#### 3.2 PREPARATION

- A. Thoroughly clean end connections before installation.
- B. Close pipe and equipment openings with caps or plugs during installation.
- C. Surface Preparation: Clean surfaces to remove foreign substances.

#### 3.3 INSTALLATION

- A. According to manufacturer instructions.
- B. Provide access for operation, removal, and maintenance, and to avoid discharge to occupied areas or other equipment.
- C. Vent the valve properly and pipe outlet to nearest drain or as directed by Engineer.

#### 3.4 FIELD QUALITY CONTROL

- A. Inspect for interferences and proper supports.
- B. Testing:
  - 1. As specified in Section 400551 "Common Requirements for Process Valves".
  - 2. Demonstrate operation without undue noise or vibration.
- C. Equipment Acceptance:
  - 1. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.
  - 2. Make final adjustments to equipment under direction of manufacturer's representative.
  - 3. Repair damaged coatings with material equal to original coating.
- D. Furnish installation certificate from equipment manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.

# 3.5 CLEANING

A. Keep interior of air release valves clean as the installation progresses.

# 3.6 DEMONSTRATION

A. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

END OF SECTION 400578.19

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# SECTION 406100 - PROCESS CONTROL AND ENTERPRISE MANAGEMENT SYSTEMS GENERAL PROVISIONS

# PART 1 - GENERAL

# 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. Section includes procurement of the services of a Process Control System Supplier (PCSS) to provide all materials, equipment, labor, and services required to achieve a fully integrated and operational system as specified herein, in "Related Requirements" under this Article, and in related drawings, except for those services and materials specifically noted.
- B. Under this Contract, PCSS will also serve as Applications Engineer System Supplier (AESS).
  - 1. The Owner shall be providing configuration and development of HMI screens for this project.
- C. Include auxiliary and accessory devices necessary for system operation or performance, such as transducers, relays, signal amplifiers, intrinsic safety barriers, signal isolators, software, and drivers to interface with existing equipment or equipment provided by others under other Sections of these specifications, whether indicated on the Drawings or not.
- D. Equipment and installations shall satisfy applicable Federal, State, and local codes. Refer to Electrical Drawings for area classifications for Class and Division ratings.
- E. Use the equipment, instrument, and loop numbering scheme indicated on the Drawings and in the specifications in the development of the submittals. Do not deviate from or modify the numbering scheme.
- F. Related Requirements:
  - 1. Section 4063XX "Sections for Control System Equipment."
  - 2. Section 4066XX "Sections for Network and Communication Equipment."
  - 3. Section 4067XX "Sections for Control System Equipment Panels and Racks."
  - 4. Section 406866 "Configuration of Controller Software."
  - 5. Section 407000 "Instrumentation for Process Systems."
  - 6. Section 4071XX "Sections for flow measurement."
  - 7. Section 4072XX "Sections for level measurement."
  - 8. Section 4073XX "Sections for pressure, strain, and force measurement."
- G. The XX in the number indicates all spec sections starting with the first 4 numbers (indicating a category described in the accompanying text) are included in the reference.

#### 1.3 DEFINITIONS

- A. Process Control System Supplier (PCSS): The entity responsible for providing all materials, equipment, labor, and services required to achieve a fully integrated and operational control system.
- B. Applications Engineering System Supplier (AESS): The entity who provides all programming, configuration, and related services for the control system equipment provided by the PCSS.
- C. Maintenance of Plant Operations (MOPO): A construction plan which prevents or limits process disruptions during construction.
- D. Leadership in Energy and Environmental Design (LEED): A green building certification indicating that a building was designed and constructed to be environmentally responsible and use resources efficiently.
- E. Section 4062XX "Sections for Computer System Hardware": The XX in the number indicates all spec sections starting with the first 4 numbers (indicating a category described in the accompanying text) are included in the reference.

## 1.4 PREINSTALLATION MEETINGS

- A. Conduct a project kickoff coordination meeting within two weeks after submitting the Project Plan. The purpose of the meeting is to discuss the PCSS's Project Plan, to summarize the PCSS's understanding of the project; discuss any proposed substitutions or alternatives; schedule testing and delivery deadline dates; provide a forum to coordinate hardware and software related issues; and request any additional information required from the Owner. The meeting will last up to 4 hours.
- B. Conduct a submittal review coordination meeting after the Hardware, Panel Drawing, and Loop Drawing Submittal package has been reviewed by the Engineer and returned to the PCSS. The purpose of this meeting is to review comments made on the submittal package; to refine scheduled deadline dates; coordinate equipment installation activities; and provide a forum for any further required coordination between the PCSS and AESS. The meeting will last up to 4 hours.
- C. Attendance at MOPO workshop.
- D. Bi-Weekly on-site or conference call coordination meetings with Engineer, Contractor, Vendors, and AESS as required prior to any field start-up or activity testing begins.
- E. Schedule mandatory coordination meetings. Hold meetings at Owner's designated location and include attendance by Owner, Engineer, Contractor, PCSS's Project Engineer, and AESS Project Engineer, if applicable. Other Division 40 specifications may require additional meetings. Prepare and distribute an agenda for this meeting a minimum of one week before the scheduled meeting date. Schedule meeting for a minimum of one week before requested meeting date.

#### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, mountings, and attachment details.
  - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Detail fabrication and assembly of control equipment, control panels, and instrumentation as specified herein.
  - 4. Include diagrams for power, signal, and control wiring.
- C. Qualifications Submittal:
  - 1. For non-listed PCSS', submit, within 30 calendar days after Notice to Proceed, detailed information on staff and organization to indicate compliance with the Quality Assurance requirements of this Section. Qualifications submittal is required to be submitted and approved before any further submittals will be accepted. Failure to meet the minimum requirements is grounds for rejection as a PCSS. Qualifications Submittal to contain the following:
    - a. Copies of ISA CCST Level 1 certificates for all field technicians or resumes demonstrating field experience.
    - b. Notarized statement from the firm's financial institution demonstrating ability for the firm to meet the obligations necessary for the performance of the work.
    - c. Copy of UL-508 certificate for panel fabrication facilities.
    - d. Project references for water or wastewater projects as defined in the "Quality Assurance" paragraphs.
    - e. Documentation to demonstrate the ability to complete this project including resumes of key staff, financial capacities, details on engineering, design, fabrication, and field service capacity, and location of staff responsible for responding to the site within four hours to resolve startup issues.
- D. Project Plan, Deviation List, and Schedule Submittal:
  - 1. Submit, within 45 calendar days after Notice to Proceed, a Project plan. Submit for approval the Project Plan before further submittals are accepted. The Project Plan to contain the following:
    - a. Overview of the proposed control system describing the understanding of the project work, a preliminary system architecture drawing, interfaces to other systems, schedule, startup, and coordination. Include a general discussion of startup, replacement of existing equipment with new, switchover (Maintaining

Plant Operations during system transition), approach to testing and training, and other tasks as required by these specifications.

- b. Preliminary list of PLC hardware, including version numbers, solely to determine compliance with the requirements of the Contract Documents prior to beginning development of system programming. The review and approval of software and hardware systems as part of this Project Plan stage does not relieve the PCSS of meeting all the functional and performance requirements of the system as specified herein. Substitution of manufacturer or model of these systems after the submittal is approved is not allowed without Engineer's approval.
- c. Project personnel and organization including the PCSS project manager, project engineer, and lead project technicians. Include resumes of each of these individuals and specify in writing their commitment to this project. These do not need to be submitted again if already submitted in the Qualification submittal.
- d. Sample formats of the shop drawings to be submitted and in conformance with the requirements of the Specifications. At a minimum include samples of panel fabrication drawings, control system architecture and I/O wiring diagrams.
- 2. Define Exceptions to Specifications or Drawings in a Deviation List consisting of a paragraph-by-paragraph review of the Specifications indicating acceptance or any proposed deviations, the reason for exception, the exact nature of the exception and the proposed substitution so that an evaluation may be made by Engineer. Specifically state if no exceptions are taken to Specifications or Drawings. If there is no statement by PCSS, then it is acknowledged that no exceptions are taken.
- 3. PCSS must coordinate their work with General Contractor's overall schedule. PCSS schedule incorporates all PCSS milestones including but not limited to the following:
  - a. Schedule for all subsequent project submittals. Include the time required for Contractor's submittal preparation, Engineer's review time, and a minimum of two complete review cycles.
  - b. Proposed dates for all project coordination meetings.
  - c. Hardware purchasing, fabrication, and assembly (following approval of related submittals).
  - d. Software purchasing and configuration (following approval of related submittals).
  - e. Shipment of instrument and control system equipment.
  - f. Installation of instrument and control system equipment.
  - g. Testing: Schedule for all testing.
  - h. Schedule for system cutover, startup, and/or going on-line for each major system. At a minimum include the schedule for each process controller and HMI server/workstation provided under this Contract.
  - i. Schedule for all training including submittal and approval of O&M manuals, factory training, and site training.
  - j. Listing of all major graphics and PLC programs intended to be created or modified for this project. Indicate if graphic or program is new or existing.
- 4. Component and Wiring Identification and Tagging Plan:
  - a. Components provided by PCSS require a tag, label, or nameplate. Review specifications and provide a table indicating the tagging and labeling scheme used by the PCSS:

- 1) Instruments.
- 2) Network Rack Components.
- 3) Panel Hardware.
- b. Provide detailed information so Engineer can review the following characteristics for each type of tag, label, or nameplate for the different types of components provided above:
  - 1) Size or range of size of the tag, label, or nameplate.
  - 2) Font style.
  - 3) Material.
  - 4) Color(s).
- E. Input/Output (I/O) List Submittal:
  - 1. Submit, within 60 days after Notice to Proceed, a complete system Input/Output (I/O) address list for equipment connected to the control system under this Contract.
  - 2. Base I/O list on P&ID's, Drawings, the design I/O list (if included), and requirements in Specifications. Submit the I/O list in both a Microsoft Excel readable electronic file format and an 8-1/2 inch by 11-inch hard copy.
  - 3. Reflect all active and spare I/O points on the I/O list. Add points to accommodate spare I/O's as required in the specifications.
  - 4. Arrange the I/O list so that each control panel has a dedicated worksheet, which includes the following information:
    - a. TAG NUMBER(S): As indicated on Drawings, the identifier assigned to a device that performs a function in the control system. As part of this information, break out the tag loop number to allow for sorting by loop.
    - b. DESCRIPTION: A description of the function of the device (text that includes signal source, control function, etc.) Include the text "Spare Points" for all I/O module points that are not connected to equipment.
    - c. PHYSICAL LOCATION: Control Panel designation of where the I/O point is wired to.
    - d. PHYSICAL POINT ADDRESS: Rack, Slot, and Point (or Channel) assignment for each I/O point.
    - e. I/O TYPE: use DO Discrete Output, DI Discrete Input, AO Analog Output, AI - Analog Input, PI - Pulse Input, or PO - Pulse Output.
    - f. RANGE/STATE: The range in engineering units corresponding to an analog 4-20 mA signal, or, the state at which the value of the discrete points is "1."
    - g. ENGINEERING UNITS: The engineering units associated with the Analog I/O.
    - h. ALARM LIMITS: Include alarm limits based on the control descriptions and the Drawings.
    - i. P&ID P&ID or Drawing where the I/O point appears on. Mark as "NA" (Not Applicable) if the I/O point is derived from a specification requirement and is not on the P&IDs.
    - j. LOGICAL POINT ADDRESS: I/O address of each point.
    - k. EXISTING or NEW I/O POINT: Indicate if point is existing (E) or new (N).
    - 1. CONDITION OF EXISTING SIGNAL: Condition of existing I/O signals to be noted as functional (F) if working properly or if not functioning (NF) with issue described.

- 5. Sort the I/O list in order by:
  - a. Physical location.
  - b. I/O Type.
  - c. Loop Number.
  - d. Device Tag.
- 6. Once I/O list is approved, PLC I/O addresses are not to be modified without approval by Engineer.
- 7. For I/O layout requirements, refer to Section 406343 "Programmable Logic Controllers."
- F. Field Instruments Submittal:
  - 1. Refer to the Instruments section for submittal requirements.
- G. Control System Architecture, Computer Equipment Rack, Hardware and Software Packages Submittal:
  - 1. For each hardware and software packages component specified in the sections above, submit a cover page that lists date, specification number, product name, manufacturer, model number, location(s), and power required. Preferred format for the cover page is ISA-TR20.00.01-2001 (updated in 2004-2006), general data sheet; however, other formats will be acceptable provided they contain all required information.
  - 2. Complete system architecture drawing(s) showing in schematic form the interconnections between major hardware components including, control panels, computers, networking equipment, control panels with PLC systems and I/O modules, local operator interfaces, process equipment vendor panels with PLCs, and networked peripherals such as power monitors, security cameras, etc. PCSS is required to provide unique network architecture drawings for the following networks:
    - a. SCADA.
    - b. Instrumentation.
    - c. Electrical.
  - 3. Develop the system architecture drawings in accordance with the following information and guidelines:
    - a. Show power connections to each piece of equipment or grouping of equipment with voltage and power sources noted such as 120VAC UPS battery, 24VDC battery, or 120VAC from LP (lighting panel). Indicate specific UPS number or circuit number whenever possible.
    - b. All communication cable types should be uniquely identified with a specific linetype and cable characteristics clearly indicated in a key or legend located on drawing(s). For example, 50/125-micron multimode mode fiber, or CAT6 Ethernet copper cabling. Any multiconductor communication cables will be clearly labeled above each individual communication with a note added to drawing that states if no quantity exists above a linetype, there is only one communication cable between devices. If a multi-conductor cable has multiple colors, legend to clearly indicate which colors are used for which networks (i.e., a multi-pair fiber optic cable used for dedicated networks such as SCADA, Electrical, Security, HVAC, etc.)

- c. Communication cables shall be assigned a unique cable identification label and shown in either a table or above the communication line.
- d. Identify network protocols for each communication path or for system indicated in a key or legend as appropriate. Examples are Allen-Bradley EtherNet/IP, Modbus TCP/IP, or DNP3.
- e. Indicate which port or connection number the communication cable is terminating at any device that has multiple ports or connection points. For multiple devices, this could be shown once in a key or legend and noted on architecture as appropriate.
- f. For each PLC control panel or network communication enclosure provided by PCSS, the architecture drawing clearly references other drawings provided by the PCSS for detailed panel wiring diagrams with a note near that PLC panel or communication enclosure indicating referenced drawing numbers. A placeholder is acceptable at the time of submission if these drawings are to be submitted at a later date.
- g. Use symbology and/or icons whenever possible to represent a device and differentiate between devices that are different form factors (i.e. tower computer vs. desktop computer vs. rack mounted). Vendor CAD libraries are preferred for symbols.
- h. Develop a diagram that will allow a qualified technician to interconnect all equipment without having to refer to additional manuals or literature.
- i. Use a minimum sheet size of 11 inch x 17 inch and use of more than one sheet is acceptable with a logical breakout between sheets (i.e., head end on one sheet and plant control system on another). Clearly identify line continuations between drawings.
- H. Panel Layout Drawings and Wiring Diagrams Submittal:
  - 1. Panel Layout Drawings: Submit Drawings for all panels specified. Draw to scale panel assembly and elevation drawings and detail all equipment in or on the panel. Use 11 inch x 17 inch sheet size for panel drawings and include the following:
    - a. Clearly indicate a legend sheet with all symbols used on drawings and with voltage, color, and size of each wire.
    - b. Interior and exterior panel elevation drawings to scale.
    - c. Nameplate schedule.
    - d. Conduit access locations.
    - e. Panel construction details.
    - f. Cabinet assembly and layout drawings to scale. Include a bill of material on the assembly drawing with each panel component clearly defined. Cross-reference the bill of material to the assembly drawing so that a non-technical person can readily identify all components of the assembly by manufacturer and model number.
    - g. Fabrication and painting specifications including color (or color samples).
    - h. Construction details, NEMA ratings, intrinsically safe barrier information, gas sealing recommendations, purging system details, etc. for panels located in hazardous locations or interfacing to equipment located in hazardous areas.
    - i. For every outdoor control panel, heating and cooling calculations for each panel supplied indicating conformance with cooling requirements of the supplied equipment and environmental conditions. Include on calculations the recommended type of equipment required for both heating and cooling.

- j. Submit evidence that all control panels are constructed in conformance with UL 508 and bear the UL seal confirming the construction. Specify if UL compliance and seal application accomplished at the fabrication location or by field inspection by UL inspectors. Costs associated with obtaining the UL seal and any inspections are be borne by Contractor.
- 2. Wiring Diagrams Submittal:
  - a. PCSS to provide complete wiring diagrams showing all wiring connections in the I/O system where direct hardwired interfaces exist between the PCSS control panels and vendor provided control panels furnished under other Divisions. This includes but is not limited to terminal block numbering, relay contact information, instruments, equipment, and control panel names. Include drawings in Final O&M submittal. Leaving this information blank on Final Documentation drawings is not acceptable.
  - b. ISA Loop Wiring Diagrams: Not required.
- I. Controller Program Submittal:
  - 1. Refer to Section 406866 "Configuration of Controller Software" for specific submittal requirements.
- J. Testing Plan Submittals:
  - 1. Refer to Section 406121.20 "Process Control System Testing" for specific testing submittal requirements.

## 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For all PCSS supplied hardware to include in operation and maintenance manuals.
  - 1. Include the following information on the operations and maintenance manuals:
    - a. Table of Contents:
      - 1) Provide Table of Contents for the entire manual with the specific contents of each volume clearly listed. Include the complete Table of Contents in each volume.
    - b. Instrument and Equipment Lists:
      - 1) Develop the following lists in Microsoft Excel format:
        - a) An instrument list or spreadsheet for all instruments supplied including tag number, description, specification section and paragraph number, manufacturer, model number, calibrated range, location, manufacturer phone number, local supplier name, local supplier phone number, completion year replacement cost, and any other pertinent data.

- b) An equipment list or spreadsheet for all non-instrument devices supplied listing description, specification section and paragraph number, manufacturer, model number, location, manufacturer phone number, local supplier name, local supplier phone number, completion year replacement cost, and any other pertinent data.
- c. Equipment Operations and Maintenance Information:
  - Provide ISA-TR20.00.01-2001(updated in 2004-2006) data sheets for all field instruments. For non-field instrumentation devices, provide a cover page for each device, piece of equipment, and OEM software that lists date, specification number, product name, manufacturer, model number, Location(s), and power required. Preferred format for the cover page is ISA-TR20.00.01-2001(updated in 2004-2006), general data sheet; however, other formats will be acceptable provided they contain all required information.
  - 2) Provide either new documentation written specifically for this project or modified standard vendor documentation to the vendor O&M documentation for each device, piece of equipment, or OEM software. Indicate with arrows or circles all portions that apply to all standard vendor documentation furnished. Neatly line out or cross out all portions that do not apply. Remove groups of pages or sections that do not apply to the specific model supplied.
  - 3) Provide the record documentation of the system audit and completed test forms with sign-offs as specified in Section 406121.20 "Process Control System Testing."
  - 4) Include instrument/equipment calibration and configuration forms.
- d. As-Built Drawings:
  - Complete as-built drawings, including all drawings and diagrams specified in this section under the "Submittals" section. Include on the drawings all termination points on all equipment the system is connected to, including terminal points of equipment not supplied by the PCSS. Provide electronic files for all drawings produced. Provide drawings in AutoCAD ".dwg" format and in Adobe Acrobat format. Provide drawings using the AutoCAD eTransmit feature to bind external references, pen/line styles, fonts, and the drawing file into individual zip files.
  - 2) Include on as-built documentation information from submittals, as described in this Specification, updated to reflect the as-built system. Incorporate errors in or modifications to the system resulting from the Factory and/or Functional Acceptance Tests.
- B. Operations and Maintenance Data Software Maintenance Manual:
  - 1. Include these manuals as part of "Final System Documentation."
  - 2. Software Listings and Databases: Submit hard copies of the same information required in the "Controller Program Submittal" except include files updated to reflect the as-built system. Include PDF versions of these files on the DVDs specified below.
  - 3. PID Loop Tuning Parameters: Submit annotated chart recorder traces or computer system trend screen printouts showing tuned control loop response to plus and minus 40 percent of full span step changes of loop setpoint for each individual loop. For cascade loops,

submit charts showing response of the secondary loop with secondary setpoint on manual and also response of the entire cascade control loop in automatic mode. Include a description of tuning methodology used.

- 4. Supply hardcopies of configuration information for the HMI systems, reporting systems, Historian Systems, and any other programs developed under this Contract.
- 5. Machine Readable Documentation: Provide two sets of as-built software documentation on DVDs or USB thumb drives in original electronic format for all PLC, HMI systems, reporting systems, Historian Systems, and any other programs developed under this Contract. Incorporate all changes made during or after testing, start-up, and commissioning.
- 6. Include final version of the system standards and conventions manual reflecting asprogrammed conditions.
- 7. System Configuration Section:
  - a. Include a printout (or screen capture) of all configuration screens for every device requiring PCSS configuration. This includes, but is not limited to, PLC processors, EtherNet/IP and any other communication modules.
- C. Operations and Maintenance Data Operators' Manual:
  - 1. Provide Operator's Manuals prior to final acceptance of the system.
  - 2. Separately bind and include in the manual all information necessary for the operator to monitor and control the plant from the control system. Write the manuals in non-technical terms and organize for quick access to each detailed description of the operator's procedure. Include the following information:
    - a. A comprehensive table of contents of the manual.
    - b. A simple overview of the entire system indicating the function and purpose of major control system components described by area or building.
    - c. A detailed description of the operation of the HMI and OIT including all appropriate displays. Including a screenshot of each HMI and OIT display screen and annotating each function in text is an acceptable format for presenting this information.
    - d. Step-by-step procedures for starting up or shutting down critical component of the control system such as server or a control panel.
    - e. Login / logout procedures for the operator interface system(s).
    - f. Complete, step-by-step procedures for printing reports and entering manual data.
    - g. Complete, step-by-step procedures for performing system or selected file backup and restoration including archiving historical data. Include recommended archiving schedule for historical data and/or frequency system performs an automatic back-up with a listing of all applications that are backed up or need to be backed up.
    - h. Operational description for operating HMI computer equipment and peripherals including printers, CD-ROMs, removable bulk storage devices, UPS, etc. Include in the description procedures for typical maintenance and troubleshooting tasks.
    - i. A complete glossary of terms and definition of acronyms.
    - j. List of personnel to be contacted for warranty and emergency services, including name, address, telephone number, pager or cell phone number, fax number, and email address.
- 3. Electronic O&M Information:
  - 1) In addition to the hard copy of O&M data, provide an electronic version of all equipment manuals and data sheets, along with any software back-up of configuration files, on DVD or USB thumb drive. Supply electronic documents in Adobe Acrobat format.
  - 2) Provide electronic files for all custom-developed manuals including training manuals. Supply text in Microsoft Office and Adobe Acrobat formats.
  - 3) Provide electronic files for all drawings produced. Supply drawings in AutoCAD ".dwg" and in Adobe Acrobat formats. Provide drawings using the AutoCAD eTransmit feature to bind external references, pen/line styles, fonts, and the drawing file into individual zip files.
  - 4) Back up each computer system hardware device onto DVD or USB thumb drive after Substantial Completion and turn over to the Owner.
  - 5) If specified in the training section, provide digital copies of all training videos. Format videos so they are readable by standard DVD players and by standard PC DVD drives, a minimum of 800 by 600 pixels, and include sound.

## 1.7 MAINTENANCE MATERIAL SUBMITTAL

- A. Furnish extra materials from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Refer to individual specification sections in Division 40 for spare equipment requirements and provide one comprehensive spare parts submittal for project.
- B. Pack all spare parts in individual cartons and label with indelible markings clearly indicating components inside. Supply with the required spare parts complete ordering information paperwork including manufacturer's contact information (address and phone number), part name, part number, equipment name and tag number(s) for which the part is to be used (if applicable). Deliver and store the spare parts in a location directed by the Owner or Engineer.

#### 1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications: PCSS to hold a valid UL-508 certification for their panel fabrication facility.
- B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- C. Responsible for the technical supervision of the installation by providing on-site supervision to the installers of the various components.
- D. Process Control System Supplier (PCSS) shall be a "systems integrator" regularly engaged in the design and the installation of instrumentation systems and their associated subsystems as they are applied to the municipal water and wastewater industry. For the purposes of this Specification Section, a "systems integrator" means an organization that complies with all of the following criteria:

- 1. Employs personnel on this project who have successfully completed ISA or manufacturer's training courses on general process instrumentation and configuration and implementation of the specific programmable controllers, computers, and software proposed for this project. Key personnel to hold ISA CCST Level 1 certification or have a minimum of 10 years of verifiable plant startup experience. Key personnel includes, as a minimum, the lead field technician.
- 2. Has successfully completed work of similar or greater complexity on at least three previous projects within the last five years. Successful completion is defined as a finished project completed on time, without any outstanding claims or litigation involving the PCSS. Potential references for projects where the PCSS's contract was of similar size to this project.
- 3. Has been actively engaged in the type of work specified in this Section for a minimum of five years.
- E. Maintain a permanent, fully staffed and equipped service facility with full-time employees capable of designing, fabricating, installing, calibrating, and testing the systems specified herein. Respond to on-site problems within 12 hours of notice. Provide an on-site response within four hours of notification starting at two months before scheduled startup to two months after startup completion.
- F. Listed suppliers will not be required to submit a qualifications proposal (see "Informational Submittals"). Contractors interested in listing an equal to the above listed suppliers to submit PCSS' qualifications for review and approval as specified herein.
- G. Select a PCSS from one of the following:
  - 1. Carollo, Contact: Joe Hanlon, Phone: 727-460-2550.
  - 2. McKim & Creed, Contact: Robert Garland, Phone: 941-379-3404.
  - 3. Tetra Tech, Contact: Danny Nelson, Phone: 239-438-2108.
  - 4. Revere Control Systems, Contact: Ben Matthews, Phone: 863-337-3001.
  - 5. Jacobs, Contact: Bill Gramer, Phone: 239-860-4922.
- H. Select a fiber optic cable provider/installer from one of the following:
  - 1. Aztek Communication Technologies, Phone: 239-659-0017.
  - 2. IT Solutions, Inc. Phone: 239-354-7755.
- I. Being listed in this specification does not relieve any potential PCSS from meeting the qualifications specified in this Section.

### 1.9 FIELD CONDITIONS

- A. Environmental Requirements: Refer to Electrical Drawings for specific environmental and hazardous area classifications.
- B. Elevation: Design equipment to operate at the project ground elevation.

## C. Temperature:

- 1. Outdoor area equipment to operate between -4 to 122 degrees F ambient.
- 2. Equipment in indoor locations operate between 50 to 95 degrees F degrees ambient minimum.
- 3. Storage temperatures range from 32 to 122 degrees F degrees ambient minimum.
- 4. Furnish additional cooling or heating if required by the equipment specified herein.
- 5. Relative Humidity. Air-conditioned area equipment operate between 20 to 95 percent relative, non-condensing humidity. All other equipment operates between 5 to 100 percent relative, condensing humidity.
- D. Do not ship control system equipment located in the control room until the control room areas comply with specified ambient temperature and humidity and free of dust and debris.

## 1.10 WARRANTY

A. Warranty Period: One year from Date of Final Completion unless noted otherwise in individual specification Sections.

## PART 2 - PRODUCTS

- 2.1 GENERAL
  - A. Electrical Requirements for Control System:
    - 1. Operate equipment on a 60 Hertz alternating current power source at a nominal 120 volts, plus or minus 10 percent, except where specifically noted. Regulators and power supplies required for compliance with the above to be provided between power supply and interconnected instrument loop. Supply constant voltage transformers where equipment requires voltage regulation.
    - 2. With the exception for field device network connected devices, all electronic instrumentation utilize linear transmission signals of isolated 4 to 20 mA DC (milliampere direct current) capable of driving a load up to 750 ohms, unless specified otherwise. However, signals between instruments within the same panel or cabinet may be 1 5 VDC (volts direct current).
    - 3. Outputs of equipment that are not of the standard signals as outlined, have the output immediately raised and/or converted to compatible standard signals for remote transmission. No zero-based signals will be allowed.
    - 4. All switches have double-pole, double-throw (DPDT) contacts rated at a minimum of 600 VA, unless noted otherwise.
    - 5. Switches and/or signals indicating an alarm, failure or upset condition wired in a fail-safe manner. A fail-safe condition is when an open circuit generates an alarm state (i.e. contact opens).
    - 6. Materials and equipment UL approved whenever such approved equipment and materials are available.
    - 7. All equipment furnished designed and constructed so that in the event of power interruption, the systems specified all go through an orderly shutdown with no loss of

memory and resume normal operation without manual resetting when power is restored, unless otherwise noted.

8. Surge protection requirements for control system power, signal, and communication lines are specified in Section 407856 "Isolators, Intrinsically Safe Barriers, and Surge Suppressors."

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine walls, floors, roofs, and process area for suitable conditions where control panels and instrumentation will be installed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 GENERAL INSTALLATION

- A. The shield on each process instrumentation cable to be continuous from source to destination and be grounded at only one ground point for each shield.
- B. Provide sunshades for equipment mounted outdoors in direct sunlight. Include sunshades standoffs to allow air circulation around the cabinet. Orient equipment outdoors to face to the North to minimize the impact of glare and ultraviolet exposure on digital readouts.

#### 3.3 IDENTIFICATION

A. Provide identification system for all PCSS provided hardware, instrumentation, and communication cabling. Provide details as specified in "Project Plan".

#### 3.4 FIELD QUALITY CONTROL

A. Refer to individual hardware and instrument specification Sections.

### 3.5 STARTUP SERVICE

- A. Refer to Section 406121.20 "Process Control System Testing."
- B. Refer to Section 406126 "Process Control System Training."
- C. Engage factory-authorized service representative to perform startup service as specified in individual hardware and instrument specification sections.
- D. Weekly on-site coordination meetings with Engineer, Contractor, Vendors, and AESS as required during active construction period.

### 3.6 PCSS MAINTENANCE SERVICE

- A. Provide a written proposal for a maintenance contract executed by the PCSS to the Owner for on-site preventive maintenance services related to the Instrumentation and Control system. Do not include the cost of this maintenance contract in the Contract Price.
- B. Visits to the sites to correct deficiencies under warranty are not included in this preventive maintenance service contract.

END OF SECTION 406100

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## SECTION 406121.20 - PROCESS CONTROL SYSTEM TESTING

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. Section includes process control system testing, where the Applications Engineering services are performed by Contractor.
  - 1. Furnish labor, materials, equipment, and incidentals required to complete testing of provided devices and systems.
- B. Related Requirements:
  - 1. Section 406100 "Process Control and Enterprise Management Systems General Provisions."

#### 1.3 DEFINITIONS

- A. Process Control System Supplier (PCSS): Entity responsible for providing materials, equipment, labor, and services required to achieve a fully integrated and operational control system.
- B. Applications Engineering System Supplier (AESS): Entity who provides programming, configuration, and related services for the control system equipment provided by the PCSS.
- C. Human Machine Interface (HMI): A software-based user interface with supervisory level control and of machine level equipment.
- D. Operator Interface Terminal (OIT): A hardware component of the HMI used for device level control and monitoring.
- E. Programmable Logic Controller (PLC): A ruggedized programmable computer used for industrial automation.
- F. Input/Output (I/O): Analog or digital field instrument signals to be received and interpreted by a PLC.
- G. Uninterruptible Power Supply (UPS): A device capable of providing emergency battery power when the main power source fails.

### 1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Refer to Section 4061000 "Process Control and Enterprise Management Systems General Provisions."

### 1.5 ACTION SUBMITTALS

- A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions."
- B. Testing Submittals Submit, in one submittal, the following testing related documents:
  - 1. Status Signoff Forms:
    - a. Develop and submit project specific I/O Status and Automatic Control Strategy signoff forms to be used during factory and field testing to organize and track each loop's inspection, adjustment, calibration, configuration, and testing status and sign off. Include sign-off forms for each testing phase showing all loops.
      - 1) Example forms are shown in the Appendices.
      - 2) Separate forms for factory and field testing can be used, or they can be combined, at the discretion of the PCSS.
      - 3) Submit testing forms prior to start of testing.
  - 1. Testing Procedures:
    - a. Submit detailed procedures proposed to be followed for each of the tests specified herein. Test procedures serve as the basis for the execution of the required tests to demonstrate that the system meets and functions as specified. At a minimum, provide the following test procedures:
      - 1) Network and Communications Testing.
      - 2) I/O Testing.
      - 3) UPS.
      - 4) Control panel power, indictors, and hardwired logic tests.
    - b. Structure documents in an orderly and easy to follow manner to facilitate an efficient and comprehensive test.
    - c. Indicate in test procedures all pre-testing setup requirements, all required test equipment, and simulation techniques to be used.
    - d. Structure test procedures in a cause-and-effect manner where the inputs are indicated, and the outputs are recorded.
    - e. Include in test procedures the demonstration and validation under normal operating conditions and under various failure scenarios as specified in Contract Documents.
    - f. Do not start testing until all Testing Submittals have been approved.
- C. Test Documentation:
  - 1. Upon completion of each required test, document the test by submitting a copy of the signed off Testing Status forms. Testing is not to be considered complete until the signed-

off forms have been submitted and approved. Submittals of other test documentation, including "highlighted" wiring diagrams with field technician notes, are not acceptable substitutes for the formal test documentation.

## 1.6 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For Test Documentation of system:
  - 1. Upon completion of each required test, document the test by submitting a copy of the signed-off Testing Status forms. Testing is not considered complete until the signed-off forms are submitted and approved. Submittal of other test documentation, including "highlighted" wiring diagrams with field technician notes, are not acceptable substitutes for the formal test documentation.

## 1.7 CLOSEOUT SUBMITTALS

- A. Refer to Section 406100 "Process Control and Enterprise Management System General Provisions."
- 1.8 COST OF TRAVEL
  - A. Scheduled tests will only be attended once by Engineer /Owner. If test is not successful, all subsequent tests will be performed at Contractor's expense. Reimburse Owner for all costs, including labor and expenses, invoiced by Engineer and incurred by Owner for subsequent retests.

### PART 2 - PRODUCTS (NOT USED)

# PART 3 - EXECUTION

### 3.1 TESTING - GENERAL

- A. Refer to Section 406100 "Process Control and Enterprise Management System General Provisions."
- B. Track results of all testing on a project specific status sign-off form or similar document. The PCSS is responsible for maintaining the sheet. Appendix of this Section has an example template for this sheet.
- C. Tests the PCSS is required to perform are as follows:
  - 1. Factory Testing:
    - a. Unwitnessed Factory Test (UFT).
    - b. Witnessed Factory Test (WFT).

- 2. Field Testing:
  - a. Operational Readiness Test (ORT).
  - b. Functional Demonstration Test (FDT).
  - c. Site Acceptance Test (SAT).
- D. Wherever possible, perform tests using actual process variables, equipment, and data. Where it is not practical to test with real process variables, equipment, and data, provide all special testing materials and equipment required for a suitable means of simulation.
- E. PCSS to coordinate all required testing with Contractor, affected subcontractors, Engineer, and Owner.
- F. Do not ship equipment to jobsite until Engineer or Owner has received all Factory Testing results and approved the system as ready for shipment.
- G. Engineer reserves the right to test or re-test any functions.
- H. Correction of Deficiencies:
  - 1. Correct deficiencies in workmanship and/or items not meeting specified testing requirements to meet specification requirements at no additional cost to Owner.
  - 2. Repeat testing, as specified herein, after correction of deficiencies is made until specified requirements are met.

# 3.2 FACTORY TESTING - UNWITNESSED FACTORY TEST (UFT)

- A. Purpose of UFT is for PCSS to check system prior to Engineer and/or Owner attending factory testing. This type of testing is part of any quality firm's internal QA/QC procedures.
- B. Temporary network connections are required to confirm the network configuration. Temporary wiring of primary elements, final control elements, and field-mounted transmitters is not required.
- C. Hardware to be tested includes all control system devices shown on System Architecture drawings and provided by PCSS.
- D. Perform these tests, but not be limited to the following. Address each of these tests in the Test Procedure submittal.
  - 1. All panels and enclosures provided to undergo a thorough inspection to verify integrity of cabinet enclosures, frame structures, paint work and finish, etc. Review panel drawings to ensure they accurately reflect panel layout and wiring.
  - 2. Perform a system audit to verify all components have been staged for test and have been documented properly with correct model numbers, serial numbers, etc. Prove documentation of audit at factory test and submit as part of O&M Manual Documentation:
    - a. For each workstation and server, list of all software installed (including the operating system), with software revision number, software improvement modules

or patches installed, license number and owner registration information, warranty period, vendor and local distributor names and contacts.

- b. For each microprocessor-based component connected to control communication backbone in system (PLCs, managed switches, protocol converters, communication cards on final field devices, radios, etc.), list firmware revision, vendor and local distributor information, and system, warranty information, configuration parameters (e.g., communication settings, fail position settings, etc.)
- 3. Perform panel wire pull tests to ensure all wiring has been connected with appropriate torque to prevent wires from coming loose.
- 4. Test UPS to verify UPS switch power correctly while keeping all UPS powered loads online. Perform testing of UPS to determine if they have been sized correctly to maintain specified run time during field testing.
- 5. Perform a 100 percent I/O point checkout to verify proper operation of input/output points from panel terminations to HMI and OIT nodes. At a minimum, I/O checkout consists of four steps.
  - a. Jumper discrete input signals at field terminal blocks in control panels to verify proper status in HMI and OIT nodes.
  - b. Connect analog input signals to a signal generator at field terminal blocks in control panels to verify proper status in HMI and OIT nodes and verify signals are at zero percent, 50 percent, and 100 percent of full scale.
  - c. Test discrete output signals by switching equipment to manual control at HMI and OIT nodes and turning the output on or other means to turn the output on. Then verify the output is on by connecting a digital multimeter to measure continuity at terminations, thus verifying command from PLC has properly executed contact closure.
  - d. Test analog output signals by switching the equipment to manual control at HMI and OIT nodes and turning output on or other means to turn the output on. Then verify output by utilizing a digital multimeter to measure current or voltage generated at termination points.
- 6. Verify all control strategies using simulation or other means to verify logic performs as expected. Verify faults and logical failure conditions for control strategies such instrument failures, equipment failures, loss of communication between HMI Server and PLC, loss of peer-to-peer communication, out of range testing (over and under scale) for analog inputs, and all other strategies specified in control strategy document.
- 7. For each hardware enclosure, include with inspection, but not be limited to, cabinet enclosures, frame structure, paint work and finish, dimensions, and hardware operability (i.e., fans, door hinges, keylocks, etc.).
- 8. For each subpanel, include with inspection, but not be limited to, I/O subsystem physical layout, power supply sizing and mounting, cable routing, wire runs across hinges properly installed, fans and blowers unobstructed and mounted to maximize air flow, power conditioning correctly installed, and overall layout and installation of components meets manufacturer's recommendations and standard industry accepted practices.
- 9. All other control panel circuitry.
- 10. Perform the following systems tests:
  - a. Demonstrate ability to share data between operator workstations and servers.
  - b. Demonstrate ability of each workstation to print reports on all designated report printers.

- c. Demonstrate ability for each workstation to read and write designated files from servers and other workstations on the network.
- d. Demonstrate operability of all back-up and mass storage equipment.
- e. Demonstrate communication failure and recovering self-healing ring testing.
- f. Demonstrate total power failure and recovery. Remove the UPS for this test.
- g. Demonstrate capabilities of the historical server.
- h. Demonstrate failover capabilities of the redundant HMI servers.
- i. Demonstrate failover capabilities of the redundant PLCs.
- E. Upon successful completion of UFT, PCSS to submit a record copy of test results as specified in PART 1. As part of this test results submittal, notify Engineer and Owner in writing that system is ready for WFT. No other notice of Factory test will be accepted. Engineer and/or Owner to schedule a test date within 30 days of receipt of this submittal.

#### 3.3 FACTORY TESTING - WITNESSED FACTORY TEST (WFT)

- A. Purpose of WFT is to allow Engineer or Owner representatives to witness functionality, performance, and stability of entire hardware and software system as a complete integrated system. WFT to be run by PCSS and conducted at PCSS's facility.
- B. Required Documents for Test:
  - 1. Clean set of approved panel drawings and wiring diagrams.
  - 2. Set of Contract Documents: Drawings and Specifications.
  - 3. All design-change related documentation.
  - 4. Master copy of the PCSS developed factory testing signoff forms.
  - 5. Testing procedures.
- C. Operate the system continuously throughout WFT without failure, except where initiated per established test procedures. Unanticipated failures may, at Owner or Engineer's option, result in overall WFT being deemed unsuccessful. Correct and re-test all deficiencies identified during these tests prior to completing WFT or shipment of panels to jobsite as determined by Owner/Engineer.
- D. Perform these tests during the WFT, but not be limited to, the following:
  - 1. A repeat of all tests specified in the UFT.
- E. Daily schedule during these tests to be as follows:
  - 1. Morning meeting to review the day's test schedule.
  - 2. Scheduled tests and sign-offs.
  - 3. End of day meeting to review day's test results and to review or revise next day's test schedule.
  - 4. Unstructured testing period by witnesses.
- F. Upon successful completion of WFT, PCSS to submit a record copy of test results as specified in PART 1.

#### 3.4 FIELD TESTING - OPERATIONAL READINESS TEST (ORT)

- A. Purpose of ORT is to check that process equipment, instrument installation, instrument calibration, instrument configuration, field wiring, control panels, and all other related system components are ready to monitor and control the processes. This test determines if equipment is ready for operation.
- B. This test to take place prior to FDT and startup. Prior to starting this test, install relevant process equipment and mechanically test instruments installed, control panels installed, and field wiring complete.
- C. Required Documents for Test:
  - 1. Master copy of the PCSS developed field testing sign-off forms.
  - 2. Testing procedures.
  - 3. Calibration forms.
- D. These inspections, calibrations, and tests do not require witnessing. However, Engineer may review and spot-check testing process periodically. All deficiencies found to be corrected by PCSS prior to commencement of Functional Demonstration Test.
- E. PCSS to maintain Sign-off forms and Calibration forms at job site and make them available to Engineer/Owner at any time.
- F. Perform the following tests as part of ORT:
  - 1. Instrument calibration, configuration, and set-up.
  - 2. Input/Output (I/O) Testing to HMI and OITs.
  - 3. Testing of control strategies.
- G. Instrument calibration, configuration, and set-up:
  - 1. Calibrate, configure, and set-up all components and instruments to perform specified functions.
  - 2. Calibration form:
    - a. For any component or instrument requiring dip switch settings, calibration, or custom configuration, maintain a calibration form in field documenting this information. These forms provide a summary of the actual settings used in the field to allow an Instrument technician to replace the device entirely and configure it to function as it did before.
    - b. Add this information to Instrument data sheet and to a copy of manufacturer's standard "Configuration Sheet" or create a separate form.
      - 1) If a separate form, list Project Name, Loop Number, ISA Tag Number, I/O Module Address, Manufacturer, Model Number/Serial Number, Output Range and Calibrated Value.

- c. Some examples of required information are:
  - 1) For Discrete Devices: Actual trip points and reset points.
  - 2) For Instruments: Any configuration or calibration settings entered into instrument.
  - 3) For Controllers: Mode settings (PID).
  - 4) For I/O Modules: Dip switch settings, module configuration (if not documented in native programming documentation).
- d. Maintain copy of these forms in field during testing and make them available for inspection at any time.
- e. For any device that allows a software back-up of configuration files to a laptop, make configuration files available to Engineer/Owner for inspection. Submit as part of Final System Documentation as specified in Section 406100 "Process Control and Enterprise Management Systems General Provisions."
- H. I/O Testing:
  - 1. Purpose of I/O testing is to check that process equipment, instrument installation, calibration, configuration, field wiring, and control panels are set-up correctly to monitor and control the processes. This test is commonly referred to as a "loop test" or an I/O checkout.
  - 2. PCSS in conjunction with Contractor to test signals under process conditions. Preferred test method will always be to execute test wherever possible to end elements. For example, preferred test will prove valve open/close limit switches by operating valve, not by installing a jumper on limit switch contacts. However, if equipment or process is not available to test a signal over its entire calibrated range, PCSS may test using a simulation method and make a note on sign-off form.
  - 3. Perform the following I/O tests:
    - a. Discrete Input: At device or instrument, change signal condition from inactive to active state. Observe results on all indicators within loop such as HMI screens, OIT screens, pilot lights, horns, beacons, etc.
    - b. Analog Input: Test analog signal over entire engineering range at various intervals including 0, 50 percent, and 100 percent as well as on increasing and decreasing range. Observe results on all indicators within loop such as HMI screens, OIT screens, recorders, digital indicators, etc.
    - c. Test discrete output signals by switching equipment to manual control at the HMI and OIT nodes and turning output on or using other means to turn output on. Then verify equipment responds accordingly.
    - d. Test analog output signals by switching equipment to manual control at HMI and OIT nodes and turning output on or other means to turn output on. Then verify equipment responds accordingly.
- I. Testing of Automatic Control Strategies:
  - 1. Verify all automatic control strategies using actual process equipment and instruments, or other means, to verify logic performs as expected. Verify faults and logical failure scenarios for control strategies such as instrument failures, equipment failures, loss of communication between HMI Server and PLC, loss of peer-to-peer communication, out

of range testing for analog inputs, loss of power, and all other strategies specified in control strategy document.

- J. Repeat all systems tests specified under factory testing.
- K. Test UPS to verify UPS switch power correctly while keeping all UPS powered loads online. Also, test sizing of UPS by switching off-line power to UPS and verify if they maintain specified run time.
- L. For all panels with enclosures modified by this Contract, test internal control panel temperature under full running conditions to ensure proper cooling/ventilation is being provided.
- M. Upon successful completion of ORT, PCSS to submit a record copy of test results as specified in PART 1 and request scheduling of FDT.

### 3.5 FIELD TESTING - FUNCTIONAL DEMONSTRATION TEST (FDT)

- A. After facility is started-up and running treatment process in automatic control to extent possible, perform a Functional Demonstration Test. Purpose of FDT is to allow Engineer or Owner representatives to witness actual functionality, performance, and stability of system while connected to process equipment.
- B. Required Documents for Test:
  - 1. Set of panel drawings and wiring diagrams from ORT with corrections noted.
  - 2. Set of Contract Documents: Drawings and Specifications.
  - 3. All design-change related documentation.
  - 4. Signed-off master copy of the PCSS developed field testing signoff forms.
  - 5. Testing procedures.
  - 6. Copy of completed calibration forms.
  - 7. One copy of all O & M Manuals for PCSS supplied equipment.
- C. Perform a witnessed FDT on each process area. To extent possible, repeat testing performed during ORT.
- D. Follow specified daily schedule during factory tests and FDT.
- E. After coordinating with Operations, perform a "Black Start" of the plant to confirm plant operation recovers as specified in Contract Documents. Black start means shutting off power to the plant and turning it back on. Perform separate tests by recovering the plant while on generator (if a generator is specified) and while on utility power.
- F. Document punch list items and resolutions noted during test on Punch list/Resolution form. In event of rejection of any part or function test procedure, PCSS to perform repairs, replacement, and/or retest within 10 days.
- G. Upon successful completion of the FDT, PCSS to submit a record copy of test results as specified in PART 1.

### 3.6 FIELD TESTING - SITE ACCEPTANCE TEST (SAT)

- A. After completion of FDT, and system is started-up and running treatment process in automatic control to extent possible, perform a test on system.
- B. While this test is proceeding, Engineer and Owner have full use of system. Only allow plant operating personnel to operate equipment associated with live plant processes. Plant operations remain the responsibility of Owner and decision of plant operators regarding plant operations are final.
- C. During this test, PCSS personnel to be present as required to address any potential issues that would impact system operation. PCSS is expected to provide personnel for this test who have an intimate knowledge of hardware and software of system. When PCSS personnel are not on-site, PCSS to provide cell phone/pager numbers that Owner personnel can use to ensure that support staff is available by phone and/or on-site within four hours of a request by operations staff.
- D. PCSS to analyze and correct any malfunctions during test. In event of rejection of any part or function, PCSS to perform repairs or replacement within 5 days.
- E. Throughout duration of SAT, do not make software or hardware modifications to the system without prior approval from Owner or Engineer.

END OF SECTION 406121.20

## APPENDIX 40 61 21-A: EXAMPLE INPUT/OUTPUT (I/O) STATUS SIGN OFF FORM

An example template for I/O Status signoff form to be used for documenting testing results to Owner is attached. PCSS is required, prior to testing, to create a project specific I/O Status signoff form based on attached template or approved equal. PCSS may obtain an electronic copy of template from Engineer or develop it on their own.

#### APPENDIX 40 61 21-B: EXAMPLE AUTOMATIC CONTROL STRATEGIES SIGN OFF FORM

An example template for Automatic Control Strategies signoff form to be used for documenting testing results to Owner is attached. PCSS is required, prior to testing, to create a project specific Automatic Control Strategies signoff form based on attached template or approved equal. PCSS may obtain an electronic copy of template from Engineer or develop it on their own.

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NRO Wells 117N and 119N Improvements Collier County, Florida

## SECTION 406126 - PROCESS CONTROL SYSTEM TRAINING

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. Section includes process control system training for provided devices and systems.
- B. Related Requirements:
  - 1. Section 406100 "Process Control and Enterprise Management Systems General Provisions."

#### 1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions."

## 1.4 ACTION SUBMITTALS

- A. Preliminary Training Plan Submittal:
  - 1. Prior to the preparation of the Final Training Plans, submit outlines of each training course including course objectives and target audience, resumes of instructors, prerequisite requirements for each class, and samples of handouts for review.
- B. Final Training Plan Submittal:
  - 1. Upon receipt of the Engineer's comments on the preliminary training plan, submit the specific proposed training plan with the following:
    - a. Definitions, objectives, and target audience of each course.
    - b. Schedule of training courses including proposed dates, duration and locations of each class.
    - c. Complete copy of all proposed handouts and training materials bound and logically arranged with all materials reduced to a maximum size of 11 inch by 17 inch, then folded to 8.5 inch by 11 inch for inclusion into the binder.

### 1.5 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 "Process Control and Enterprise Management System General Provisions."

## PART 2 - PRODUCTS (NOT USED)

### PART 3 - EXECUTION

### 3.1 GENERAL

- A. Directly relate training and instruction to system being supplied. Training program represents a comprehensive program covering all aspects of the operation and maintenance of the system.
- B. Coordinate all training schedules with and at the convenience of Owner, including shift training required to correspond to Owner's working schedule.
- C. Onsite instructors must be intimately familiar with operation and control of Owner's facilities.
- D. Provide detailed training manuals to supplement the training courses including specific details of equipment supplied and operations specific to the project. Provide manuals in hardcopy for each student. Provide electronic copy of each training manual in PDF format for Owner's future use.
- E. Make use of teaching aids, manuals, or slide/video presentations as required. After the training services, deliver all training materials to Owner.
- F. Owner reserves the right to videotape all custom training sessions. All training tapes become the sole property of Owner.
- G. Cost of Travel for Off-Site Training:
  - 1. Cost of Travel for off-site training is paid directly by the entity employing the staff doing the traveling.

### 3.2 TRAINING SUMMARY

Description	Minimum	Maximum	Number of	Intended
	Course	Number of	Times	Audience
	Duration	Trainees	Course to	
	(hours)	per Course	be Given	
Onsite Training				
Control System Overview Seminar	Covered in	AESS scope o	f work	
Operator Control System Training	Covered in	AESS scope o	f work	
Installed Control System	2	2	1	Maintenance,
				Administrator

A. Provide the following training courses listed in the summary table below:

PLC Hardware/Software	2	2	1	Maintenance
Instruments – Magnetic Flowmeter	4	2	1	Maintenance
Instruments - Operator familiarity	2	8	1	Operations
Fiber Optics	4	2	1	Maintenance

- B. Definitions of Audience Roles:
  - 1. Administrator: Personnel responsible for maintaining the HMI / SCADA system.
  - 2. Maintenance: Personnel responsible for maintaining the field controller hardware and instrumentation system.
  - 3. Operations: Personnel responsible for daily plant operations.
  - 4. Management: Non-daily operations personnel.

### 3.3 ONSITE TRAINING

- A. Training personnel are required to be intimately familiar with the control system equipment, its manipulation, and configuration. Training personnel are required to command knowledge of system debugging, program modification, troubleshooting, maintenance procedure, system operation, and programming, and capable of transferring this knowledge in an orderly fashion to technically oriented personnel.
- B. Installed Control System Training:
  - 1. Provide training for Owner's personnel in the functionality, maintenance, and troubleshooting, of the installed Control System. Conduct the training before the Functional Demonstrator Test (FDT), but not more than two months before.
  - 2. Provide training and instruction specific to the system that is being supplied.
  - 3. Provide training consisting of classroom instructions and hands-on instruction utilizing Owner's system.
  - 4. Provide detailed training on the actual configuration and implementation for this Contract covering all aspects of the system that will allow Owner's personnel to maintain, modify, troubleshoot, and develop future additions/deletions to the system. Provide training covering the following subjects:
    - a. System overview.
    - b. System hardware components and specific equipment arrangements.
    - c. Periodic maintenance.
    - d. Troubleshooting and diagnosis.
    - e. Network configuration, communications, and operation.
    - f. TCP/IP addressing procedures for all Ethernet devices.
- C. Programmable Logic Controller (PLC) Hardware and Software:
  - 1. Provide training for Owner's personnel in the operation, maintenance, troubleshooting, etc. with the PLC hardware and software system. Conduct the training before the FDT, but not more than two months before.
  - 2. Provide training and instruction specific to the system that is being supplied.
  - 3. Provide training consisting of classroom instructions and hands-on instruction utilizing Owner's system. Provide detailed training on the actual configuration and implementation for this Contract covering all aspects of the PLC system that will allow Owner's

personnel to maintain, modify, troubleshoot, and develop future additions/deletions to the PLC system. Provide training covering the following subjects:

- a. PLC system overview.
- b. PLC system architecture.
- c. PLC system hardware components and specific equipment arrangements.
- d. PLC system startup, shut down, load, backup, and PLC failure recovery.
- e. Periodic maintenance.
- f. Troubleshooting and diagnosis down to the I/O card level.
- g. PLC configuration, communications, and operation.
- D. Instrument Manufacturer Training:
  - 1. Provide manufacturer instrument training for those instruments where specifically indicated in the Instruments section. This is on-site training provided by an authorized representative of the manufacturer. The manufacturer's representative is required to be fully knowledgeable in the operation and maintenance of the equipment.
- E. Instrument Training:
  - 1. Provide instruction on the maintenance of the field and panel instrumentation for Owner's instrumentation technicians. Conduct this training before the FDT, but no more than 1 month before and at a time suitable to Owner. This training takes place at Owner's facility. Training program is required to include the following elements:
    - a. Training in standard hardware maintenance for the instruments provided.
    - b. Specific training for actual instrumentation configuration to provide a detailed understanding of how the equipment and components are arranged, connected, and set up for this Contract.
    - c. Testing, adjustment, and calibration procedures.
    - d. Troubleshooting and diagnosis.
    - e. Maintenance and frequency.
- F. Instruments Operator Familiarity:
  - 1. Provide operator level instruction on the use of field and panel instrumentation for Owner's operations staff. Conduct training before the 30-day site acceptance test, but no more than one month before and at a time suitable to Owner. This training takes place at Owner's facility. Include hands on demonstration of the information each transmitter indicates, and the method used to retrieve any operator information from the transmitter, including use of pushbuttons and interpretation of international graphic symbols used on the instruments.
- G. Fiber Optic Training:
  - 1. Provide instruction on maintenance of the fiber optic system for Owner's instrumentation technicians. Conduct training before the FDT, but no more than one month before and at time suitable to Owner. This training takes place at Owner's facility. Provide training covering the following topics:

- a. Fiber cable layout and basic of cable construction.
- b. Termination procedures.
- c. "Jumper" installation.
- d. Testing procedures.
- e. Troubleshooting and diagnosis.

END OF SECTION 406126

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## SECTION 406193 - PROCESS CONTROL SYSTEM INPUT/OUTPUT LIST

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Related Requirements:
  - 1. Section 406100 "Process Control and Enterprise Management Systems General Provisions" for I/O list submittal requirements.

### 1.3 DEFINITIONS

- A. Input/Output (I/O): Analog or digital field instrument signals to be received and interpreted by PLC.
- B. Programmable Logic Controller (PLC): Ruggedized programmable computer used for industrial automation.

#### 1.4 ACTION SUBMITTALS

- A. Process Controller Input/Output (I/O) Schedule:
  - 1. Submit complete I/O schedule as specified in Section 406100 "Process Control and Enterprise Management Systems General Provisions."

### 1.5 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 "Process Control and Enterprise Management System General Provisions."

## PART 2 - PRODUCTS (NOT USED)

### PART 3 - EXECUTION (NOT USED)

#### END OF SECTION 406193

## SECTION 406196 - PROCESS CONTROL DESCRIPTIONS

PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

- A. Section Includes: Applications Engineer System Supplier (AESS) Programming Scope:
  - 1. Develop the control system applications to implement the process control descriptions for all new and existing systems. This Section is provided to define control strategies to be used for PLC programming of the system.
  - 2. Contract Documents are a single integrated document, and as such, all Drawings and Specifications apply. It is the responsibility of Contractor and subcontractors to review all Sections to ensure a complete and coordinated project.
  - 3. PCSS is cautioned to read this Section and all related Sections and their entirety prior to starting any programming. Many general control strategies and requirements are defined once in the body of this Section with the specific requirement called out in the individual control strategy. Implement these general strategies throughout this Contract unless specifically directed otherwise in the individual loop process control descriptions.
  - 4. Follow loop and device tagging criteria shown on Drawings without exception.
- B. Related Requirements:
  - 1. Section 406100 "Process Control and Enterprise Management Systems General Provisions."
  - 2. Section 406866 "Configuration of Controller Software."

### 1.3 DEFINITIONS

- A. Applications Engineering System Supplier (AESS): Entity who provides all programming, configuration, and related services for the control system equipment provided by the PCSS.
- B. Human Machine Interface (HMI): A software-based user interface with supervisory level control of machine level equipment.
- C. Input/Output (I/O): Analog or digital field instrument signals to be received and interpreted by a PLC.
- D. Operator Interface Terminal (OIT): A hardware component of the SCADA system used for device level control and monitoring.
- E. Operator Workstation (OWS): A hardware component of the SCADA system used for supervisory level control and monitoring.

- F. Process Control System Supplier (PCSS): Entity responsible for providing all materials, equipment, labor, and services required to achieve a fully integrated and operational control system.
- G. Programmable Logic Controller (PLC): A ruggedized programmable computer used for industrial automation.
- H. Supervisor Control and Data Acquisition (SCADA): Hardware and software components used for high-level supervisory monitoring of industrial processes. Typical devices that are part of the SCADA network include computers (OWS), PLCs, Ethernet switches, OITs, and HMIs.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

- 3.1 GENERAL
  - A. Control System Hierarchy:
    - 1. The control descriptions are broken into a hierarchical layer concept. There may be one layer or multiple layers per loop, depending upon that loop. An example of multiple layered loop is shown in Figure 1.



Figure 1. Control System Hierarchy

## 3.2 GENERAL CONTROLS AND MONITORING

- A. Overview:
  - 1. Hardware and/or software functions noted by this Paragraph reference are to be implemented in the PLC control system.

- 2. Setpoints, as defined by this section, refer to numerical values adjustable from the HMI.
- 3. PLC is responsible for resetting command bits sent from the HMI to the PLC. If the commanded state cannot be achieved for any reason, the PLC resets the bit to allow the operator to set the command bit again. For example, when pressing the AUTO button on the HMI, the PLC resets the AUTO command from the HMI after the device is in the AUTO Mode. If the AUTO Mode is not available for any reason, the PLC resets the bit, so the AUTO button can be selected at the HMI once AUTO control is available.
- B. Interlocks:
  - 1. Hardwired interlocks will interlock the controls locally, at the vendor PLC, and at the plant PLC. If the interlock occurs, the shutdown will cause the equipment to be inoperable at all levels of control.
  - 2. Software interlocks are represented in a particular layer of the operation description and interlock the controls in that layer and the layers above it. However, the interlock does not interlock the commands in the layer before it. For example, a software interlock implemented at the SCADA/PLC level will not stop equipment from being controlled locally.
  - 3. Interlocks that shutdown (stop a piece of equipment and prevent it from being restarted or moved) are displayed on the faceplate pop-up graphic for that piece of equipment.

# C. Motors:

- 1. Provide monitoring and control of the signals shown on the P&IDs.
- 2. Hardwired and software interlocks are defined in individual loop descriptions.
- 3. Motors can be started manually by the operator at the HMI, or automatically by the control strategy.
- 4. Automatic control strategies are defined in individual loop descriptions.
- 5. The SCADA system stops a motor or drive, if it does not receive the AUTO or REMOTE status or one of its software interlocks trips. If the drive or motor is in HAND or LOCAL, it will continue to run but the SCADA start/stop output will be open.
- 6. If a motor stops for any reason, it cannot be restarted automatically once the problem with the motor has been resolved. A manual reset from the OWS or OIT is required to resume operation.
- 7. Motors that have a HAND-OFF-AUTO (HOA) selector, indicate to the operator that the pump is being run in the HAND position. A motor is being run in HAND when the AUTO position is not true and the run confirm status is true. If not in AUTO, the SCADA PLC output contact will open and stop (shutdown) the pump.
- D. Valves:
  - 1. Provide monitoring and control of the signals shown on the P&IDs.
  - 2. Hardwired and software interlocks are defined in individual loop descriptions.
  - 3. Valves with only full travel capability can be opened or closed manually by the operator at the HMI, or automatically by the control strategy.
  - 4. Modulating valves with position feedback can be positioned between 0 percent and 100 percent open manually by the operator at the HMI, or automatically by the control strategy.
  - 5. Automatic control strategies are defined in individual loop descriptions with their corresponding process variable used for control.

## E. Analog Instruments:

- 1. Analog instruments refer to indicating devices capable of providing a continuous output relative to time.
- 2. Provide monitoring of the analog signals shown on the P&IDs.
- 3. Analog signals may be a continuous voltage (-10V to 10V, 0V to 5V, 0V to 10V) or current (0 mA to 20mA, 4mA to 20mA) as determined by the output of the field instrument. The output range corresponds to the minimum and maximum full-scale measurement.
- 4. The PLC will linearly scale the output range (voltage or current) to the equivalent values in engineering units.
- 5. Provide cutoff deadbands for when the analog signal is approaching the minimum or maximum full-scale measurement.
  - a. An analog signal measuring less than or equal to 2 percent of full-scale will be forced to zero after an adjustable time delay.
  - b. An analog signal measuring greater than 100 percent of full-scale will be clamped at 100 percent.
- 6. Provide a CALIBRATION mode with an adjustable time setpoint (in hours).
  - a. When entering CALIBRATION mode, the last good value is held prior to CALIBRATION mode being activated. The value is held until the calibration time setpoint expires.
  - b. The Operator may enter a calibration value, which will be the value held until the calibration time setpoint expires.
  - c. When active, clearly indicate the instrument is in CALIBRATION mode on any local OITs and in the HMI system.
- F. Discrete Instruments:
  - 1. Discrete instruments refer to indicating devices with any number of non-continuous defined states (e.g., ON/OFF, 0 or 1).
  - 2. Provide monitoring of the discrete signals shown on the P&IDs.
    - a. When a contact or status from the instrument is true, the PLC will receive power to its input channel. The PLC registers this as a binary bit of 1.
    - b. When a contact or status from the instrument is false, the PLC will receive no power (open circuit) to its input channel. The PLC registers this as a binary bit of 0.
- G. PLC Hardware:
  - 1. Monitor status and communication faults at the HMI.
    - a. Implement watchdog timers to monitor CPU and I/O module health, and execution time for PLC routines.
    - b. Generate an alarm at the HMI if any watchdog timer expires.
  - 2. Program the system time for all PLCs to synchronize with a Network Time Protocol (NTP) server once every 24 hours.

## H. Input Validation:

- 1. Provide input validation for setpoints used in process control (e.g., chemical dosage setpoints, pump flow setpoints).
- 2. The PLC will verify that the HMI setpoint is within an acceptable predefined range.
- 3. Out of range values will be rejected by the PLC and the current value will be retained.

# 3.3 ACCUMULATORS AND TOTALIZERS

### A. Accumulators:

- 1. Display accumulated run time for all equipment with a RUNNING status. Each run time accumulation is resettable from the HMI with a reset push button.
- 2. PLC will update the flow totals at 12:00 a.m. local time.

Runtime	Display Format
Current Day:	XX.XX Hrs.
Yesterday:	XX.XX Hrs.
Current Month:	XXX.X Hrs.
Previous Month:	XXX.X Hrs.
Accumulated Total:	XXXXXX Hrs.

- B. Flow Totalizers:
  - 1. Totalize all flow indications.
    - a. If the flowmeter provided has a configurable pulse output for totalized flow, perform flow totalization using the pulse output. The PLC calculates totalized flow by multiplying the number of pulses by the volume per pulse.
    - b. If the flowmeter provided does not have a configurable pulse output for totalized flow, perform flow totalization using the analog 4-20 mA signal.
      - 1) Do not totalize if the analog signal is outside the 4-20 mA range.
      - 2) Do not totalize if the value of the flow input is less than 2 percent of the full range of the input.
      - 3) Do not totalize if a discrete status exists that can be used to determine if flow is present (for example, no flow can be present unless a pump is running).
  - 2. Each flow totalization is resettable from the HMI/OIT with a reset push button.
  - 3. Display totalized flow in million gallons (MG), thousands of gallons (kGal), or Gallons (Gal) in accordance with the following:

Totalizer	MG Format	kGal Format	Gal Format
Current Day:	X.XXX	XXX.XX	XXXX.X
Yesterday:	X.XXX	XXX.XX	XXXX.X
Current Month:	XXX.X	XXX.X	XXXX
Previous Month:	XXX.X	XXX.X	XXXX
Accumulated Total:	XXXX	XXXX	XXXX

- 4. Use appropriate flow totalizer units for the total volume anticipated for the time period. Unless requested by Owner, water process flows are totalized in million gallons (MG) and chemical flows are totalized in gallons (Gal). Auxiliary flow (e.g., backwash) units are determined based on the total flow for the day.
- 5. Chemical systems which do not have flowmeters will calculate usage based on the chemical tank volume. The PLC will calculate tank volume based on the measured level and the vessel geometry or the measured weight and the specific weight of the chemical.
- 6. PLC will update the flow totals at 12:00 a.m. local time.

# 3.4 ALARMING AND EQUIPMENT FAILURES

- A. Analog Alarms:
  - 1. Provide analog alarming capability for all analog signals monitored by the PLC.
  - 2. Supervisor level users can set a common time setpoint (initially set to 5 seconds) that is used to generate alarms. The following alarms (setpoints to be Supervisor adjustable) are generated based on the analog feedback value. Each alarm includes the ability for individual enabling and disabling.
    - a. High-High.
    - b. High.
    - c. Low.
    - d. Low-Low.
    - e. Loss of Signal.
  - 3. LOSS OF SIGNAL alarm is generated when an analog signal goes outside the 4-20 mA range due to a failure at the instrument or PLC card. The following SCADA programming occurs:
    - a. If the analog signal is used in a control loop or ratio control loop, that loop is placed into MANUAL.
    - b. If the analog signal is used in a calculation, that calculation uses the last good analog signal. If the calculation is used in a control loop, that loop is placed into MANUAL.
  - 4. SETPOINT REJECTED alarm is generated at the HMI when an analog setpoint is out of range and rejected by the PLC.
- B. Discrete Alarms:
  - 1. Program all discrete alarm signals wired to the PLC (float switches, pressure switches, overload alarms) to alarm after an HMI adjustable time delay expires.
  - 2. The maximum alarm delay for Safety related alarms (e.g., E-stop) is 500 ms. Set each alarm timer during startup.
- C. Motor Failure Alarms:
  - 1. Supervisor level users can set a common elapsed time setpoint for each scenario below:
    - a. Motors being remotely controlled generate a FAIL-TO-START alarm when the PLC sends the START command to the motor and it does not receive a RUNNING status from the motor after a supervisor adjustable time setpoint.

When a FAIL-TO-START alarm is generated, the START output command from the PLC is deenergized and the motor is prevented from starting until a reset is issued from the HMI.

- b. Motors being remotely controlled generate a FAIL-TO-STOP alarm when the PLC sends the STOP command to the motor and it continues to run after a supervisor adjustable time setpoint.
- c. Motors with adjustable speed control generate a SPEED DEVIATION alarm when the motor is running and the PLC sends a speed setpoint to the motor and it does not reach the correct speed (within a deadband, initially set to 10 percent) within a supervisor adjustable time setpoint. The motor remains running if the SPEED DEVIATION alarm is activated.
- D. Valve Failures:
  - 1. Supervisor level users can set a common time setpoint that is used to generate the following alarms. When a valve position alarm is active, the PLC output is maintained unless explicitly stated in the individual loop descriptions (e.g., a fail to open alarm does not trigger the PLC to close the valve).
    - a. All discrete valves (OPEN-CLOSE) being remotely controlled generate a FAIL-TO-OPEN alarm when the PLC sends the OPEN command to the valve and it does not reach the OPENED limit within a supervisor adjustable time setpoint.
    - b. All discrete valves (OPEN-CLOSE) being remotely controlled generate a FAIL-TO-CLOSE alarm when the PLC sends the CLOSE command to the valve and it does not reach the CLOSED limit within a supervisor adjustable time setpoint.
    - c. All modulating valves (POSITIONING) being remotely controlled generate a FAIL-TO-POSITION alarm when the valve feedback does not match the PLC commanded position within a supervisor adjustable time setpoint.

# 3.5 AUTOMATIC CONTROLS

- A. Lead/Lag and Duty/Standby Strategy:
  - 1. Pump Priority:
    - a. When pumps are called to operate by the automatic sequence, the order of their priority is determined by the following mode selection.
      - 1) Operator Mode: The operator manually selects the priority of each pump (LEAD/LAG/STANDBY/OFFLINE) using radio buttons on a popup display. The order can be changed at any time, but no two pumps can be selected to have the same priority. The pump cannot run in automatic mode or be used in any of the following automatic sequences if placed OFFLINE.
      - 2) Alternation Mode: Used for pumps operating in a DUTY/STANDBY configuration. The pump priorities are rotated each time the DUTY pump is stopped by the control strategy.
      - 3) Sequential Mode: Used for groups of three or more pumps (e.g., LEAD/LAG/STANDBY). The pumps are inserted into the sequence in ascending numerical order and the PLC rotates the pumps using a revolving queue. After an adjustable time setpoint expires, the LEAD pump becomes the STANDBY and the previous LAG pump becoming the new LEAD.

# 2. Automatic Operation:

- a. If the individual loop description requires that the pumps operate in the LEAD/LAG/STANDBY mode, the LAG is called to start when the following conditions are met after a time delay. If more than one LAG pump is included in the strategy (LEAD/LAG1/LAG2/STANDBY), the sequence repeats.
  - 1) LEAD pump is running at maximum speed for an adjustable length of time.
  - 2) The process variable being controlled is more than 5 percent from the target value. For example, in flow control, the flow must be 5 percent below the target.
- b. If multiple pumps are called to run by the automatic logic, the pumps will run at the same speed.
- c. If the automatic strategy determines that a pump is needed and the pump for the required sequence position is unavailable, the pump with the next highest position immediately starts.
- d. If the individual loop description requires the pumps to operate in the DUTY/STANDBY mode, the STANDBY pump only starts if the DUTY pump is not available to run when called to start by the automatic strategy.
- B. PID Control:
  - 1. When individual control loops require PID control, use the PLC manufacturer's standard PID control functions. Provide a PID faceplate with the following parameters:
    - a. Setpoint (SP): Reference to the setpoint. This is the setpoint entered (either manually from the HMI or via program logic, as required by the individual loop description) and is maintained by the PID controller.
    - b. Process Variable (PV): Reference to the process variable. The process variable is the feedback from a field device or instrument for comparison to the SP by the PID controller.
    - c. Output (CV): Reference to the controlled variable. This is the signal varied by the PID controller in order to maintain the PV at the desired SP.
  - 2. PID controller accepts inputs for proportional (P), integral (I), and derivative (D) setpoints used to tune the controller response. PID tuning parameters can be entered manually by the Operator at the HMI or calculated automatically if the PID controller supports autotuning functionality.
  - 3. Operator can place the PID controller in MANUAL or AUTOMATIC mode.
    - a. In MANUAL, the Operator will enter the desired output (CV). The PID controller will use setpoint tracking to write the process variable (PV) to the controller setpoint (SP) to ensure bumpless transfer when the controller is switched from MANUAL to AUTO.
    - b. In AUTO, the PID controller adjusts the output (CV) to hold the process variable (PV) at the setpoint (SP).
  - 4. Configure PID controller to prevent reset windup when operating in MANUAL mode or when the output (CV) has reached maximum limit.
#### 3.6 INDIVIDUAL CONTROL DESCRIPTIONS AND CONTROL SEQUENCES

### LOOP 120, 220 WELL DISCHARGE FLOW

- A. General:
  - 1. Continuous monitoring of raw water flow by means of a flow transmitter to SCADA.
- B. Control:
  - 1. Raw water flow indication used to control the Wells described in WELL MONITORING AND CONTROL.
- C. Alarms/Monitoring:
  - 1. Provide flow totalization, analog alarming, and monitoring as described in "Accumulators and Totalizers," "General Controls and Monitoring," and "Alarming and Equipment Failures" Articles of this Section.
  - 2. Generate a NO FLOW alarm if no flow is measured while any of the Wells are running.
- D. Data Collection:
  - 1. Provide historical data collection as described in "Historical Data Collection" Article of this Section.

#### LOOP 115, 215 WELL DISCHARGE PRESSURE

- A. General:
  - 1. Continuous monitoring of Well Discharge Pressure by means of a pressure transmitter to SCADA.
- B. Control:
  - 1. Pressure indication used to control the Wells described in WELL MONITORING AND CONTROL.
- C. Alarms/Monitoring:
  - 1. Provide analog alarming and monitoring as described in "General Controls and Monitoring," and "Alarming and Equipment Failures" Articles of this Section.
- D. Data Collection:
  - 1. Provide historical data collection as described in "Historical Data Collection" Article of this Section.

# LOOP 100, 200 WELL MONITORING AND CONTROL

- A. General:
  - 1. Wells shall run locally via the Local Pump Control Panel. Wells shall be able to be controlled remotely via SCADA. When in Remote/Manual mode, operations shall start and stop a well pump and enter well pump speed. When in Remote/Auto mode, VFD shall modulate the well pump speed to maintain a flow setpoint as entered by the operator via SCADA. In Remote/Auto mode, the well pumps shall not start automatically, they must be started by the operator.
- B. Alarms/Monitoring:
  - 1. Provide alarming and monitoring as described in "General Controls and Monitoring," and "Alarming and Equipment Failures" Articles of this Section.
- C. Data Collection:
  - 1. Provide historical data collection as described in "Historical Data Collection" Article of this Section.

# SECTION 406343 - PROGRAMMABLE LOGIC CONTROLLERS

# PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. Section includes programmable logic controllers<Insert description of any other essential item included in the Section.
- B. Related Requirements:
  - 1. Section 406100 "Process Control and Enterprise Management Systems General Provisions."

#### 1.3 DEFINITIONS

- A. Analog Input (AI): An electrical signal (1-5 Volts DC or 4-20 milliamps, for example) to be interpreted by a PLC.
- B. Analog Output (AO): An electrical signal (1-5 Volts DC or 4-20 milliamps, for example) sent from a PLC to a field device.
- C. Digital/Discrete Input (DI): A binary signal (0 or 1) to be interpreted by a PLC.
- D. Digital/Discrete Output (DO): A binary signal (0 or 1) sent from a PLC to a field device.
- E. Input/Output (I/O): Analog or digital field instrument signals to be received and interpreted by a PLC.
- F. Human Machine Interface (HMI): A software-based user interface with supervisory level control and of machine level equipment.
- G. Operator Interface Terminal (OIT): A hardware component of the HMI used for device level control and monitoring.
- H. Peer to Peer: Communication between two or more devices, typically PLC's, in which each device can control the communication exchange.
- I. Programmable Logic Controller (PLC): A ruggedized programmable computer used for industrial automation.

J. Remote I/O (RIO): I/O that is located remotely from the processor. Remote I/O can communicate over a variety of communication protocol and can use standard rack based I/O, or specialized Remote I/O hardware referred to as Distributed I/O.

# 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Refer to Section 406100 "Process Control and Enterprise Management System General Provisions."
- B. Shop Drawings:
  - 1. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions."

# 1.5 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 "Process Control and Enterprise Management System General Provisions."

# 1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. I/O Cards: Provide spares for each unique I/O module type installed. Provide two or 10 percent of installed quantity, whichever is greater.
  - 2. Network interface, remote I/O, and communication modules: Provide one spare module for each unique type of module installed.
  - 3. Miscellaneous components (including cables): Provide spares for each unique component installed.

## 1.7 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

## 1.8 FIELD CONDITIONS

A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions."

## 1.9 WARRANTY

A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions."

## PART 2 - PRODUCTS

#### 2.1 SYSTEM DESCRIPTION

A. Configuration: Networked programmable controller incorporated into system control panel.

# 2.2 SPARE I/O, SLOTS, AND FUTURE EXPANSION

- A. Spare PLC I/O:
  - 1. Provide 20 percent minimum of four points per type (AI, AO, DI, and DO) for future use, regardless of whether any of those point types are used in that panel or not.
  - 2. Provide spare I/O points of same type of I/O modules supplied.
- B. Future PLC Expansion (Non-Chassis-Based PLC Systems):
  - 1. Provide adequate space to the right of the last I/O card per row of I/O cards for 2 future I/O cards.
  - 2. Card width based on the widest I/O card provided in panel.
  - 3. Wire all unused points on all I/O to terminal blocks in the order that they occur on the I/O modules. Wire all unused points complete with fuses, surge protectors, relays, and any other accessories that are provided with active points of the same type.

#### 2.3 COMPACT PLC SYSTEM

- A. Manufacturers:
  - 1. Provide all PLCs from a single manufacturer. If PLC manufacturer has authorized third party vendors to provide modules that are compatible with their platforms, then products manufactured by these authorized third-party vendors will be acceptable.
  - 2. Manufacturers and their products are subject to compliance with requirements. Provide the following:
    - a. Rockwell Automation Allen-Bradley 1769-L33(L3) CompactLogix.
    - b. Remote I/O:
      - 1) Rockwell Automation Allen-Bradley FlexIO.
    - c. Substitutions: Not Permitted.

## B. General:

- 1. Provide processor, power supply, I/O modules, communication modules, and remote interface modules as required to meet system requirements.
- 2. PLC is modular based, rather than chassis-based.
- 3. Listed and classified by UL, CSA, or FM approval as suitable for purpose specified and indicated.
- 4. Contains the required memory and functional capacity to perform the specified sequence of operation with the scheduled inputs and output points.

- 5. Designed for continuous industrial service.
- 6. Provide products of a single manufacturer.
- 7. Provide equipment models that are currently in production.
- 8. In the event of power interruption, the system undergoes an orderly shutdown with no loss of memory and resumes normal operation without manual intervention when power is restored.
- 9. Provide PLCs that communicate between workstations, servers, instruments, switches, controllers, process actuators, etc. as shown on the Drawings.
- 10. PLC capable of stand-alone operation in the event of failure of the communication link to the HMI subsystem.
- C. Physical:
  - 1. Vibration: 3.5mm Peak-to-Peak, 5-9 Hz: 1.0G, 9-150 Hz. Vibration tested in accordance with IEC 68-2-6 and JIS C 0911. The system is to be operational during and after testing. Vibration Rating of 2.0G maximum peak acceleration for 10 to 500 Hz. In accordance with one of the following:
    - a. DIN rail mounted PLC, 10 57 Hz., amplitude 0.075 mm, acceleration 25-100 Hz.
    - b. Panel or plate mounted PLC: 2-25 Hz., amplitude 1.6mm, acceleration 25-200 Hz.
    - c. In compliance with IEC 60068 and IEC 61131.
  - 2. Shock: 15G, 11msec. Shock tested in accordance with IEC 68-2-27 and JIS C 0912. The system is to be operational during and after testing.
  - 3. Operating Temperature: 32 to 140 degrees F (0 to 60 degrees C).
  - 4. Storage Temperature: -13 to 158 degrees F (-25 to 70 degrees C).
  - 5. Relative Humidity: 10 to 95 percent, non-condensing.
  - 6. Noise Immunity: Tested to operate in the high electrical noise environment of an industrial plant as governed by the following regulations: IEEE 472, IEC 801, MILSTD 461B, IEC 255-4, NEMA ICS 2-230.40, and ANSI/IEEE C-37.90A-1978.
  - 7. Altitude (Operating): 0 to 6,500 feet (0 to 1,980 meters).
  - 8. Altitude (Storage): 0 to 9,800 feet (0 to 2,990 meters).
  - 9. Degree of protection: NEMA 1 (IP20).
  - 10. All products have corrosion protection.
- D. Identification:
  - 1. Identify all major assemblies and sub-assemblies, circuit boards, and devices using permanent labels or markings indicating:
    - a. Module product type such as analog or digital.
    - b. Module catalog number.
    - c. Module major revision number.
    - d. Module minor revision number.
    - e. Module manufacturer vendor.
    - f. Module serial number.
- E. Power Supplies:
  - 1. Power Input: 85 to 265VAC, 47 63Hz.
  - 2. Provide DC power supplies capable of handling ripple up to 2.4V peak to peak.

- 3. Power supply provide power for the processor and applicable modules.
- 4. Provide clearly visible LED to indicate that the incoming power is acceptable, and the output voltage is present.
- 5. Provide over-current and over-voltage protection designed to operate in most industrial environments without the need for isolation transformers.
- 6. Size power supplies to accommodate the nominal load plus 30 percent.
- 7. Provide power supplies capable of sustaining brown out conditions of at least 1/2 of a cycle, a harmonic rate of 10 percent, and continuous operation through momentary interruptions of AC line voltage of 10 ms or less.
- 8. Automatically shut down the PLC system whenever its output power is detected as exceeding 125 percent of its rated power.
- 9. Provide surge protection, isolation, and outage carry-over up to 2 cycles of the AC line.
- F. Discrete Input & Output Modules:
  - 1. General:
    - a. Digital input and output modules provide ON/OFF detection and actuation capability.
    - b. Provide cards of I/O type and count as required to implement the functions specified plus an allowance for active spares, as specified herein.
    - c. Provide modules capable of being installed or removed while chassis power is applied.
    - d. Provide the following status indicators:
      - 1) On/Off state of the field device.
      - 2) Module's communication status.
      - 3) Module health.
  - 2. Module Specifications 120VAC Input Module:
    - a. Nominal Input Voltage: 120VAC.
    - b. On-State Current: 15mA at 132VAC, 47 63Hz maximum.
    - c. Maximum Off-State Voltage: 20V.
    - d. Maximum Off-State Current: 2.5mA.
    - e. Number of Points per Card: 16.
  - 3. Module Specification 120 VAC Solid State Output Module:
    - a. For each triac type discrete output, provide an associated interposing relay located in the same control panel. Provide 120 VAC power for relay outputs from the associated motor starter control circuit (when used with motor starters) or other 120 VAC source (when I/O is not associated with a particular motor starter).
    - b. Output Voltage Range: 74 265 VAC, 47 63 Hz.
    - c. Output Current Rating:
      - 1) Per Point: 0.5A maximum at 86 degrees F (30 degrees C); 0.25A maximum at 140 degrees F (60 degrees C); Linear Derating.
      - 2) Per Module: 4A maximum at 86 degrees F (30 degrees C); 2A maximum at 140 degrees F (60 degrees C); Linear Derating.

- d. Surge Current per Point: 5A for 43ms each, repeatable every 2s at 140 degrees F (60 degrees C).
- e. Minimum Load Current: 10mA per point.
- f. Maximum On-State Voltage Drop: 1.5V peak at 2.0A and 6V peak at load less than 50mA.
- g. Maximum Off-State Leakage: 2.5mA per point.
- h. Number of Points per Card: 16.
- G. Analog Input & Output Modules:
  - 1. General:
    - a. Analog input modules convert an analog signal (1 to 5 Volts DC, 4 to 20 milliamps, for example) that is connected to the module's screw terminals into a digital value.
    - b. Furnish analog output modules to convert a digital value that is delivered to the module into an analog signal on the module's screw terminals.
    - c. Provide modules designed to be installed or removed while power is applied.
    - d. Provide the following status indicators:
      - 1) Module's communication status.
      - 2) Module health.
      - 3) Input/output devices.
    - e. Hardware and software indication provided when a module fault has occurred. Each module provided with an LED fault indicator and the programming software displays the fault information.
    - f. Provide analog modules that are software configurable through the I/O configuration portion of the programming software.
    - g. Following status can be examined in ladder logic:
      - 1) Module Fault Word: Provides fault summary reporting.
      - 2) Channel Fault Word: Provides under-range, over-range, and communications fault reporting.
      - 3) Channel Status Words: Provides individual channel under-range and overrange fault reporting for process alarm, rate alarms and calibration faults.
    - h. Provide 24 VDC power for analog instrument loops as a part of the system. Derive 24 VDC power supply from the 120 VAC input power circuit to the PLC. Group the field side of the 24 VDC power sources(s) as individual or grouped (of logically associated circuits) fusing and provide with a readily visible, labeled blown fuse indicator.
  - 2. Differential Analog Input Module:
    - a. Input Range: 0-20 mA.
    - b. Resolution: Approximately 16 bits across range.
    - c. Input Impedance: Greater than 249 Ohms.
    - d. Overvoltage Protection: 8V ac/dc with on-board current resistor.
    - e. Normal Mode Rejection: 60 dB at 60 Hz.
    - f. Common Mode Noise Rejection: 120 dB at 60 Hz, 100 dB at 50 Hz.

- g. Isolation Voltage:
  - 1) Channel to Ground/Chassis 100 percent tested at 1000 VDC minimum for 1s based on 250 VAC.
- h. Number of Points per Card: 8.
- 3. Isolated Analog Output Current Module:
  - a. Output Current Range: 4 to 20 mA.
  - b. Current Resolution: 12 bits across 20 mA.
  - c. Open Circuit Detection: None.
  - d. Output Overvoltage Protection: 24V DC/AC maximum.
  - e. Output Short Circuit Protection: 20 mA or less (electronically limited).
  - f. Calibration Accuracy: Better than 0.1 percent of range from 4 mA to 20 mA.
  - g. Number of Points per Card: 8.
- H. Required Accessories:
  - 1. Include all necessary cables as specified by the manufacturer. Assemble and install cables per manufacturer recommendations.

# 2.4 PLC SOFTWARE

- A. Manufacturer: As required to match supplied PLCs.
- B. General:
  - 1. Provide PLC configuration and application development software package complete with documentation and installation media.
  - 2. Install PLC software package and associated licensing and/or activation on the computers shown on Drawings.
  - 3. Allows for on-line/off-line program development, annotation, monitoring, debugging, uploading, and downloading of programs to the PLCs.
  - 4. Provide required hardware (including cables, cable adapters, etc.) for connection to PLCs.
  - 5. Provide software licenses required to achieve the functionality described in the Specifications.
  - 6. Include a software license agreement allowing Owner the right to use the software as required for any current or future modification, documentation, or development of the PLCs provide for this project.
  - 7. Provide software capable of the following IEC 61131-3 functions:
    - a. Ladder logic.
    - b. Function block.
    - c. Sequential function chart.
    - d. Structured text.
  - 8. Add-on instruction editor allows for the development of custom reusable function blocks. The software permits function block modification while on-line.

- 9. Software is Microsoft Windows-based and run on the supplied computers.
- 10. Software includes a security feature to prevent unauthorized personnel from modifying and downloading the programs.
- 11. Provide I/O simulator which allows PLC application load program to be tested on a PC with simulated analog and digital inputs and outputs, allowing I/O testing and debugging to be performed in safe, isolated environment without the need for running the PLC CPU and process I/O boards.

## PART 3 - EXECUTION

## 3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

# 3.2 IDENTIFICATION

A. Refer to control system architecture for tagging designations.

# SECTION 406613 - SWITCHES AND ROUTERS

# PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes switches and routers.
- B. Related Requirements:
  - 1. Section 406100 "Process Control and Enterprise Management Systems General Provisions" for submittal requirements.
  - 2. Section 406717 "Industrial Enclosures."
  - 3. Section 406343 "Programmable Logic Controllers."

#### 1.3 DEFINITIONS

- A. Fiber optic Ethernet switch (FOES): An Ethernet based networking device with a combination of fiber optic and copper physical connections.
- B. Local Area Network (LAN): A localized group of network devices (e.g. buildings, homes, offices, etc.)
- C. Managed Ethernet switch (MES): An Ethernet based networking device that permits the management, configuration, and monitoring of a local area network.
- D. Power over Ethernet (PoE): A method of providing electrical current over an Ethernet connection.
- E. Small form-factor pluggable (SFP): A hot-pluggable network interface module connecting a device motherboard (Ethernet switch, router, etc..) to a fiber optic or copper networking cable.
- F. Unmanaged Ethernet Switch (UMES): An Ethernet based networking device with a fixed configuration (i.e. "plug-and-play" devices).
- G. Virtual Private Network (VPN): An encrypted connection between a private network and a public network (the internet).
- H. Wide Area Network (WAN): A network that covers a broad geographic area, typically through use of a public network (e.g. communication across cities, national boundaries, etc..).

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Refer to Section 406100 "Process Control and Enterprise Management System General Provisions"
- B. Shop Drawings:
  - 1. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions"

#### 1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions."

## 1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 "Process Control and Enterprise Management System General Provisions."

#### 1.7 MAINTENANCE MATERIAL SUBMITTALS

A. None Required.

#### 1.8 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

#### 1.9 TECHNOLOGY OBSOLESCENCE MITIGATION

A. Due to rapidly evolving technology of the equipment specified herein, requirements specified are to establish a baseline for the type of equipment required. Provide the current version of hardware and software of similar specification at the time of purchase equivalent in cost to that which is specified.

#### 1.10 FIELD CONDITIONS

A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions."

### 1.11 WARRANTY

A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions."

### PART 2 - PRODUCTS

#### 2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

#### 2.2 INDUSTRIAL MANAGED ETHERNET SWITCH FOR PLC PANEL

- A. Manufacturers:
  - 1. Manufacturers and their products are subject to compliance with requirements. Provide the following:
    - a. Allen-Bradley: Stratix 5800 version.
    - b. Substitutions: Not Permitted.
- B. General:
  - 1. Provide DIN rail mountable industrial managed Ethernet switch for connection to the network as shown in Drawings and specified herein.
  - 2. Provide ethernet switches by the same manufacturer for the project, regardless of type.
- C. Physical Features:
  - 1. SFP slots: 4 x 1G/10G SFP slots.
  - 2. Copper ports: 8 x 10/100/1000BaseT(X) ports.
  - 3. Operating temperature: 0 to 130 degrees F.
  - 4. Power: redundant 24VDC power input.
  - 5. Enclosure: Metal case.
  - 6. Rating: UL Class 1, Division 2 Groups A, B, C, and D.
- D. Network Features:
  - 1. Layer 2 switching.
  - 2. Spanning Tree Protocol (STP).
  - 3. Rapid Spanning Tree Protocol (RSTP) (IEEE 802.1w).
  - 4. Full duplex on all port.
  - 5. Auto negotiation and manual configurable speed and duplex.
  - 6. Wire speed switching fabric.
  - 7. IGMP snooping.
  - 8. IGMP filtering.
  - 9. Configuration password protected.
  - 10. Configuration backup capability required.

- 11. SNMP V3.
- 12. Lock port function for blocking unauthorized access based on MAC address.
- E. Additional Features:
  - 1. Provide dry contact rated for 24VDC 5A to be used for common trouble alarm and programmable alarm.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine walls, floors, roofs, and rooms for suitable conditions where computers will be installed.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

# 3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

## 3.3 IDENTIFICATION

A. Refer to drawings for tagging designations.

## 3.4 FIELD QUALITY CONTROL

A. Switchers and routers will be considered defective if it does not pass tests and inspections.

## 3.5 STARTUP SERVICE

- A. Perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.
  - 2. For Managed Ethernet Switches:
    - a. Enable lock port function to block unauthorized access based on MAC address for each switch and router. Assign static IP addresses to devices connecting to switch.

b. Lock down all spare switch and router ports.

## 3.6 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning at Substantial Completion, ensure service agreement includes software support for two years.
- B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within 2 years from date of Substantial Completion. Ensure upgrading software includes operating system and new or revised licenses for using software.
  - 1. Upgrade Notice: At least 30 days in advance to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

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# SECTION 406619 - MEDIA CONVERTERS

# PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. Section includes media converters.
- B. Related Requirements:
  - 1. Section 406100 "Process Control and Enterprise Management Systems General Provisions" for submittal requirements.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Refer to Section 406100 "Process Control and Enterprise Management System General Provisions."
- B. Shop Drawings:
  - 1. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions."

#### 1.4 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions."

# 1.5 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 "Process Control and Enterprise Management System General Provisions."

## 1.6 MAINTENANCE MATERIAL SUBMITTALS

A. None Required.

#### 1.7 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

#### 1.8 FIELD CONDITIONS

A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions."

#### 1.9 WARRANTY

A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions."

## PART 2 - PRODUCTS

## 2.1 COPPER TO FIBER MEDIA CONVERTER

- A. Manufacturers:
  - 1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:
    - a. Rockwell Automation 1783-ETAP1F.
    - b. Substitutions: Not allowed.
- B. General:
  - 1. Provide copper to fiber media converter as shown in Drawings.
- C. Physical Features:
  - 1. RJ45 port: 10/100/1000BaseT(X).
  - 2. Fiber uplink: 1000Base-X (LC/ST/SC connectors).
  - 3. Fiber optics: Multi- or single-mode capability as shown in Drawings.
  - 4. Operating temperature: 0 to 130 degrees F.
  - 5. Power: 24 VDC.
  - 6. Enclosure: DIN-rail mountable.

## PART 3 - EXECUTION

## 3.1 EXAMINATION

A. Examine walls, floors, roofs, and rooms for suitable conditions where media converters will be installed.

- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

#### 3.3 IDENTIFICATION

- A. Refer to drawings for tagging designations.
- 3.4 FIELD QUALITY CONTROL
  - A. Media converters will be considered defective if it does not pass tests and inspections.
  - B. Prepare test and inspection reports in accordance with the following:
    - 1. Section 406100 "Process Control and Enterprise Management Systems General Provisions."
    - 2. Section 406121.20 "Process Control System Testing."

#### 3.5 STARTUP SERVICE

- A. Perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.

### 3.6 SOFTWARE SERVICE AGREEMENT

A. Not Required.

#### 3.7 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

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# SECTION 406717 – INDUSTRIAL ENCLOSURES

# PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

- A. Section includes industrial enclosures.
- B. Related Requirements:
  - 1. Section 406100 "Process Control and Enterprise Management Systems General Provisions" for submittal requirements.
  - 2. Section 406733 "Panel Wiring."

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Refer to Section 406100 "Process Control and Enterprise Management System General Provisions."
- B. Shop Drawings:
  - 1. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions."

#### 1.4 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions."

## 1.5 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 "Process Control and Enterprise Management System General Provisions."

#### 1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Touch-up Paint: Provide touch-up paint of each type and color used for all cabinets, panels, and consoles supplied.

### 1.7 QUALITY ASSURANCE

- A. Perform work in accordance with UL 508.
- B. Provide components compatible with functions required to form complete working system.
- C. Provide UL 508 label on complete assembly.

#### 1.8 FIELD CONDITIONS

A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions."

#### 1.9 WARRANTY

A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions."

# PART 2 - PRODUCTS

# 2.1 INDUSTRIAL ENCLOSURES PLC PANEL

- A. Manufacturers:
  - 1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:
    - a. nVent: Hoffman.
    - b. Rittal.
    - c. Saginaw.
    - d. Substitutions: Not Permitted.
- B. Structure and Enclosure:
  - 1. Panels in indoor, dry, non-corrosive environments:
    - a. NEMA 12, painted steel or aluminum construction, as required by the schedule in PART 3.

- 2. Panels in outdoor, wet, or chemically corrosive environments:
  - a. NEMA 4X, stainless steel or FRP construction, as required by the schedule in PART 3.
- 3. Panels located in hazardous locations:
  - a. Rated for the type of hazard (e.g., NEMA 7 for Class 1, Division 1).
- 4. Construction:
  - a. Freestanding and floor-mounted vertical panels:
    - 1) Panels of 12-gauge sheet steel.
    - 2) Front panels or panels containing instruments: provide 10-gauge stretcherleveled sheet steel, reinforced to prevent warping or distortion.
  - b. Wall and Unistrut mounted panels:
    - 1) Panels no less than 14-gauge steel.
  - c. Consoles:
    - 1) Panels of 12-gauge sheet steel.
    - 2) Front panels: provide 10-gauge stretcher-leveled sheet steel, reinforced to prevent warping or distortion.
- 5. Provide angle stiffeners on the back of the panel face to prevent panel deflection under instrument loading or operation, as follows:
  - a. Structural framework internal to the panel allows for instrument support and panel bracing.
  - b. Interior structure framework to permit panel lifting without racking or distortion.
  - c. Removable lifting rings designed to facilitate simple, safe rigging, and lifting of the control panels during installation.
- 6. Full height and fully gasketed access door with full-length, continuous, piano type stainless steel hinges with stainless steel pins.
  - a. Provide doors with three-point stainless steel latch and heavy-duty stainless steel locking handle.
  - b. Provide front access doors of sufficient width to permit instrument or control device mounting without interference from flush mounted instruments.
  - c. Clamp-type door latches are not permitted.
- 7. Avoid kinks and sharp bends in wiring.
  - a. Route wiring for easy access to other components for maintenance and inspection purposes.

- 8. Panel suitable for top and bottom conduit entry as required by the Electrical Drawings.
  - a. For top mounted conduit entry, provide panel top with nominal one-foot square removable access plates, which may be drilled to accommodate conduit and cable penetrations.
  - b. Provide all conduit and cable penetrations with ground bushings, hubs, gasketed locknuts, and other accessories as required to maintain the NEMA rating of the panel and electrical rating of the conduit system.
- C. General Requirements:
  - 1. UL labeled control panels and cabinets.
    - a. UL listing includes enclosure, specific equipment supplied with enclosure, and equipment installation and wiring within and on the enclosure. If required for UL labeling, provide ground fault protective devices, isolation transformers, fuses and other equipment necessary to achieve compliance with UL 508A requirement. The Drawings do not detail all UL 508A requirements.
  - 2. Panel door handles with lock, or a hasp and staple for padlocking: key the locks for all control panels provided under this Contract alike.
  - 3. Arrange devices for rear of panel mounting within the panel according to respective panel drawings and in a manner to allow for ease of maintenance and adjustment.
    - a. Locate heat generating devices, such as power supplies, at or near the top of the panel.
  - 4. Mount all components in a manner that permits servicing, adjustment, testing, and removal without disconnecting, moving, or removing any other component.
    - a. Mount interior panel components on removable plates (sub-panels) and not directly on the enclosure. Unless shock mounting is required by the manufacturer to protect equipment from vibration, provide rigid and stable mounting.
    - b. Mount and orient components in accordance with manufacturer's recommendations.
    - c. Identify internal components with suitable plastic or metal engraved nametags mounted adjacent to (not on) each component identifying the component in accordance with the drawings and specifications.
  - 5. Mount all panel components on a single rear-of-panel sub-panel unless density of devices exceeds the panel mounting space permitted by the minimum panel dimensions specified. Side panel mounted components are not permitted without review and approval by Engineer.
  - 6. Type 316 stainless steel hardware and fasteners:
    - a. Provide drilled and tapped mounting screws; self-tapping screws are not permitted.
  - 7. Install suitable gaskets and faceplates, required to maintain NEMA rating of the panel.

# D. Mounting Elevations:

- 1. Refer to ISA Recommended Practice RP60.3 for guidance on layout and arrangement of panels and panel mount components. Account for housekeeping pad dimensions.
- 2. Locate centerline of indicators and controllers no lower than 48 inches or higher than 66 inches above the floor on a panel face.
- 3. Locate centerline of lights, selector switches, and pushbuttons no lower than 32 inches or higher than 70 inches above the floor on a panel face.
- 4. Locate tops of annunciators no higher than 86 inches above the floor on a panel face.
- 5. Install panel components in accordance with manufacturer's guidelines.

# 2.2 INDUSTRIAL ENCLOSURES VIDEO PANEL

- A. Manufacturers:
  - 1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:
    - a. Tripp Lite Smart Rack 5U Low-Profile Vertical-Mount. Switch-Depth Wall-Mount Rack Enclosure, SRWF5U.
    - b. Substitutions: Not Permitted.

# 2.3 TEMPERATURE CONTROL

- A. Provide force air ventilation or air conditioning units as required to prevent temperature buildup inside of panel.
- B. Heat Load Calculations:
  - 1. Submit heat load calculations for all control panels located in areas where either venting is not possible due to NEMA rating of panel or control panel is located in an area or building without air conditioning.
  - 2. Utilize manufacturer available thermal calculators to determine heating/cooling requirements (i.e. Saginaw SCE thermal calculator, nVent Hoffman cooling selection tool, or equivalent).
  - 3. Ensure the internal temperature of the panel is regulated between 45 to 104 degrees F (7 to 40 degrees C) under all conditions.
  - 4. Account for the following conditions in the heat load calculations:
    - a. Loading and dissipation effects on all surfaces of the enclosure. Account for surfaces not available for heat transfer (e.g., against a wall).
    - b. Internal heat load of components (load and duty cycle).
    - c. For outside temperature limits, refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions."
- C. Sun Shields:
  - 1. Provide custom fabricated sun shields for all outdoor panels in accordance with the following requirements:

- a. Fabricate sun shields from a material suited for the area classification rating of its environment.
- b. Design, fabricate, install, and support the unit to fully cover and shade the top, sides, and back of the enclosure, and to partially shade the front panel of the enclosure from direct exposure to sunlight from sunrise to sunset.
- c. Depending on overall size, sun shields may be fabricated in single or multiple segments for attachment to the enclosure support framing or to separate free standing framing around the enclosure, to preserve rigidity.
- d. Design and mount sun shields with a minimum 3-inch air gap around the enclosure for air circulation and heat dissipation.
- e. Drilling holes or welding studs directly to the enclosure for sun shield mounting is not permitted.
- f. Slope the top section of the sun shield a minimum angle of 5 degrees from horizontal.
  - 1) Wall mounted enclosures: slope the top section downward away from the wall and towards the front of the enclosure.
  - 2) Free standing, floor mounted, and frame mounted enclosures: slope the top section downward towards the back side of the enclosure.
- g. Incorporate a narrow and more steeply sloped drip shield segment on the front edge of the top section to shed water away from the front of the enclosure and prevent dripping or running directly onto the front panel of the enclosure.
- h. Fabricate sun shields with continuous seam welds that are ground smooth.
- i. Smooth round or chamfer exposed corners, edges, and projections to prevent injury.
- D. Louvers:
  - 1. If louvers are used, provide louver plate and filter kit.
  - 2. Provide louver plates of stamped sheet metal construction.
  - 3. Provide washable and replaceable filters.
  - 4. Install louvers on the rear, top, or bottom of the panel, as required by the panel installation location.
  - 5. For wall mounted enclosures with their backs directly adjacent to a wall, install louvers on the sides.
- E. Forced Air Ventilation:
  - 1. Provide forced air ventilation fans to create positive internal pressure within the panel.
  - 2. Provide washable and replaceable filters.
  - 3. Fan motors operate on 24 VDC.
- F. Air Conditioning:
  - 1. For panels with internal heat that cannot be adequately dissipated with natural convention and heat sinks, or forced air ventilation, provide an air conditioner sized to deliver sufficient cooling.
  - 2. NEMA rating equivalent to the NEMA rating of the panel. Maintain NEMA rating of panel when installed.
  - 3. Provide air conditioner with conformal coating on exposed surfaces.

4. Mount air conditioners on panel side. If provided, cut sun shields to accommodate air conditioner.

## G. Heating:

- 1. Provide an integral heater, fan, and adjustable thermostat for outdoor enclosures and enclosures located in unheated areas indoors or in areas subject to humidity and moisture, to reduce condensation and maintain the minimum internal panel temperature.
  - a. Mount unit near enclosure bottom with discharge away from heat-sensitive equipment.
  - b. Provide Hoffman DAH series, Stego PTC series, or equal.

#### 2.4 ACCESSORIES

- A. Nameplates:
  - 1. Identify the panel and individual devices as required, unless otherwise indicated:
    - a. Include up to three lines:
      - 1) First line containing the device tag number as shown on the Drawings.
      - 2) Second line containing a functional description (e.g., Recirculation Pump No. 1).
      - 3) Third line containing a functional control description (e.g., Start).
  - 2. Unless escutcheon plates are specified or unless otherwise noted on the Drawings:
    - a. Furnish nameplates as 3/32-inch thick, black against white background unless otherwise noted, Lamicoid with engraved inscriptions. Bevel and smooth edges of nameplate.
    - b. Nameplates with chipped or rough edges are not acceptable.
  - 3. Mount or fasten cabinet mounted nameplates with epoxy adhesive or stainless-steel screws.
  - 4. Provide a panel nameplate with a minimum of 1-inch high letters for every panel.
  - 5. Provide legend plates or 1-inch by 3-inch engraved nameplates with 1/4-inch lettering for identification of door mounted control devices, pilot lights, and meters.
  - 6. Use single Lamicoid nameplates with multiple legends for grouping of devices such as selector switches and pilot lights that relate to one function.
- B. Print Storage Pockets:
  - 1. Provide print storage pockets of steel construction, welded onto the door of the enclosure.
  - 2. Size storage pockets to accommodate all prints required to service the equipment, and to accommodate 8.5-inch by 11-inch documents without folding.
- C. Corrosion Control:
  - 1. Protect panels from internal corrosion by use of corrosion-inhibiting vapor capsules. Size and quantity as necessary per manufacturer recommendations.

- 2. Manufacturer:
  - a. Zerust VC.
  - b. Hoffman Model AHCI.
  - c. Or equal.

# 2.5 GENERAL FINISH REQUIREMENTS

- A. Descale, degrease, fill, grind and finish sections.
- B. Finish steel-fabricated enclosures with two rust resistant phosphate prime coats and two coats of enamel, polyurethane, or lacquer finish which are applied by either hot air spray or conventional cold spray methods.
  - 1. Brushed anodized aluminum, stainless steel, and FRP panels do not require a paint finish.
- C. Grind smooth, sandblast and then clean with solvent. Fill surface voids and grind smooth.
- D. Immediately after cleaning, apply one coat of a rust-inhibiting primer inside and outside, followed by an exterior intermediate and topcoat of a two-component type epoxy enamel.
  - 1. Apply final sanding to the intermediate exterior coat before top coating.
- E. Apply a minimum of two coats of manufacturer's standard, flat light-colored lacquer, on panel interior after priming.
- F. Unless otherwise noted, finish exterior colors as ANSI 61 gray with textured finish.
- G. Finish products after assembly.

## PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine walls, floors, roofs, and rooms for suitable conditions where industrial enclosures will be installed.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 INSTALLATION

- A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.
  - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
  - 2. Comply with requirements for cable trays.

- 3. Comply with requirements for raceways and boxes.
- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

## 3.3 ADJUSTING

A. Adjust hardware and moving parts to function smoothly and lubricate as recommended by manufacturer.

## PART 4 - INDUSTRIAL ENCLOSURE SCHEDULE

A. Provide the following industrial enclosures:

 Table 1. Industrial Enclosure Schedule

Panel Designation	Minimum Size	Maximum Size	Enclosure Rating	General Requirements
PLC-W117	36 x 36 x 20 inches	48 x 36 x 20 inches	NEMA 4X	Wall mounted, single door, powder coated white, with sunshield and rain shed
PLC-W119	36 x 36 x 20 inches	48 x 36 x 20 inches	NEMA 4X	Wall mounted, single door, powder coated white, with sunshield.

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# SECTION 406733 - PANEL WIRING

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes requirements for internal wiring of control panels and consoles.
- B. Related Requirements:
  - 1. Section 406100 "Process Control and Enterprise Management Systems General Provisions" for submittal requirements.
  - 2. Section 406717 "Industrial Enclosures."
  - 3. Section 406763 "Control Panel Mounted UPS."
  - 4. Section 407856 "Isolators, Intrinsic Safety Barriers, and Surge Suppressors."

### 1.3 DEFINITIONS

- A. American Wire Gage (AWG): Measurement of the cross-sectional area of a conductor.
- B. Input/Output (I/O): Analog or digital field instrument signals to be received and interpreted by a PLC.
- C. Programmable Logic Controller (PLC): A ruggedized programmable computer used for industrial automation.
- D. Process Control System Supplier (PCSS): The entity responsible for providing all materials, equipment, labor, and services required to achieve a fully integrated and operational control system.

#### 1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

## 1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions."

#### 1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 "Process Control and Enterprise Management System General Provisions."

# 1.7 MAINTENANCE MATERIAL SUBMITTALS

A. None Required.

#### 1.8 QUALITY ASSURANCE

- A. Perform work in accordance with UL 508.
- B. Provide components compatible with functions required to form complete working system.
- C. Provide UL 508 label on complete assembly.

## 1.9 FIELD CONDITIONS

A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions."

#### 1.10 WARRANTY

A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions."

## PART 2 - PRODUCTS

#### 2.1 CONTROL PANEL - INTERNAL CONSTRUCTION

- A. Internal Electrical Wiring:
  - 1. Provide stranded, type MTW interconnecting wiring:
    - a. Use 600-volt insulation rated for not less than 90 degrees Celsius.
    - b. Segregate wiring for systems operating at voltages in excess of 120 VAC from other panel wiring.
      - 1) Locate either in a separate section of a multi-section panel or behind removable Plexiglas or similar dielectric barrier.
    - c. Develop panel layout such that technicians have complete access to 120 VAC and lower voltage wiring systems without direct exposure to higher voltages.
  - 2. For power distribution wiring on the line side of fuses or breakers:

- a. Use 12 AWG minimum.
- b. For control wiring on the secondary side of fuses:
  - 1) Use 16 AWG minimum.
  - 2) Utilize 18 AWG shielded, twisted pair cable insulated for not less than 600 volts for electronic analog circuits.
- 3. Cover power distribution blocks with protective guards to meet "finger-safe" requirements of IP20.
- 4. Route power and low voltage DC wiring systems in separate wireways.
  - a. Cross different system wires at right angles.
  - b. Separate different system wires routed parallel to each other by at least 6-inches.
  - c. Terminate different wiring systems on separate terminal blocks.
  - d. Do not fill wiring troughs to more than 60 percent visible fill.
- 5. Terminations:
  - a. Terminate wiring onto single tier terminal blocks:
    - 1) Uniquely and sequentially number each terminal block.
    - 2) Direct wiring between field equipment and panel components is not acceptable.
    - 3) Multi-level terminal blocks or strips are not acceptable.
  - b. Arrange terminal blocks in vertical rows and separated into groups (power, AC control, DC signal).
    - 1) Provide each group of terminal blocks with a minimum of 25 percent spares.
  - c. Use compression type, fused, unfused, or switched terminal blocks.
    - 1) Use two terminals per point for discrete inputs and outputs (DI and DO) with adjacent terminal assignments.
    - 2) Wire all active and spare PLC and controller points to terminal blocks.
  - d. Use three terminals per point for analog inputs and outputs (AI and AO) per shielded pair connection with adjacent terminal assignments for each point.
    - 1) The third terminal is for shielded ground connection for cable pairs.
      - a) Ground shielded signal cable at PLC cabinet.
      - b) Wire all active and spare PLC and controller points to terminal blocks.
  - e. Use sleeve-type wire and tube markers with heat impressed letters and numbers.
  - f. Use only one side of a terminal block row for internal wiring.
    - 1) Field wiring side of the terminal not to be within 6-inches of the side panel or adjacent terminal or within 8-inches of the bottom of free-standing

panels, or within 3-inches of stanchion mounted panels, or 3-inches of adjacent wireway.

- g. Isolate circuit power from the SCADA cabinet to field devices (switches, dry contacts etc.) that are used as discrete inputs to the PLC input cards with an isolating switch terminal block with flip cover that is supplied with a dummy fuse.
  - 1) Use Phoenix Contact CLIPLINE series or equal.
  - 2) One isolating switch terminal block per loop numbered piece of equipment and one per spare I/O point is acceptable.
- h. Isolate all PLC discrete outputs to the field with an isolating fuse switch terminal block with a flip cover and a neon blown fuse indicator.
  - 1) Use Phoenix Contact CLIPLINE series or equal.
- 6. Clearly identify wiring to hand switches and other devices, which are live circuits independent of the panel's normal circuit breaker protection as such.
- 7. Clearly tag and color code wiring.
  - a. Tag numbers and color coding to correspond to panel wiring diagrams and loop drawings prepared by the PCSS.
  - b. Power wiring, control wiring, grounding, and DC wiring to utilize different color insulation for each wiring system used.
  - c. Color coding scheme to be in accordance with UL 508a, following the below criteria:
    - 1) 120 VAC  $\rightarrow$  Hot Black
    - 2) 120 VAC Neutral  $\rightarrow$  White
    - 3) 120 VAC Hot (Foreign)  $\rightarrow$  Yellow
    - 4) 120 VAC Return (Foreign) → Yellow
    - 5) Switched Hot
      - 24 VDC +
      - 24 VDC  $\rightarrow$  White on Blue
    - 8) 4-20 mA +
    - 4-20 mA Ground-Sign

6)

7)

11)

→Black →Green

→Red

→Blue

→Red

- Ground-Signal →Gra Ground-Panel →Ye
  - →Yellow on Green
- 8. Provide surge protectors on all incoming power supply lines at each panel per requirements of Section 407856 "Isolators, Intrinsic Safety Barriers, and Surge Suppressors."
- 9. Each field instrument furnished under Division 40 and shown on the Drawings as deriving input power from the control panel(s) to have a separate power distribution circuit with a circuit breaker or fuse and blown fuse indication.
  - a. Power instruments requiring 120VAC power as shown on the drawings.

- 10. Wiring trough for supporting internal wiring:
  - a. Plastic type with snap-on covers.
  - b. Side walls to be open top type to permit wire changing without disconnecting.
  - c. Trough to be supported to the subpanel by stainless steel screws.
  - d. Do not bond trough to the panel with glue or adhesives.
- 11. Provide each panel with a single tube, LED light fixture, 20 Watt in size (minimum):
  - a. Mounted internally to the ceiling of the panel.
  - b. Light fixture to be switched and be complete with the lamp.
- 12. Each panel to have a specification grade duplex convenience receptacle with ground fault interrupter:
  - a. Mount internally within a stamped steel device box with appropriate cover.
  - b. Convenience receptacle is not to be powered from a UPS.
  - c. Protect by a dedicated fuse or circuit breaker.
- 13. Each panel to be provided with an isolated copper grounding bus for all signal and shield ground connections.
  - a. Shield grounding to be in accordance with instrumentation manufacturer's recommendations.
- 14. Provide each panel with a separate copper power grounding bus (safety) in accordance with the requirements of the National Electrical Code.
- 15. Each panel to have control, signal, and communication line surge suppression in accordance with Section 407856 "Isolators, Intrinsic Safety Barriers, and Surge Suppressors."
- 16. Microprocessor-based electronic devices in the panel that are powered by 120VAC to be powered by the UPS.
- 17. Provide each panel with a circuit breaker to interrupt incoming power.
- 18. Additional electrical components including transformers, motor starters, switches, circuit breakers, etc. to be in compliance with the requirements of Division 26.
- B. Relays not provided under Division 26 and required for properly completing the control function specified in Division 40, Division 26 or shown on the Drawings to be provided under this Section.
- C. Orientation of devices including PLC and I/O when installed to be per the manufacturer's recommendations.
  - 1. No vertical orientation of PLC racks are allowed unless specifically indicated by manufacturer as an acceptable mounting alternative and also approved by the Engineer.

# PART 3 - EXECUTION

# 3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
## SECTION 406763 - CONTROL PANEL MOUNTED UPS

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes control panel mounted uninterruptible power supplies (UPS).
- B. Related Requirements:
  - 1. Section 406100 "Process Control and Enterprise Management Systems General Provisions" for submittal requirements.
  - 2. Section 406717 "Industrial Enclosures."

#### 1.3 DEFINITIONS

A. Uninterruptible Power Supply (UPS): A device capable of providing emergency battery power when the main power source fails.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Refer to Section 406100 "Process Control and Enterprise Management System General Provisions"
- B. Shop Drawings:
  - 1. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions"

## 1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions."

#### 1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 "Process Control and Enterprise Management System General Provisions."

# 1.7 MAINTENANCE MATERIAL SUBMITTALS

A. None Required.

#### 1.8 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

#### 1.9 FIELD CONDITIONS

A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions."

#### 1.10 WARRANTY

A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions."

## PART 2 - PRODUCTS

#### 2.1 SINGLE PHASE UPS - INTERNAL TO CONTROL PANELS

- A. Manufacturers:
  - 1. Manufacturers and their products are subject to compliance with requirements. [Provide the following:
    - a. Phoenix Contact QUINT4-UPS-DC-IQ.
    - b. Substitutions: Not Permitted.
- B. System Description:
  - 1. Provide an industrially rated continuous-duty, on-line, solid state, line interactive, singlephase uninterruptible power system.
  - 2. UPS to provide power conditioning and power backup for PLC, communications hardware, and other critical electronic loads as indicated on Drawings.
  - 3. UPS system consists of the following major components:
    - a. Rectifier and battery charger.
    - b. Inverter.

- c. Batteries.
- d. Other features as described in this Section and as indicated on Drawings.
- C. General Requirements:
  - 1. Provide battery protection via an internal circuit breaker disconnect.
  - 2. UPS must be EthernetI/P capable with Allen Bradley AOP.
  - 3. Current limiting circuitry to protect inverter output under any load condition.
  - 4. AC output neutral be electrically isolated from UPS chassis.
    - a. UPS chassis to have an equipment ground terminal.
    - b. Provide provisions for installation of a bonding connector.
  - 5. Suitable for installation in a UL508A listed panel.
  - 6. DIN rail mountable.
  - 7. UL recognized components for industrial applications in accordance with UL508 without derating.
- D. Performance Requirements:
  - 1. Ratings:
    - a. Output power: 24 VDC.
    - b. Battery runtime: 14 minutes at full-load, 34 minutes at half-load.
  - 2. Environment:
    - a. Ambient temperature: 0 to 40 degrees C.
    - b. Elevation: Up to 500 feet above mean sea level.
    - c. Relative humidity: 1 to 95 percent non-condensing.
  - 3. System Input Primary source:
    - a. Nominal Input Voltage: As shown in the schedule in PART 3.
    - b. Frequency: 45 to 65 Hz.
    - c. Input Power Factor: 0.95 lag minimum, 50 to 100 percent load.
    - d. Input Surge Withstandability: Per IEEE 587/ANSI C62.41. Category A and B, (6 kV).
  - 4. System Output:
    - a. Nominal Output Voltage: As shown in the schedule in PART 3.
    - b. Frequency: 60 Hertz plus or minus 3 Hertz.
    - c. 100 percent load with 3:1 Crest Ratio.
    - d. Frequency Slew Rate: 1 Hz/second. (Adjustable at startup).
  - 5. Acoustical Noise:
    - a. Noise generated by UPS under normal operation not to exceed 65 dBA (60 dBA typical) at one meter from any surface, measured at 25 degrees C (77 degrees F) and full load.

- 6. EMI Suppression:
  - a. UPS to meet FCC Rules and Regulation 47, Part 15, Subpart J, for Class A devices.
- E. Modes of Operation:
  - 1. UPS to operate as a line interactive on-line, fully automatic system in the following modes:
    - a. Normal:
      - 1) Critical load continuously supplied with filtered and regulated AC power by inverter. Rectifier/battery chargers derive power from preferred AC source and supply DC power to inverter while simultaneously floats charge the batteries.
    - b. Emergency:
      - Upon failure of preferred AC power source, critical load continues to be supplied by inverter. Inverter power supplied without switching from storage battery. No interruption to critical load upon failure or restoration of preferred ac sources. If AC source cannot be restored before battery discharges to its low voltage dropout value, UPS automatically shuts itself down in an orderly manner.
    - c. Recharge:
      - 1) Upon restoration of AC source, rectifier/battery charger to power inverter and simultaneously recharge batteries. This to be an automatic function causing no interruption to critical load.
- F. Rectifier/Charger:
  - 1. Solid-state equipment and controls necessary to convert incoming AC power to regulated DC power for input to inverter and for battery charging.
  - 2. Solid-state SCR/IGBT power transistor type with constant voltage/current limiting control circuitry.
- G. Inverter:
  - 1. Include all solid-state equipment and controls to convert DC power from rectifier/charger or battery to regulated AC power for powering critical load.
    - a. Use Insulated Gate Bipolar Transistors (IGBTs) in a phase-controlled, pulse width modulated (PWM) design capable of providing the specified AC output.
  - 2. Capable of supplying current and voltage for overloads exceeding 100 percent.
    - a. Provide 150 percent of full load for 30 seconds and 125 percent of full load for 2 minutes.
    - b. Status indicator and audible alarm indicate overload operation.

- 3. Maintain output voltage to within plus or minus 5 percent.
- 4. Output voltage total harmonic distortion (THD) not greater than 5 percent at full load.
- H. Batteries:
  - 1. High Temperature sealed, maintenance-free, high-rate discharge, lead-acid cells suitable for use indoors with no off gassing, or water addition requirements.
    - a. Require no special ventilation.
    - b. One or more battery banks with number of cells required to meet requirements of rest of these specifications.
  - 2. Battery Design Life: 2 to 4 years.
- I. Controls and Monitoring:
  - 1. Microprocessor-controlled circuitry:
    - a. Provide fully automatic operation of UPS through use of a microprocessor-based controller.
    - b. Operating and protection parameters firmware controlled.
    - c. Logic includes system test capability to facilitate maintenance and troubleshooting.
    - d. Startup, battery charging, and transfers to be automatic.
  - 2. Front Indicators: As a minimum, the following indicators to be provided on UPS control panel:
    - a. On-line (UPS is using utility power to power the load).
      - 1) In bypass mode.
      - 2) On battery.
      - 3) Overload.
      - 4) Replace battery / battery disconnected.
      - 5) Fault.
      - 6) Bar graph for utility voltage.
      - 7) Bar graph for battery.
    - b. Front Panel UPS Controls:
      - 1) Power On/Off.
      - 2) Self-test.
      - 3) Alarm silence.
      - 4) Cold start.
      - 5) Load off.
    - c. Remote alarm and status indication:
      - 1) Isolated SPDT dry contacts provided to indicate UPS status for remote monitoring. Contacts rated for 250VAC @ 5A or 30VDC @ 5A.

- a) Individual contacts provide for separate annunciation of the following alarm and status conditions:
  - a. UPS Running on Battery.
  - b. UPS Fail.
- 2) Provide the following information via Ethernet/IP communications:
  - a. UPS Running on Battery.
  - b. Battery low.
  - c. Replace Battery.
  - d. UPS Fail.
  - e. UPS runtime.
  - f. UPS used runtime.
  - g. Battery mode runtime.
  - h. Charger fail.
  - i. Battery end of lifetime.

# PART 3 - EXECUTION

3.1

- 3.1 INSTALLATION
  - A. Comply with NECA 1.
  - B. Wiring Method:
    - 1. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
  - C. Wiring within Enclosures:
    - 1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

## 3.2 IDENTIFICATION

A. Refer to drawings for tagging designations.

## 3.3 FIELD QUALITY CONTROL

- A. Uninterruptible power supplies will be considered defective if it does not pass tests and inspections.
- B. Prepare test and inspection reports in accordance with the following:
  - 1. Section 406100 "Process Control and Enterprise Management Systems General Provisions."
  - 2. Section 406121.20 "Process Control System Testing."

# 3.4 STARTUP SERVICE

- A. Perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.

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# SECTION 406866 - CONFIGURATION OF CONTROLLER SOFTWARE

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. Section Includes: If referred to anywhere else in the project manual, AE or AESS services include, but are not limited to, those services specified in this Section.
- B. Provide all programming, configuration, and related services required to achieve a fully integrated and operational system. Control all equipment in full conformity with the Contract Drawings, process control descriptions, specifications, engineering data, instructions, and recommendations of the equipment manufacturer. Coordinate the control system for proper operation with related equipment and materials furnished by other suppliers under other Sections of these specifications and with related existing equipment.
  - 1. Provide configuration of the PLC provided for all equipment shown on Drawings, except for controls equipment shown being provided as part of a vendor package system.
- C. Coordinate all work with plant operating personnel to minimize impacts on daily operation. Note delays caused for any reason and formally submitted to Engineer and Owner in the form of a letter.
- D. Related Requirements:
  - 1. Section 406100 "Process Control and Enterprise Management Systems General Provisions" for submittal requirements.
  - 2. Section 406196 "Process Control Descriptions."
  - 3. Section 406343 "Programmable Logic Controllers."

## 1.3 DEFINITIONS

- A. Applications Engineering System Supplier (AESS): Entity who provides all programming, configuration, and related services for the control system equipment provided by the PCSS.
- B. Human Machine Interface (HMI): A software-based user interface with supervisory level control and of machine level equipment.
- C. Input/Output (I/O): Analog or digital field instrument signals to be received and interpreted by a PLC.

- D. Operator Interface Terminal (OIT): A hardware component of the HMI used for device level control and monitoring.
- E. Process Control System Supplier (PCSS): Entity responsible for providing all materials, equipment, labor, and services required to achieve a fully integrated and operational control system.
- F. Programmable Logic Controller (PLC): A ruggedized programmable computer used for industrial automation.

# 1.4 PREINSTALLATION MEETINGS

A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions." The meetings below are in addition to the meetings specified in that section.

## 1.5 ACTION SUBMITTALS

- A. Controller Program Submittal:
  - 1. For each controller, submit the following using the controller manufacturer's built-in printing functions. Electronic submission of Adobe Portable Document Format ("pdf") files in lieu of paper submittals is acceptable. Review will be for general program organization, level of documentation, and overall programming standards (basic pump and valve control, for example). The review will not attempt to confirm the logic works correctly for every loop.
    - a. PLC programs showing ladder logic, function block, high level language or another controller language used. Include individual rung, network, and/or command descriptions with abundant comments to clearly identify function and intent of each code segment. Clearly present each logic segment, describe the function of each timer, label and define the purpose of each subroutine call, etc. Ensure that program documentation is sufficiently clear to allow determination of compliance with the process control requirements included in the control descriptions and with the Drawings. The submittal demonstrates that all logic provided under this project follows the same structure and format and reflects a common programming approach.
    - b. Submit a memory usage report for the controller. Indicate total memory capacity and unused memory capacity.
    - c. Submit cross reference index of I/O allocation and controller memory address. Include every physical I/O point as well calculated or virtual I/O required for the implementation of the process scheme.
  - 2. Submit details of control system communication. Submit a "memory map" or other means showing which signals are exchanged between PLCs. Also submit an HMI tag database showing all signals exchanged between the PLCs and HMI. Define any specific communication block memory addresses.
- B. Submit all electronic files associated with controller such that Owner and Engineer can open complete copy of controller program using controllers native programming package.

## PART 2 - PRODUCTS (NOT USED)

# PART 3 - EXECUTION

## 3.1 CONTROLLER PROGRAMS

- A. Develop application programs in a structured manner and follow an intuitive arrangement so that instrumentation technician with basic programming knowledge will be able to understand. Utilize standard program templates or subroutines for repetitive logic such as equipment control, flow total calculations, equipment runtime calculations.
- B. Make changes to application programs and software configuration, based on comments during submittals, factory tests, field tests, and during commissioning process to meet design intent.

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# SECTION 407000 - INSTRUMENTATION FOR PROCESS SYSTEMS

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes the general requirements to furnishing, installing, and servicing PCSS provided instruments.
- B. Related Requirements:
  - 1. Section 406100 "Process Control and Enterprise Management Systems General Provisions" for submittal requirements.
  - 2. Section 4071XX "Sections for flow measurement."
  - 3. Section 4073XX "Sections for pressure, strain, and force measurement."

#### 1.3 DEFINITIONS

- A. Process Control System Supplier (PCSS): Entity responsible for providing all materials, equipment, labor, and services required to achieve a fully integrated and operational control system.
- B. Section 4071XX "Sections for flow measurement": The XX in the number indicates all spec sections starting with the first 4 numbers (indicating a category described in the accompanying text) are included in the reference.

#### 1.4 ACTION SUBMITTALS

- A. Submit complete documentation for all field instruments in one comprehensive submittal. Use ISA-TR20.00.01-2007 data sheet format as a cover sheet for each instrument prior to data sheets. Submit a complete Bill of Materials (BOM) or Index that lists all instrumentation equipment, sorted by Loop Number.
- B. Submit separate data sheets for each instrument type:
  - 1. Plant Equipment Number and ISA tag number per Drawings.
  - 2. Product (item) name used herein and on Drawings.
  - 3. Manufacturer's complete model number.
  - 4. Location of the device.
  - 5. Input output characteristics.
  - 6. Range, size, and graduations in engineering units.

- C. Submit the following information for each instrument type:
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles.
  - 2. Sizing calculations where applicable.
  - 3. Indicate which instruments will be provided with certified calibration data (i.e., all flow metering devices) as part of O&M manual.
  - 4. Include rated capacities, operating characteristics, electrical characteristics and furnished specialties and accessories.
  - 5. Two-wire or four-wire device type as applicable.
  - 6. Indicate which instruments will be provided with manufacturer's maintenance services if specified.
- D. Submit catalog cuts for all instruments. Submit descriptive literature for each hardware component, which fully describes the units being provided.

#### 1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions."

#### 1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions."

#### 1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Refer to individual instrument specifications for spare parts requirements.
- B. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions" for PCSS requirements regarding submission of maintenance materials.

#### 1.8 QUALITY ASSURANCE

- A. Refer to individual instrument specifications for quality assurance requirements as well as which specific instruments require manufacturer's start-up and training services.
- B. Provide components compatible with functions required to form complete working system.
- C. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions" for overall quality assurance requirements for PCSS scope of work.

#### 1.9 FIELD CONDITIONS

A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions."

## 1.10 WARRANTY

A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions."

## PART 2 - PRODUCTS

# 2.1 INSTRUMENT TAGS

- A. Permanent stainless steel or other non-corrosive material tag firmly attached and indelibly marked with instrument tag number, as indicated in Drawings. Tag equipment before shipping to the site.
- B. Provide 1/8-inch by 3/8-inch, Type 316 stainless steel button head machine screws.
- C. All supplied instrument transmitters and instrument transmitter elements require a stainless steel identification tag.
  - 1. Attach tag via stainless steel chain or stainless steel wire, 24-gauge minimum, to a non-removable part of the device.
  - 2. Stamp the ISA alphanumeric instrument number as indicated on the P&ID, loop, or detail drawings into the tag.
  - 3. Minimum tag size is 1 inch H x 3 inches W with 3/16 inch thick alphanumeric characters.

# PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. See installation requirements in individual specification sections.
- B. Refer to Instrumentation Drawings.

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# SECTION 407113 - MAGNETIC FLOW METERS

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. Section includes magnetic flow meters.
- B. Related Requirements:
  - 1. Section 406100 "Process Control and Enterprise Management Systems General Provisions."
  - 2. Section 407000 "Instrumentation for Process Systems."

## 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Refer to Section 407000 "Instrumentation for Process Systems."
- B. Shop Drawings:
  - 1. Refer to Section 407000 "Instrumentation for Process Systems."

#### 1.4 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 "Process Control and Enterprise Management System General Provisions."

## 1.5 QUALITY ASSURANCE

- A. Provide components compatible with functions required to form complete working system.
- B. Ensure that materials of construction of wetted parts are compatible with process liquid.
- C. Materials in Contact with Potable Water: Certified to NSF 61 and NSF 372.

#### 1.6 FIELD CONDITIONS

A. Refer to Section 406100 "Process Control and Enterprise Management System General Provisions."

## 1.7 WARRANTY

A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions."

## PART 2 - PRODUCTS

#### 2.1 SYSTEM DESCRIPTION

A. Furnish sensors, field preamplifiers, signal conditioners, offset and span adjustments, amplifiers, transducers, transmitters, control devices, interconnecting cables, and unit conversions and algorithms as required for application.

## 2.2 MAGNETIC FLOW METERS

- A. Manufacturers:
  - 1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following or equal:
    - a. Endress-Hauser Promag W400.
    - b. Substitutions: Not Permitted.
- B. General:
  - 1. Low-frequency, electromagnetic induction-type flow meter, producing linear signal directly proportional to flow rate, consisting of flow tube, signal cable, and transmitter.
- C. Type:
  - 1. Between-flange mounting.
  - 2. Comply with AWWA M33.
- D. Performance and Design Criteria:
  - 1. Process Fluid: Refer to Device Schedule.
  - 2. Accuracy: Plus or minus 0.5 percent of actual flow rate over a 30:1 range, within velocity limits of 0.1 to 10 ft/sec (0.03 to 3.04 meters/sec).
  - 3. Flow Tubes:
    - a. Body Material: Carbon Steel.
  - 4. Liner: Polyurethane or hard rubber.

- 5. Flanges: ANSI 150 lb. or DIN PN 16.
- 6. Flange Material: Stainless steel.
- 7. Environment: For meters with remote mounted transmitters, meters below grade to be suitable for submergence for up to 48 hours to a depth of 30 feet (9 m). Meters above grade to be NEMA 4X (IP65).
- 8. Electrodes:
  - a. Type 316L stainless steel.
  - b. Bullet-nose, self-cleaning.
- E. Accessories:
  - 1. Rated for hazardous area, Class I, Division 2.
  - 2. Provide manufacturer cable between transmitter and receiver.
  - 3. Furnish stainless steel grounding rings, wires, and gaskets as recommended by the manufacturer. All materials must be suitable for process and surrounding pipe.

# 2.3 TRANSMITTERS

- A. Manufacturer: Same manufacturer as meter.
- B. Transmitter Output:
  - 1. 4- to 20-mA DC analog signal.
- C. Housing: NEMA 4X (IP65), suitable for surface or pipe stand mounting.
- D. Display:
  - 1. Touch-screen programming, functioning through enclosure window without opening enclosure.
  - 2. Size: Four lines by 16 characters.
  - 3. Type: Backlit digital display.
  - 4. User-selectable engineering units.
  - 5. Readout of diagnostic error messages.
- E. Control Power:
  - 1. 120VAC, single phase, 60 Hz.
  - 2. Provide local transformers as required.
- F. Mounting:
  - 1. Mounting: Remote, up to 30 feet from flow meter.
- G. Required Accessories:
  - 1. Fully configurable and locally viewable totalizer integral to the transmitter.
  - 2. Current signal output simulation.
  - 3. Empty pipe detection.
  - 4. Self-diagnostics.

- 5. Signal Cable: Provided by flow meter manufacturer.
- 6. Automatic zero adjust.
- 7. For outdoor installations, provide sunshield of sturdy, corrosion- and UV-resistant material.

## 2.4 DEVICE SCHEDULE

- A. Well Discharge Flow, FE/FIT-120, FE/FIT-220.
  - 1. Meter Size: 6 inch.
  - 2. Flow Range: 0 600 gpm.

# PART 3 - EXECUTION

# 3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

# 3.2 IDENTIFICATION

A. Refer to item in this specification for tagging designation.

# SECTION 407243 - PRESSURE AND DIFFERENTIAL PRESSURE TYPE LEVEL METERS

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

# 1.2 SUMMARY

- A. Section includes pressure and differential pressure type level meters.
- B. Related Requirements:
  - 1. Section 406100 "Process Control and Enterprise Management Systems General Provisions."
  - 2. Section 407000 "Instrumentation for Process Systems."

## 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Refer to Section 407000 "Instrumentation for Process Systems."
- B. Shop Drawings:
  - 1. Refer to Section 407000 "Instrumentation for Process Systems."

## 1.4 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions" for any PCSS requirements regarding informational submittals for instruments.

## 1.5 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 "Process Control and Enterprise Management System General Provisions."

## 1.6 MAINTENANCE MATERIAL SUBMITTALS

A. None Required.

#### 1.7 QUALITY ASSURANCE

- A. Provide components compatible with functions required to form complete working system.
- B. Ensure that materials of construction of wetted parts are compatible with process liquid.
- C. Materials in Contact with Potable Water: Certified to NSF 61 and NSF 372.

#### 1.8 FIELD CONDITIONS

A. Refer to Section 406100 "Process Control and Enterprise Management System General Provisions."

#### 1.9 WARRANTY

A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions."

# PART 2 - PRODUCTS

## 2.1 HYDROSTATIC-SUBMERSIBLE LEVEL MEASUREMENT DEVICES

- A. Manufacturers:
  - 1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:
    - a. Emerson's Rosemount 3051 with Hart and integral manifold.
    - b. Gauge Pressure Units: Rosemount; Model 3051s TG.
    - c. Absolute Pressure Units: Rosemount; Model 3051s TA.
    - d. Substitutions: Not Permitted.
- B. Type:
  - 1. Submersible, hydrostatic pressure type level transmitter.
- C. Function/Performance:
  - 1. Temperature Compensation: Provided over a range of 32 to 122 degrees F.
  - 2. Accuracy: Plus or minus 0.04 percent of span, unless otherwise noted.
  - 3. Over Pressure: Protected for over pressure of 1.5 times the span.
  - 4. Output: 4-20 mA proportional to the calibrated span.
- D. Physical:
  - 1. Provide an assembly with Type 316 stainless steel or titanium body with a bottom diaphragm.

- 2. Provide sensor with integral cable. Provide vent tube as part of the cable for the transducer.
- 3. Provide a tension-relieving mounting clamp from 4-inch flange. Provide Type 316 stainless steel material for both clamp and flange.
- 4. Wetted Metallic Parts: Type 316 stainless steel, unless otherwise noted.
  - a. Includes drain/vent valves, process flanges and adapters, and process isolating diaphragm.
- 5. Wetted O-Rings: Glass filled TFE, graphite filled PTFE, or Viton, unless otherwise noted.
- 6. Bolts and Nuts (if required): Type 316 stainless steel, unless otherwise noted.
- 7. Fill Fluid: Silicone, unless otherwise noted.
- 8. Sensor: Submersible (IP68), and CSA approved or CENELEC certified intrinsically safe when intrinsically safe barriers are provided for the instrument loop.
- 9. 24 VDC loop powered.
- E. Required Accessories:
  - 1. Signal cable as recommended by the manufacturer, for installation between the sensor and transmitter as shown on Drawings. Provide reinforced cable to support the weight of the transducer and cable.
  - 2. Cable clamp for suspending instrument provided by instrument supplier.
  - 3. All fittings required for pressure calibration of the instrument.

## 2.2 SOURCE QUALITY CONTROL

- A. Provide shop inspection and testing of completed assembly.
- 2.3 DEVICE SCHEDULE
  - A. Well Level, PE/LIT-1201, PE/LIT-1202, PE/LIT-1203.

## PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine walls, floors, roofs, and process area for suitable conditions where pressure and differential pressure level meters will be installed.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 INSTALLATION

A. Comply with NECA 1.

- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

# 3.3 IDENTIFICATION

A. Refer to item in this specification for tagging designation.

## 3.4 FIELD QUALITY CONTROL

- A. Pressure and differential pressure type level meters will be considered defective if they do not pass tests and inspections.
- B. Prepare test and inspection reports.

## 3.5 STARTUP SERVICE

- A. Perform startup service.
  - 1. Complete installation and startup check according to manufacturer's written instructions.

## 3.6 MAINTENANCE SERVICE

A. Not Required.

## SECTION 407326 - GAUGE-PRESSURE TRANSMITTERS

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. Section includes gauge-pressure transmitters.
- B. Related Requirements:
  - 1. Section 406100 "Process Control and Enterprise Management Systems General Provisions."
  - 2. Section 407000 "Instrumentation for Process Systems."

## 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Refer to Section 407000 "Instrumentation for Process Systems."
- B. Shop Drawings:
  - 1. Refer to Section 407000 "Instrumentation for Process Systems."

## 1.4 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions" for any PCSS requirements regarding informational submittals for instruments.

## 1.5 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 "Process Control and Enterprise Management System General Provisions."

## 1.6 QUALITY ASSURANCE

- A. Provide components compatible with functions required to form complete working system.
- B. Ensure that materials of construction of wetted parts are compatible with process liquid.

C. Materials in Contact with Potable Water: Certified to NSF 61 and NSF 372.

## 1.7 FIELD CONDITIONS

A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions."

## 1.8 WARRANTY

A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions."

# PART 2 - PRODUCTS

# 2.1 GAUGE PRESSURE TRANSMITTERS

- A. Manufacturers:
  - 1. Manufacturers and their products are subject to compliance with requirements. Provide the following or equal:
    - a.
    - b. Rosemount 3051CG.
    - c. Siemens Sitrans P DS III.
    - d. Substitutions: Not Permitted.
- B. Type:
  - 1. Microprocessor based, intelligent type.
- C. Function/Performance:
  - 1. Accuracy: 0.075 percent of span.
  - 2. Operating Temperature: -4 to 176 degrees F (-20 to 80 degrees C).
  - 3. Temperature Effect: Combined temperature effects less than 0.2 percent of maximum span per 82 degrees F (28 degrees C) temperature change.
  - 4. Output Signal: 4 to 20 mA DC linear with pressure, with HART protocol.
  - 5. Output: Zero adjustable over the range of the instrument calibrated span is greater than the minimum calibrated span.
  - 6. Stability: 0.05 percent of upper range limit for one year.
  - 7. Response Time: Less than 1 ms.
  - 8. Display: Digital indicator displaying pressure in the engineering units indicated on the Drawings or in the instrument device schedule.
  - 9. Diagnostics:
    - a. Self-diagnostics with transmitter failure driving output to above or below out of range limits.
    - b. Simulation capability for inputs and loop outputs.

- c. Test terminals available to ease connection for test equipment without opening the loop.
- d. Registers to record minimum and maximum pressure and temperatures transmitter has been exposed to be available.
- 10. Over Range Protection: Provide positive over range protection to 150 percent of the maximum pressure of the system being monitored.
- D. Physical:
  - 1. Power Supply: 24 VDC loop power.
  - 2. Enclosure:
    - a. NEMA 4X (IP66), explosion proof.
    - b. Approved for Class I, Division 1, Groups C and D.
    - c. Instruments for hazardous locations have Factory Mutual (FM), Canadian Standards Association (CSA), and CENELEC approvals and certifications as specified and as indicated on Drawings or in the instrument device schedule.
  - 3. Process Wetted Parts (except for ozone/oxygen service):
    - a. Isolating diaphragm and other wetted metal parts: Type 316L stainless steel.
    - b. Gaskets and O-rings: Teflon.
  - 4. Sensor Fill Fluid (except for ozone/oxygen service): Silicone.
- E. Required Accessories:
  - 1. Shutoff Cocks: Furnished by gauge manufacturer.
  - 2. Provide diaphragm seals as shown on Drawings.
- F. Device Schedule:
  - 1. Well Discharge Pressure, PIT-115, PIT-215:
    - a. Range: 0-200 psig.

## 2.2 SOURCE QUALITY CONTROL

A. Provide shop inspection and testing of completed assembly.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine walls, floors, roofs, and process area for suitable conditions where gauge pressure transmitter will be installed.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

#### 3.3 IDENTIFICATION

A. Refer to item in this specification for tagging designation.

#### 3.4 FIELD QUALITY CONTROL

- A. Gauge-pressure transmitters will be considered defective if it does not pass tests and inspections.
- B. Prepare test and inspection reports.

#### 3.5 STARTUP SERVICE

- A. Perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.
  - 2. Start-up services include calibration, oversight of installations of the sensor, and start-up of the sensor/transmitter in order to provide reliable measurement at the instrument. Work with the PCSS and AESS to verify the transmitter sends correct information to the control system (i.e., that the scaling and units are the same at the instrument and on the control system's operator interface/PLC). Submit instrument calibration report in order to document the calibration procedure of the instruments.

#### 3.6 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain units.
- B. While starting up the instruments, manufacturer shall provide training to Owner's instrumentation technicians as follows:
  - 1. How to calibrate, install, troubleshoot, read the diagnostics, and maintain the sensor and transmitter.

# SECTION 407856 - ISOLATORS, INTRINSICALLY SAFE BARRIERS, AND SURGE SUPPRESSORS

## PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes surge suppressors.
- B. Related Requirements:
  - 1. Section 406100 "Process Control and Enterprise Management Systems General Provisions" for submittal requirements.
  - 2. Section 406717 "Industrial Enclosures."
  - 3. Section 407000 "Instrumentation for Process Systems."
  - 4. Section 4072XX "Sections for level measurement."

#### 1.3 DEFINITIONS

A. Section 4072XX "Sections for level measurement": The XX in the number indicates all spec sections starting with the first 4 numbers (indicating a category described in the accompanying text) are included in the reference.

## 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Refer to Section 407000 "Instrumentation for Process Systems."
- B. Shop Drawings:
  - 1. Refer to Section 407000 "Instrumentation for Process Systems."

## 1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions" for any PCSS requirements regarding informational submittals for instruments.

#### 1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 "Process Control and Enterprise Management System General Provisions."

## 1.7 MAINTENANCE MATERIAL SUBMITTALS

A. None Required.

#### 1.8 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

#### 1.9 FIELD CONDITIONS

A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions."

#### 1.10 WARRANTY

- A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions."
- B. Warranty: Manufacturer and Installer agree to repair or replace components of that fail(s) in materials or workmanship within specified warranty period.

## PART 2 - PRODUCTS

#### 2.1 SURGE PROTECTION FOR CONTROL SYSTEMS

- A. Manufacturers:
  - 1. Manufacturers and their products are subject to compliance with requirements. Provide the following:
    - a. Phoenix Contact Series.
    - b. Substitutions: Not Permitted.
- B. Function/Performance:
  - 1. Provides surge protection of electronic instrumentation from induced surges propagated along the signal and power supply lines from lightning, utility, or the plan electrical systems.
  - 2. Protection system lower than the instrument withstand level, while not interfering with normal operation.
  - 3. Maintenance free and self-restoring.

- 4. Response time: Less than 50 nanoseconds.
- 5. Discharge surge current: At least 8kA (at an 8x20µs impulse waveform).
- C. Required Surge Protection:
  - 1. Analog Signal (4-20mA) Circuits:
    - a. Provide surge protection where any part of the circuit is outside of building envelope.
    - b. Protect circuits at both the transmitter and the control system end of the circuit.
    - c. Mount transmitter surge protectors in separate NEMA 4X enclosure or conduit mount.
    - d. Use of single device to protect both 120VAC and 4-20mA wires is acceptable.
    - e. Provide surge protector from one of the following:
      - 1) Phoenix Contact PT Series.
      - 2) Substitutions: Not Permitted.
  - 2. Control Panel Power Feed (120VAC):
    - a. Provide protection of 120VAC power feed into control panels, instruments, and control room equipment.
    - b. Provide surge protector from one of the following:
      - 1) Phoenix Contact "Mains-PlugTrab."
      - 2) Substitutions: Not Permitted.
  - 3. Non-Fiber Based Data Highway or Communications Circuits:
    - a. Provide protection on all communication and data highway circuits that leave a building or are routed external to a building.
    - b. Provide circuit protection at both ends of the line.
    - c. Provide surge protector from one of the following:
      - 1) Phoenix Contact PlugTrab Series.
      - 2) Substitutions: Not Permitted.
  - 4. Inductive Loads:
    - a. Provide coil surge suppression devices, such as varistors or interposing relays, on all process controller outputs or switches rated 120VA or less that drive solenoid, coil, or motor loads.

# PART 3 - EXECUTION

# 3.1 EXAMINATION

- A. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

# 3.3 FIELD QUALITY CONTROL

- A. Special Inspections: Engage qualified special inspector to perform the following special inspections:
- B. Manufacturer's Field Service: Engage factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Isolators, intrinsically safe barriers and surge suppressors will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

#### 3.4 STARTUP SERVICE

- A. Perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.

## 3.5 MAINTENANCE SERVICE

A. Not Required.

#### 3.6 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

# SECTION 432520 - SUBMERSIBLE TURBINE PUMPS (FOR WATER WELL)

# PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

# 1.2 SUMMARY

- A. Section Includes: Submersible vertical turbine well pumps (pumps), including their respective column pipe, submersible motors, and variable frequency drives for two new production wells.
- B. Contractor to be fully responsible for all elements of pump installation and setting, including:
  - 1. Depth of setting.
  - 2. Discharge column pipe.
  - 3. Column check valve.
  - 4. Surface discharge head assembly.
  - 5. Supervisory services during installation and field testing of each unit and instructing the regular operating personnel in the proper care, operation and maintenance of the equipment.
  - 6. Include following paragraph to emphasize pump manufacturer unit responsibility.
- C. Pump Manufacturer shall have unit responsibility for complete pumping system.
- D. Related Requirements:
  - 1. "Specifications for Rehabilitation of Two Collier County Production Wells: RO-117N and RO-119N", for rehabilitation requirements including acidification and disinfection of the existing wells.

## 1.3 DEFINITIONS AND ABBREVIATIONS

- A. AESS: Applications Engineering System Supplier; refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions" for additional information.
- B. AOR: Allowable Operating Region.
- C. Failsafe: Normally closed contacts that open on alarm condition.
- D. I/O: Input/Output (signals).
- E. LCP: Local Control Panel.
- F. PCSS: Process Control System Supplier.

- G. POR: Preferred Operating Region.
- H. P&ID: Process and Instrumentation Diagram.
- I. Unit Responsibility: Sole responsibility for all components provided as part of pumping system.

# 1.4 ACTION SUBMITTALS

- A. If manufacturing techniques differ, completely describe all aspects that do not conform to specifications.
- B. Product Data: Submit manufacturer's literature, which may include drawings, describing the equipment including materials of construction, to indicate full conformance with specifications.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for submersible turbines and motors.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
  - 3. Total weight of pumping unit as well as weights of individual components.
- C. Shop Drawings:
  - 1. Certified dimensional drawings of each item of equipment and auxiliary apparatus to be furnished including pump and motor, discharge head, column pipe, column check valve, power and signal cables, and water level monitoring system.
  - 2. Schematic electrical wiring diagram and other data as required for complete pump installation.
  - 3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 4. Details of motor shroud/flow inducer for motor cooling.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Manufacturer's certified rating curves, to satisfy the specified design conditions including:
  - 1. Operating speed specified.
  - 2. Pump characteristics of head and flow showing full recommended range of performance including shut-off head for pump proposed. Curve for pump proposed not catalog sheets showing a family of curves.
  - 3. Anticipated operating condition.
  - 4. Brake horsepower.
  - 5. Bowl efficiency.
  - 6. Guaranteed net positive suction head required (NPSHR).
  - 7. Identify POR and AOR (refer to ANSI/HI 9.6.3).
  - 8. Plot curves on 8-1/2-inch by 11-inch sheets at as large a scale as practical specifically for proposed pump from no flow at shut-off head to pump capacity at minimum specified TDH.

- 9. Variable Speed Pumps: Include variable speed curves with five evenly spaced speeds plotted from maximum to minimum recommended speeds.
- 10. Curves shall be rising head capacity curve for stable pump operation.
- B. Certification that velocity of flow past motor is adequate for motor cooling, based upon motor proposed and size of well casing. Submit details of enclosing flow inducer/suction sleeve/shroud required to provide cooling.
- C. Tabulated data for drive motors including rated horsepower, full load rpm, power factor, efficiency curves at 1/2, 3/4 and full load, service factor, and kW input, including when pump operates at design point. Submit a certified statement from motor manufacturer that motors are capable of continuous operation on variable frequency drive power supply without affecting their design life for bearings or windings.
- D. Test Reports:
  - 1. Copies of all test data as described in Part 2 and 3.
  - 2. A schedule of the date of shop testing and delivery of the equipment to the job site.
  - 3. Description of pump factory test procedures and equipment.
  - 4. Rotor balance report demonstrating compliance with balancing requirements of AWWA E102.
- E. Welding certificates.
- F. Material Test Reports: Certified analysis of impeller material: by a qualified testing agency.
- G. Source quality-control reports.
- H. Field quality-control reports.
- I. Sample Warranty: For manufacturer's warranty.
- J. Certify all product components suitable for contact with drinking water by an accredited certification organization in accordance with NSF/ANSI 61, Drinking Water System components Health Effects, and NSF/ANSI 372, Drinking Water System Components Lead Content.

## 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Manual:
  - 1. Provide an Operating and Maintenance Manual for equipment specified herein, specifically prepared for this installation and including all required drawings, equipment and materials information, descriptions, complete bill of materials, etc., as required to instruct operating and maintenance personnel unfamiliar with such equipment.
- B. Warranty Documentation: submit warranty complying with requirements herein.
- C. Project Record Documents:

1. Submit Project Record Documents recording actual locations and final orientation of all equipment and accessories.

## 1.7 QUALITY ASSURANCE

- A. Furnish and coordinate all motors with the pump manufacturer.
- B. Furnish units from a single manufacturer.
- C. Install for satisfactory operation as shown on the Drawings.
- D. Manufacturer to be fully responsible for the design, arrangement and operation of all connected rotating equipment components.
- E. Pumps to be in accordance with the Hydraulic Institute Standards, except when otherwise specified herein.
- F. Equipment to be standard pumping equipment proven to have been manufactured by a manufacturer concerned and experienced in the production of such.
  - 1. The pump manufacturer an authorized permanent service organization for servicing both pump and motor, within 100 miles of the installation site.
- G. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept materials on Site in Manufacturer's original packaging and inspect for damage. As necessary, provide inspection report to Manufacturer identifying any damage and rework necessary prior to installation.
- B. Storage: Store pumps and all appurtenances according to Manufacturer's instructions.
- C. Do not disassemble factory assembled parts and components for shipment unless written permission received from Engineer.
- D. Protection:
  - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
  - 2. Provide additional protection according to Manufacturer's instructions.
  - 3. Protect unpainted finished iron and steel surfaces to prevent rust and corrosion.
  - 4. Protect finished surfaces of exposed flanges with wood or equivalent blank flanges.
  - 5. Protect bearings against formation of rust in accordance with bearing manufacturer's recommendations. Apply lubricant or corrosion inhibiting treatment during transportation, storage, handling, installation, and lapse of time prior to start-up. Intermittently manually rotate equipment prior to start-up to ensure distribution of lubricant/protection.
#### 1.9 SITE CONDITIONS

- A. Ambient temperature range: 30 to 104 degrees F.
- B. Field Measurements: as applicable confirm field measurements and interferences prior to fabrication. Indicate field measurements on Shop Drawings.

#### 1.10 WARRANTY

- A. Provide manufacturer's warranty for pumping system.
- B. Warranty Period: Two years from date of Substantial Completion.

#### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE AND DESIGN CRITERIA

- A. Pumps to conform to AWWA E-102, Submersible Vertical Turbine Pumps.
- B. Furnish and coordinate motors with pump manufacturer.
- C. Furnish units from a single manufacturer.
- D. Install for satisfactory operation as shown on the Drawings.
- E. Manufacturer to be fully responsible for design, arrangement and operation of all connected rotating equipment components.
- F. Pumps to be in accordance with the Hydraulic Institute Standards, except otherwise specified herein. Pump performance Acceptance Grade: 1U.
- G. Equipment to be standard pumping equipment proven to have been manufactured by a manufacturer concerned and experienced in the production of such.
- H. Pumps to have a continuously rising (from runout toward shutoff) head-flow rate performance curve for stable pump operation within the AOR.
- I. Comply with NSF/ANSI 61, Drinking Water System Components Health Effects, and/or NSF/ANSI 372, Drinking Water System Components Lead Content.
- J. Submersible pump to be set in a newly constructed water supply well. Work includes excavation and backfill necessary to install well head after cutting well casing to level shown on Drawings. Install all instrumentation to be fitted in the well as is specified in Division 40.
- K. Pumping units:
  - 1. Designed and built for 24-hour continuous service at all points within the required range of operation, without overheating, without cavitation, and without excessive vibration or strain.

- 2. Designed and proportioned as to have liberal strength, stability and stiffness and to be especially constructed to meet the Specifications.
- L. RO-117N Design criteria:

Item Description	Design Conditions
Service	Raw Water
Grundfos Product Number and Name	2025003 800\$750-3
Number of Pumps	1
Maximum Motor Full Load Speed (FLS) (rpm)	3,600
Minimum Motor Speed as a Percentage to Full Load Speed (percent)	50
Maximum Allowable Motor Horsepower (non-overloading throughout operating range) (HP)	75
Motor Design Voltage/Phase/Frequency	460/3/60
Maximum Anticipated Pumped Fluid Temperature (degrees F.)	75
Minimum Pump and Column Discharge Size (inches)	6
Minimum Pump Shut-Off Head at Motor FLS Acceptable Range (minimum/maximum) (feet)	475/550
Flow Rate at Secondary Operation Point (gpm)	300
Minimum TH at Secondary Operation Point (feet)	420
Minimum Overall Efficiency at Secondary Operation Point (percent)*	45
Maximum NPSH3 at Secondary Operation Point (feet)	25
Intermediate (Design) Point Flow Rate (gpm)	450
Minimum TH at Intermediate (Design) Point Flow Rate (feet)	375
Minimum Overall Efficiency at Intermediate (Design) Point Flow Rate (percent)*	60
Best Efficiency Point (BEP) Flow Rate Acceptable Range (minimum/maximum) (gpm)	500/1000
Minimum Overall Efficiency at BEP (percent)*	70
Primary Operation Point TH (feet)	200
Minimum Flow Rate at Primary Operation Point (gpm)	1000
Minimum Overall Efficiency at Primary Operation Point (percent)*	50
Maximum NPSH3 at Primary Operation Point (feet)	60

\* Note that minimum overall efficiencies listed are "wire-to-water" in accordance with ANSI/HI 11.6 – latest edition.

- M. RO-117N Pump Setting Details:
  - 1. Confirm elevations with final grading plans and data collected from well construction.
    - a. Elevation of Finished Ground Surface at Well Head: 15 feet.
    - b. Elevation of Discharge Centerline: 18 feet.

- c. Elevation of Pump Intake: -160 feet.
- d. Approximate range of static well water surface elevation: -33 to 15 feet.
- e. Approximate minimum pumping water level elevation: -150 feet.

#### N. RO-119N Design criteria:

Item Description	Design Conditions
Service	Raw Water
Grundfos Product Number and Name	18BG9603 1100S1250-
	3
Number of Pumps	1
Maximum Motor Full Load Speed (FLS) (rpm)	3,600
Minimum Motor Speed as a Percentage to Full Load Speed	50
(percent)	
Maximum Allowable Motor Horsepower (non-overloading	100
throughout operating range) (HP)	
Motor Design Voltage/Phase/Frequency	460/3/60
Maximum Anticipated Pumped Fluid Temperature (degrees F.)	75
Minimum Pump and Column Discharge Size (inches)	6
Minimum Pump Shut-Off Head at Motor FLS Acceptable	425/600
Range (minimum/maximum) (feet)	
Flow Rate at Secondary Operation Point (gpm)	300
Minimum TH at Secondary Operation Point (feet)	520
Minimum Overall Efficiency at Secondary Operation Point	45
(percent)*	
Maximum NPSH3 at Secondary Operation Point (feet)	25
Intermediate (Design) Point Flow Rate (gpm)	750
Minimum TH at Intermediate (Design) Point Flow Rate (feet)	410
Minimum Overall Efficiency at Intermediate (Design) Point	60
Flow Rate (percent)*	
	800/1400
Best Efficiency Point (BEP) Flow Rate Acceptable Range	
(minimum/maximum) (gpm)	
Minimum Overall Efficiency at BEP (percent)*	70
Primary Operation Point TH (feet)	250
Minimum Flow Rate at Primary Operation Point (gpm)	1350
Minimum Overall Efficiency at Primary Operation Point	50
(percent)*	
Maximum NPSH3 at Primary Operation Point (feet)	61

\* Note that minimum overall efficiencies listed are "wire-to-water" in accordance with ANSI/HI 11.6 – latest edition.

- O. RO-119N Pump Setting Details:
  - 1. Confirm elevations with final grading plans and data collected from well construction.
    - a. Elevation of Finished Ground Surface at Well Head: 15 feet.
    - b. Elevation of Discharge Centerline: 18 feet.
    - c. Elevation of Pump Intake: -115 feet.

- d. Approximate range of static well water surface elevation: -33 to 15 feet.
- e. Approximate minimum pumping water level elevation: -95 feet.
- P. Capable of temporary operation at and near shut off head for 30 seconds maximum, during the ramping up and down process of the pump against a closed check valve when the pump is starting and stopping.

#### 2.2 SUBMERSIBLE MOTOR PUMP DRIVE SYSTEM

- A. Manufacturers:
  - 1. Franklin.
  - 2. Grundfos.
- B. Hermetically sealed water-filled submersible motor.
- C. Electric power supply: 480Volt, 3 Phase, 60 Hz.
- D. Service factor: 1.0 (inverter duty).
- E. Motor speed: To match pump speed.
- F. Minimum full load efficiency: 85 percent.
- G. Minimum full load power factor: 80 percent.
- H. Maximum nominal motor diameter: 8-inches.
- I. Motor capable of full load operation submerged in water up to 25 degrees C.
- J. Nameplate rating on motor at 1.0 service factor not to be exceeded at any point on pump performance curve.
- K. Enclose hermetically sealed stator and resin embedded windings in an all-welded epoxy coated steel or Type 316 stainless steel case, to dissipate heat quickly to the surrounding well water. Provide an elastomer expansion diaphragm with ample sized expansion chamber within motor case to equalize internal and external pressures at any depth of submergence. Motor to not require a breather plug or pressure relief valve for proper operation.
- L. Motor windings: Solid copper conductor with class "Y" (waterproof) insulation rated for motor voltage.
- M. Seals: Single mechanical type shaft seal with Silicon Carbide/Silicon Carbide seal faces to seal motor at shaft extension to pump coupling.
- N. Wetted fasteners: Type 316 stainless steel with Monel nuts.
- O. Rotor dynamically balanced and mounted on an amply sized Type 316 stainless steel shaft stabilized by water lubricated sleeve type carbon composite bearings.

- P. Thrust bearing to carry weight of rotating assembly plus thrust of pump operating a shut-off head to be water lubricated self-aligning and self-equalizing Kingsbury Type assembly with multiple micro-finished stainless steel bearing shoes providing contact with a graphite or carbon composite rotating ring. Capability to run in either direction without damage.
- Q. Motor factory filled with food-grade propylene glycol-potable water internal lubricating solution for maximum reliability and long life.
- R. Provide a flow inducer (suction sleeve/shroud) of same material as well column pipe as required to provide adequate motor cooling. Submit details.
  - 1. Size inducer in conformance with motor manufacturer's recommendations to maintain minimum head losses and velocity for adequate motor cooling, based upon well diameter.
  - 2. Provide centralizers to position inducer uniformly around motor housing and within well casing. Provide guides to assist raising and lowering of motor past size transitions within well casing.
  - 3. Design inducer to receive flow from well screen below elevation of motor to assure external cooling flow passes along entire length of motor.
- S. Power Cable: Three-conductor plus ground power cable enclosed within a common jacket. Size conductors for voltage drop less than three percent at motor rated full load current and voltage measured at starter. Cable designed for submerged service, non-hygroscopic. Cable jacketing of neoprene or equal and insulation of Ethylene Propylene Rubber (EPR) or equal. Provide Type 316 stainless steel cable clamps to securely fasten cable at intervals of not more than 10-feet. Terminate cable at junction box at surface on discharge head. Furnish cable splicing kit for splicing of cable to motor leads.
- T. Motor thermal protection: Motor to incorporate three thermal switches, one per stator winding, connected in series, to monitor motor temperature. Should any thermal switch open, motor to stop and activate an alarm. Coordinate selections of devices and settings with total distance from control cabinet to pump mounted in well.
- U. Thermal protection cable: Provide thermal switch cable, single multi-conductor cable with sufficient individually insulated conductors sized for application, designed for submerged service, non-hygroscopic, the neoprene jacketing. Terminate cable at junction box at surface on discharge head. Furnish cable splicing kit for splicing of cable to monitoring leads on motor.

## 2.3 PUMP CONSTRUCTION

- A. Manufacturers:
  - 1. Grundfos.
- B. Pump bowls: Type 316 Stainless steel, ASTM A744M.
  - 1. Bowl bolting to be Type 316 stainless steel with Monel nuts (where nuts are used).
  - 2. Pump bowl bearings: ASTM B505, Alloy C89835 bismuth tin bronze.
  - 3. Impellers.
  - 4. Closed type.

- 5. Material: Type 316 Stainless steel, ASTM A744M.
- 6. Dynamically balanced.
- 7. Enclosed type impeller design to include adequate material to provide for future machining for addition of wear ring to restore impeller efficiency.
- 8. Impellers fastened to shaft with lock collets or keys of stainless steel conforming.
- C. Pump shaft: Type 316 Stainless steel, ASTM A276.
  - 1. Shaft diameter in accordance with AWWA E102 of sufficient diameter to transmit motor torque with a liberal safety factor, minimize vibration, and rigidly support impellers between bowl bearings.
- D. Shaft Coupling:
  - 1. Size shaft coupling between motor and pump bowl shaft in accordance with AWWA E102, of sufficient size and strength to withstand maximum torque generated by motor plus safety factor.
  - 2. Coupling of Type 316 Stainless steel, ASTM A276.
  - 3. Coupling keyed to pump shaft.
- E. Suction adapter:
  - 1. One-piece casting of Type 316 Stainless steel, ASTM A744M to serve as suction inlet, lower bearing housing and motor adapter.
  - 2. Suction inlet to include an ASTM A276, Type 316 stainless steel screen. Inlet area equal to at least five times impeller inlet area.
  - 3. Bottom bearing: ASTM B505, Alloy C89835 bismuth tin bronze.
  - 4. Design motor adaptor to prevent entrance of abrasive material into top end of motor. Provide a sand collar of rubber or bronze, ASTM B505, Alloy C89835 to protect suction adapter bearings from abrasives in liquid pumped.
- F. 6-inch column pipe:
  - 1. Column wall thickness in accordance with AWWA E102.
  - 2. Type 316L stainless steel, ASTM A276 male NPT thread by male NPT thread between pump discharge and column check valve. Coordinate end connections with equipment vendors.
  - 3. Certa-Lok Type 316 stainless steel drop pipe adapter with Certa-Lok male by male NPT thread between column check valve and Certa-Lok PVC drop pipe.
  - 4. Certa-Lok Type 316 stainless steel drop pipe adapter will connect to Certa-Lok PVC drop pipe. Certa-Lok PVC drop pipe to use Certa-Lok drop pipe coupling with Certa-Lok female by Certa-Lok female, gaskets, splines, and screws.
  - 5. Certa-Lok Type 316 stainless steel drop pipe adapter with Certa-Lok male by male NPT thread will connect to top section of Certa-Lok PVC drop pipe. Certa-Lok drop pipe adapter will connect to custom stainless steel wellhead as shown on the Drawings.
  - 6. Provide a minimum of four radially spaced guide vanes welded to discharge column pipe immediately above pump bowl assembly to assure that submersible pump and motor assembly is properly centered within well casing.
- G. Discharge Head:

- 1. Provide a discharge head as shown on drawings to support pump and riser column within well and provide discharge connection to transmission piping.
- 2. Discharge head and integral baseplate of fabricated Type 316L stainless steel. Baseplate to be 150 lb. ASME B16.5 or B16.47 flange to engage flange at top of well casing.
- 3. Drill and tap discharge head baseplate for installation of well level monitor, vent, gravel port, manual level measurement port, and power cable penetration. Refer to Drawings for details.
- 4. Pump discharge head to provide waterproof connection to well casing.
- 5. Provide two or more lifting eyes on discharge head.
- 6. Outlet nozzle of discharge head to be flanged to ASME B16.5 or B16.47.
- 7. Provide tapped boss near discharge nozzle flange for connection of pressure gauge/pressure monitor.
- 8. Provide a steel well casing flange to match discharge head baseplate to be welded to the well casing. Flange bolts to be Type 316 stainless steel with Monel nuts.
- 9. Provide gasket between well casing flange and discharge head.
- H. Column Check Valve:
  - 1. Provide a spring loaded, positive-sealing column silent globe check valve located immediately above bowl assembly.
  - 2. Check valve diameter same as column.
  - 3. Check valve body constructed of cast stainless steel. Spring of Monel. Disc and shaft of Type 316 stainless steel with bronze bushings. Bolts of Type 316 stainless steel with Monel nuts.
  - 4. Valve pressure rating to accommodate maximum total dynamic head of pump through entire performance range from shutoff to runout.
- I. Name Plates: Stainless steel nameplate (with embossed data) securely mounted to body of equipment.
  - 1. Pump nameplates include:
    - a. Manufacturer's name.
    - b. Model number.
    - c. Serial number.
    - d. Rated flow capacity.
    - e. Head.
    - f. Speed.
  - 2. Nameplate for motor:
    - a. Manufacturer's name.
    - b. Model number.
    - c. Serial number.
    - d. Horsepower.
    - e. Speed.
    - f. Input voltage.
    - g. Amps.
    - h. Number of cycles.
    - i. Power.
    - j. Service factors.

#### 2.4 ACCESSORIES

A. Refer to details in the Drawings for wellhead accessories.

#### 2.5 SHOP PAINTING

- A. Shop prime and finish coat each component of pumping system including pump, motor, column, discharge head, and associated equipment. Prepare, shop-prime and finished-coat in accordance with Manufacturer's standard practice prior to shipment. Colors Manufacturer's standard. Provide adequate supply of touch-up paints.
- B. Clean all interior and exterior surfaces of pump column pipes and discharge heads and exterior of bowl assemblies of all rust and mill scale, grease, dirt, other foreign matter and apply Manufacturer's standard epoxy coatings.
- C. All coatings on wetted surfaces to be epoxy type in compliance with AWWA E-103, ANSI/NSF 61, ANSI/NSF 61 Annex G, and ANSI/NSF 372 for use with drinking water systems. Surface preparation to conform to coating manufacturer's recommendations.
- D. Protect nameplates during painting.

#### 2.6 SOURCE QUALITY CONTROL

- A. Certified Factory Pump Tests:
  - 1. Factory test each pump in accordance with ANSI/HI 14.6, American National Standard for Rotodynamic Pumps for Hydraulic Performance Acceptance Tests and AWWA E102.
  - 2. Prior to conducting a pump test, notification of such test and list of test equipment and test procedures shall be forwarded to the ENGINEER at least ten (10) working days before the scheduled test date. All electronic transducers, meters, gauges, and other test instruments shall be calibrated in accordance with the frequency listed in the Hydraulic Institute Standards. Copies of calibration data shall be provided. Differential pressure type flow meters, such as venturis shall have been calibrated within 5 years. Mechanical variation of the meter throat diameter will be accepted as verification of calibration validity.
  - 3. Visually inspect cast surfaces of all components per MSS SP-55.
  - 4. Perform hydrostatic tests on each bowl assembly and discharge head in full compliance with ANSI/HI 14.6.
  - 5. Perform certified pump performance tests of each pump including head, capacity, brake horsepower, wire to water pump efficiency, and NPSH3 in accordance with ANSI/HI 14.6.
    - a. Testing to be performed at full rated pump speed of complete bowl assembly.
    - b. Take at least seven operating points along pump curve plus shut-off head, with two points clustered close to specified design point.
    - c. Test to demonstrate pump meets ANSI/HI 14.6, acceptance grade 1U at design point.
    - d. If Manufacturer does not have historical test records for NPSH3 at specified design pump speed, test one pump to demonstrate NPSH3 versus flow rate.

- e. Submit complete report of test including description of procedure, test set-up arrangement, calibration data, raw and final test data, and certified pump performance curves.
- f. Test results submittal to be reviewed and approved by Engineer prior to release for shipment from factory.
- g. Calibrate all meters, gauges, and other test instruments within Manufacturer's established time period prior to scheduled test and include certified calibration data test submittal. If Manufacturer has no ISO standard calibration period, Hydraulic Institute Standards to govern.
- h. Job motor or factory test motor may be used as pump driver during performance test.
- i. Testing will be non-witnessed.
- j. If any pump tested fails to meet specification requirements, modify until it meets all specification requirements. If any pump tested fails to meet efficiency requirements at any listed flow or head conditions and all reasonable attempts to correct the inefficiency are unsuccessful, replace pump(s) with unit(s) that meet specified requirements.
- 6. Factory test each motor and submit copies of test results. Tests to include the following:
  - a. Perform routine tests on motors Report results as described on NEMA MG1-12.54 "Report of Test Form for Routine Tests on Induction Motors." Test efficiency in accordance with IEEE Publication No. 112. Measure power factor on representative motors.
  - b. Pressure check stators for leaks to ensure a guaranteed leak proof housing.
  - c. Perform standard shop no load running current test, high potential test, and winding resistance test.
- 7. Prepare test and inspection reports.

## PART 3 - EXECUTION

#### 3.1 PREPARATION

A. Take all necessary field measurements to determine exact dimensions for all work and required sizes of all equipment under Contract. Verify all pertinent data and dimensions.

#### 3.2 INSTALLATION

- A. Installation to comply with AWWA E102 and applicable standards of Hydraulic Institute.
- B. Install discharge head in accordance with manufacturer's requirements.
  - 1. Ensure that protection of the well and sanitary seal is provided during excavation and subsequent backfilling of soil during the installation of the wellhead.
  - 2. Cut well casing pipe in locations required for installation of discharge head. Cut well casing to proper elevation as shown or directed, and well on top flange for attachment of discharge head.

- 3. If damage is inflicted to any part of well or sanitary seal, repair all damaged materials to satisfaction of Engineer at no additional cost to Owner.
- 4. Clean all welded joints and restore protective coatings.
- C. Pumping unit installation to comply with applicable State Health Department Requirements governing installation of pumps in Water Wells.
- D. Provide tack welded strap restraints of same material as column pipe to positively lock to pump to discharge column to prevent unscrewing due to motor starting torque. Continue strap restraints up pump column to elevation recommended by Manufacturer.
- E. Paint above grade portion of pump surface discharge with an approved paint, furnished in unopened manufacturer containers.

## 3.3 FIELD QUALITY CONTROL

- A. Installation of discharge head, pump and motor and column piping to be inspected/monitored by a factory representative of pump manufacturer in presence of ENGINEER.
- B. If Design-Builder does not provide qualified installation staff on the job during pump installation, Engineer may direct Design-Builder to provide services of a Manufacturer's factory representative to provide necessary instructions to ensure a proper installation.
- C. Submit a certificate from Manufacturer stating that installation of their equipment is satisfactory, equipment is ready for operation, and Owner's operating personnel have been suitably instructed in operation, lubrication and care of each unit.

#### 3.4 STARTUP SERVICE

- A. Provide services of a factory representative to check completed pump installation and supervise start-up of pumping system.
- B. After pump has been completely installed, conduct a test of equipment with a factory representative of pump manufacturer in presence of Engineer to demonstrate compliance with pump design. Furnish all instruments, meters, gauges and incidentals which may be required for testing.
- C. Upon recording pump discharge and pressure at five capacity points, shut-down and allow water level to recover within 1-inch of static levels. At this time, operate pump within plus or minus two percent of the design capacity for a period of one hour. Measure pump capacity, discharge head, horsepower input and motor speed shall be made. Water level drawdowns in observation wells shall be recorded at intervals approved by the Engineer.

D. If compliance with above requirements are not met and corrections not effected within 30 days of mutually agreed date, then replace pump unit with one that will meet operating requirements. Such replacement shall be in full accordance with all requirements as specified herein. Rejection of pumping unit may not preclude its use after rejection if removal of pumping unit, prior to furnishing a replacement unit, will adversely affect OWNER.

END OF SECTION 432520

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# SECTION 011000

# SUMMARY OF WORK

## PART 1 GENERAL

- 1.1 SECTION INCLUDES
  - A. Description of Work
  - B. CONTRACTOR's Use of Site
  - C. Work Sequence
  - D. COUNTY Occupancy
- 1.2 DESCRIPTION OF WORK
  - A. General: The Work to be done under this Contract is shown on the drawings and specified in Contract Documents.
  - B. The Work includes:
    - 1. Furnishing of all labor, material, superintendence, plant, power, light, heat, fuel, water, tools, appliances, equipment, supplies, services and other means of construction necessary or proper for performing and completing the Work.
    - 2. Sole responsibility for adequacy of plant and equipment.
    - 3. Maintaining the Work area and site in a clean and acceptable manner.
    - 4. Maintaining existing facilities in service at all times.
    - 5. Protection of finished and unfinished Work.
    - 6. Repair and restoration of Work or existing facilities damaged during construction.
    - 7. Furnishing as necessary proper equipment and machinery, of a sufficient capacity, to facilitate the Work and to handle all emergencies normally encountered in Work of this character.

- 8. Furnishing, installing, and protecting all necessary guides, track rails, bearing plates, anchor and attachment bolts, and all other appurtenances needed for the installation of the devices included in the equipment specified. Make anchor bolts of appropriate size, strength and material for the purpose intended. Furnish substantial templates and shop drawings for installation.
- C. Implied and Normally Required Work: It is the intent of these Specifications to provide the COUNTY with complete operable systems, subsystems and other items of Work. Any part or item of Work, which is reasonably implied or normally required to make each installation satisfactorily and completely operable, is deemed to be included in the Work and the Contract Amount. All miscellaneous appurtenances and other items of Work incidental to meeting the intent of these Specifications are included in the Work and the Contract Amount even though these appurtenances may not be specifically called for in these Specifications.
- D. Quality of Work: Regard the apparent silence of the Contract Documents as to any detail, or the apparent omission from them of a detailed description concerning any Work to be done and materials to be furnished as meaning that only the best general practice is to prevail and that only materials and workmanship of the best quality are to be used. Interpretation of these specifications will be made upon this basis.
- 1.3 CONTRACTOR'S USE OF SITE
  - A. In addition to the requirements of the Supplemental Terms and Conditions, limit use of site and premises for work and storage to allow for the following:
    - 1. Coordination of the Work under this CONTRACT with the work of the other contractors where Work under this CONTRACT encroaches on the Work of other contractors.
    - 2. COUNTY occupancy and access to operate existing facilities.
    - 3. Coordination of site use with ENGINEER.
    - 4. Responsibility for protection and safekeeping of products under this CONTRACT.
    - 5. Providing additional off site storage at no additional cost to the COUNTY as needed.
- 1.4 WORK SEQUENCE
  - A. Construct Work in stages to accommodate the COUNTY's use of premises during construction period and in accordance with the limitations on the sequence of construction specified. Coordinate construction schedules and operations with ENGINEER.

B. Coordinate Work of all subcontractors.

# 1.5 COUNTY OCCUPANCY

- A. The COUNTY will occupy premises during entire period of construction in order to maintain normal operations. Cooperate with the COUNTY's Manager or designee in all construction operations to minimize conflict, and to facilitate COUNTY usage.
- B. Conduct operations with the least inconvenience to the general public.

# 1.6 PROTECTION OF EXISTING UTILITIES

A. In case of damage to existing utilities caused by construction activities, contact the owner of the utility or appropriate COUNTY department (Water or Wastewater) immediately. Repair any damage to existing utilities caused by construction activities in coordination with or as directed by the owner of the utility.

PART 2 PRODUCTS

Not Used

# PART 3 EXECUTION

A. Starting Work: Start Work within 10 days following the date stated in the Notice to Proceed and execute with such progress as may be required to prevent delay to other contractors or to the general completion of the project. Execute Work at such items and in or on such parts of the project, and with such forces, material and equipment, as to complete the Work in the time established by the Contract. At all times, schedule and direct the Work so that it provides an orderly progression to completion within the specified time for completion.

# END OF SECTION

NO TEXT FOR THIS PAGE

COLLIER COUNTY TECHNICAL SPECIFICATIONS Section 011000 SUMMARY OF WORK Page 4 of 4

# **SECTION 014200**

# REFERENCES

## PART 1 GENERAL

## 1.1 SECTION INCLUDES

- A. Reference Abbreviations
- B. Abbreviations
- C. Reference Standards
- D. Definitions
- 1.2 RELATED SECTIONS
  - A. Information provided in this section is used where applicable in individual Specification Sections.

## 1.3 REFERENCE ABBREVIATIONS

A. Reference to a technical society, trade association or standards setting organization, may be made in the Specifications by abbreviations in accordance with the following list:

AABC	Associated Air Balance Council
AAMA	Architectural Aluminum Manufacturers Association
AASHTO	American Association of State Highway and Transportation Officials
AATCC	American Association of Textile Chemists and Colorists
ACI	American Concrete Institute
ADC	Air Diffusion Council
AFBMA	Anti-friction Bearing Manufacturers Association
AGA	American Gas Association
AGMA	American Gear Manufacturers Association
AHA	Association of Home Appliance Manufacturers
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AMCA	Air Movement and Control Association, Inc.
ANSI	American National Standards Institute
APA	American Plywood Association
ARI	American Refrigeration Institute
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers

ASSE	American Society of Sanitary Engineers
ASTM	American Society for Testing and Materials
AWI	Architectural Woodwork Institute
AWPA	American Wood Preservers Association
AWS	American Welding Society
AWWA	American Water Works Association
BHMA	Builders' Hardware Manufacturers Association
BIA	Brick Institute of American
CABO	Council of American Building Officials
CAGI	Compressed Air and Gas Institute
CISPI	Cast Iron Soil Pipe Institute
CMAA	Crane Manufacturers Association of America
CRD	U.S. Corps of Engineers Specifications
CRSI	Concrete Reinforcing Steel Institute
CTI	Cooling Tower Institute
DHI	Door and Hardware Institute
DOH	Department of Health
DOT	Department of Transportation
Fed. Spec.	Federal Specifications
FGMA	Flat Glass Marketing Association
FM	Factory Mutual
HMI	Hoist Manufacturing Institute
HPMA	See HPVA
HPVA	Hardwood Plywood Veneer Association
ICEA	Insulated Cable Engineers Association
IEEE	Institute of Electrical and Electronics Engineers
IFI	Industrial Fasteners Institute
MIL	Military Specifications
MSS	Manufacturer's Standardization Society
NAAMM	National Association of Architectural Metal Manufacturers
NACM	National Association of Chain Manufacturers
NBS	National Bureau of Standards, See NIST
NEBB	National Environmental Balancing Bureau
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NETA	National Electrical Testing Association
NFPA	National Fire Protection Association
NFPA	National Forest Products Association
NFPA	National Fluid Power Association
NIST	National Institute of Standards and Technology
NLMA	National Lumber Manufacturers Association
NSF	National Sanitation Foundation
OSHA	Occupational Safety and Health Act
PCI	Prestressed Concrete Institute
PDI	Plumbing and Drainage Institute
SAE	Society of Automotive Engineers
SCPRF	Structural Clay Products Research Foundation
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association

SPI	Society of the Plastics Industry
SSPC	Steel Structures Painting Council
STI	Steel Tank Institute
TCA	Tile Council of American
TIMA	Thermal Insulation Manufacturers' Association
UL	Underwriters' Laboratories, Inc.
USBR	U. S. Bureau of Reclamation
USBS	U. S. Bureau of Standards, See NIST

# 1.4 ABBREVIATIONS

A. Abbreviations which may be used in individual Specification Sections are as follows:

alternating current	ac
American wire gauge	AWG
ampere(s)	amp
ampere-hour(s)	AH
annual	ann
Ampere Interrupting	
Capacity	AIC
atmosphere(s)	atm
average	avg
biochemical oxygen demand	BOD
Board Foot	FBM
brake horsepower	bhp
Brinell Hardness	BH
British thermal unit(s)	Btu
calorie(s)	cal
carbonaceous biochemical	
oxygen demand	CBOD
Celsius (centigrade)	C
Center to Center	C to C
centimeter(s)	cm
chemical oxygen demand	COD
coefficient, valve flow	C <sub>v</sub>
condensate return	CR
cubic	cu
cubic centimeter(s)	CC
cubic feet per day	cfd
cubic feet per hour	cfh
cubic feet per minute	cfm
cubic feet per minute,	
standard conditions	scfm
cubic feet per second	cfs

cubic foot (feet) cubic inch(es) cubic yard(s)	cu ft cu in cu yd
decibels	dB
decibels (A scale)	dBa
degree(s)	deg
dewpoint temperature	dpt
diameter	dia
direct current	dc
dissolved oxygen	DO
dissolved solids	DS
dry-bulb temperature	dbt
- <b>f</b> (: - : - : - : - : - : - : - : - : - : -	- 44
elliciency	en
elevation	el
entering water temperature	ewt
entering air temperature	eat
equivalent direct radiation	edr
face area	fa
face to face	f to f
Fahrenheit	F
feet per day	fpd
feet per hour	fph
feet per minute	fpm
feet per second	fps
foot (feet)	 
foot-candle	fc
foot-pound	ft-lb
foot-pounds per minute	.ft-lb/min
foot-pounds per second	. ft-lb/sec
formazin turbidity unit(s)	FTU

frequency freq
fuel oilFO
fuel oil supplyFOS
fuel oil returnFOR
gallon(s) gal
gallons per day gpd
gallons per day per
cubic foot
gallons per day per
square foot
gallons per hour gph
gallons per minute
gallons per second gps
gas chromatography and
mass spectrometry GC-MS
gauge
grain(s)gr
gram(s)
grams per cubic centimeter
Heat Transfer CoefficientU
heighthgt
HertzHz
horsepower hp
horsepower-hourhp-hr
hour(s) hr
humidity, relative rh
hydrogen ion concentrationpH
inch(es)in
inches per secondips
inside diameterID
Jackson turbidity unit(s)JTU
kelvin K
kiloamperes kA
kilogram(s) ka
kilometer(s) km
kilovar (kilovolt-amperes
reactive) kvar
kilovolt(s) k/
kilovolt-ampere(s) kVA
kilowatt(s)kW
kilowatt-hour(s)kWh
linear foot (feet)lin ft
liter(s) L

megavolt-ampere(s)	MVA
meter(s)	m
micrograms per liter	ug/L
miles per hour	mph
milliampere(s)	mA
milligram(s)	mg
milligrams per liter	mg/Ľ
milliliter(s)	mL
millimeter(s)	mm
million gallons	MG
million gallons per day	mgd
millisecond(s)	ms
millivolt(s)	mV
minute(s)	min
mixed liquor suspended	
solids	MLSS
nephelometric turbidity	
unit	NTU
net positive suction head	NPSH
noise criteria	nc
noise reduction coefficient	NRC
number	no
ounce(s)	0Z
outside air	02
outside diameter	
	00
parts per billion	daa
parts per million	nom
percent	nct
phase (electrical)	nh
pound(s)	lh
pounds per cubic foot	ncf
pounds per cubic foot	
per bour	ncf/hr
pounds per day	lbe/day
pounds per day per	105/uay
cubic foot	lbc/dov/ou ft
nounds por day por	ibs/uay/cu it
square feet	lbc/dov/ca ft
squale loot	ibs/uay/sq it
pounds per square foot	psr
pourlus per square root	nof/h-
per nour course inch	psi/nr
pounds per square inch	psi
poundo por ocuero inch	
abcoluto	naia
ลมรบเนเษ	psia

pounds per square inch

gauge	psig
power factor	PF
pressure drop or difference pressure, dynamic	dp
(velocity)	vp
pressure, vapor	vap pr
quart(s)	qt
Rankine	R
Rankine	R
relative humidity	rh
Rankine	R
relative humidity	rh
resistance	res
Rankine	R
relative humidity	rh
resistance	res
return air	ra
Rankine	R
relative humidity	rh
resistance	res
return air	ra
revolution(s)	rev
Rankine	R
relative humidity	rh
resistance	ra
return air	ra
revolution(s)	rev
revolutions per minute	rpm
Rankine relative humidity resistance return air revolution(s) revolutions per minute revolutions per second	R rh res rav rpm rps
Rankine	R
relative humidity	rh
resistance	res
return air	ra
revolution(s)	rev
revolutions per minute	rpm
revolutions per second	rps
root mean squared	rms

safety factor	sf
second(s)	. sec
shading coefficient	. SC
sludge density index	SDI

## Sound Transmission

Coefficient	STC
specific gravity	sp gr
specific volume	Sp Vol
sp ht at constant pressure	Ср
square	sq
square centimeter(s)	sq cm
square foot (feet)	sq ft
square inch (es)	sq in
square meter(s)	sq m
square yard(s)	sq yd
standard	std
static pressure	st pr
supply air	sa
suspended solids	SS

temperature	temp
temperature difference	TD
temperature entering	TE
temperature leaving	TL
thousand Btu per hour	. Mbh
thousand circular mils	kcmil
thousand cubic feet	Mcf
threshold limit value	. TLV
tons of refrigeration	tons
torque	TRQ
total dissolved solids	. TDS
total dynamic head	TDH
total kjeldahl nitrogen	. TKN
total oxygen demand	TOD
total pressure	TP
total solids	TS
total suspended solids	. TSS
total volatile solids	. TVS
vacuum	vac
viscosity	visc
volatile organic chemical	VOC
volatile solids	VS
volatile suspended solids	. VSS
volt(s)	V
volts-ampere(s)	VA
volume	vol
watt(s)	W
watthour(s)	Wh
watt-hour demand	WHD
watt-hour demand meterW	/HDM
week(s)	wk
weight	wt
wet-bulb	WB
wet bulb temperature	WBT
yard(s)	yd
year(s)	ýr

# 1.5 REFERENCE PUBLICATIONS

The following publications are incorporated into this Manual and are made a part of this Manual as is set out verbatim in this Manual. Violations of any provision of every such publication, as updated from time-to-time by Resolution(s) of the Board of County

Commissioners, shall be a violation of the Collier County Utilities Standards and Procedures Ordinance, as then amended.

- A. Water Environment Federation, Manual of Practice No. 8, Wastewater Treatment Plant Design, W.E.F., 601 Wythe Street, Alexandria, VA, 22314-1994.
- B. Water Environment Federation, Manual of Practice No. 9, Design and Construction of Sanitary and Storm Sewers, W.E.F., 601 Wythe Street, Alexandria, VA, 22314-1994.
- C. Great Lakes/Upper Mississippi River Board of State Sanitary Engineers. Recommended Standards for Sewage Works, Health Education Service, Inc., P.O. Box 7283, Albany, New York, 12224.
- D. Great Lakes/Upper Mississippi River Board of State Sanitary Engineers. Recommended Standards for Water Works, Health Education Service, Inc., P.O. Box 7283, Albany, New York, 12224.
- E. Rules of the Florida Department of Environmental Protection for Water, Wastewater, and Reclaimed Water Systems, latest revisions of F.A.C. Chapters 62-550, 62-555, 62-600, 62-604, 62-610, 64E-6, and 64E-8, 3900 Commonwealth Boulevard M.S. 49, Tallahassee, Florida, 32399.
- F. American Water Works Association, Inc., Water Treatment Plant Design, 6666 West Quincy Avenue, Denver, Colorado, 80235.
- G. American Water Works Association, Inc., Water Treatment Plant Design, AWWA Standards and Applicable Manuals, 6666 West Quincy Avenue, Denver, Colorado, 80235.
- H. Ductile Iron Pipe Research Association, Handbook, Ductile Iron Pipe/Cast Iron Pipe, Ductile Iron Pipe Research Association, 245 Riverchase Parkway East, Birmingham, Alabama, 35244.
- I. Uni-Bell Plastic Pipe Association, Handbook of PVC Pipe, Uni-Bell Plastic Pipe Association, 2655 Villa Creek Drive, Suite 164, Dallas, Texas, 75234.
- J. American National Standards Institute, latest revisions of applicable standards, 1819 L Street NW, Suite 600, Washington, D.C., 20036.
- K. American Society for Testing and Materials, latest revisions of applicable standards, ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, Pennsylvania, 19428-2959.
- L. National Water Research Institute, Treatment Technologies for Removal of MTBE. NWRI, 10500 Ellis Ave., P.O. Box 20865, Fountain Valley, CA, 92728.

- M. National Water Research Institute, Valuing Ground Water: Economic Concepts/Approaches. NWRI, 10500 Ellis Ave., P.O. Box 20865, Fountain Valley, CA, 92728.7.3.14.
- N. U.S. Environmental Protection Agency, Design Criteria for Mechanical, Electric, and Fluid System and Component Reliability, Supplement to the Federal Guidelines for Design, Operation, and Maintenance of Wastewater Treatment Facilities, Technical Bulletin EPA-430-99-74-001, U.S. EPA, Office of Water Program Operations.
- O. Florida Department of Transportation, Standard Specifications for Road and Bridge Construction, Maps & Publications Sales, Mail Station 12, 605 Suwannee Street, Tallahassee, Florida 32399-0450.
- P. Plastics Pipe Institute, Handbook of Polyethylene Pipe, 1825 Connecticut Ave., NW, Suite 680, Washington, DC 20009.
- Q. National Fire Protection Association, 1995 Edition of NFPA 24 Standard for the Installation of Private Fire Service Mains and Their Appurtenances, 1 Batterymarch Park, Quincy, MA 02169.
- R. Collier County Water-Sewer District Utilities Standards Manual.
- S. National Electrical Code, latest revisions of applicable requirements.
- T. Metcalf and Eddy, Wastewater Engineering Treatment and Reuse, 4<sup>th</sup> Edition, McGraw-Hill, 2002.
- U. Water Environment Federation, Manual of Practice No. 11, Operation of Municipal Wastewater Treatment Plants, 601 Wythe Street, Alexandria, VA 22314-1994.

## 1.6 REFERENCE STANDARDS

- A. Latest Edition: Construe references to furnishing materials or testing, which conform to the standards of a particular technical society, organization, or body, to mean the latest standard, code, or specification of that body, adopted and published as of the date of bidding this Contract. Standards referred to herein are made a part of these Specifications to the extent that is indicated or intended.
- B. Precedence: The duties and responsibilities of the COUNTY, CONTRACTOR or ENGINEER, or any of their consultants, agents or employees are set forth in the Contract Documents, and are not changed or altered by any provision of any referenced standard specifications, manuals or code, whether such standard manual or code is or is not specifically incorporated by reference in the Contract Documents. Any duty or authority to supervise or direct the furnishing or performance of the Work or any duty or authority, to undertake responsibility contrary to the powers of the ENGINEER as set forth in the Contract Documents cannot be assigned to the ENGINEER or any of the ENGINEER's consultants, agents or employees.

## 1.7 DEFINITIONS

- A. In these Contract Documents the words furnish, install and provide are defined as follows:
  - 1. Furnish (Materials): to supply and deliver to the project ready for installation and in operable condition.
  - 2. Install (services or labor): to place in final position, complete, anchored, connected in operable condition.
  - 3. Provide: to furnish and install complete. Includes the supply of specified services. When neither furnish, install or provide is stated, provided is implied.
  - 4. COUNTY: Collier County Board of Commissioners, County Government Center, 3301 East Tamiami Trail, Naples, Florida 34112, or authorized staff or representatives.
  - 5. ENGINEER: The terms Design Professional, Design Engineer, and Engineer are interchangeably used throughout the Contract Documents.

# PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

# **SECTION 014500**

# QUALITY CONTROL

## PART 1 GENERAL

## 1.1 SECTION INCLUDES

- A. Submittals
- B. Inspection Services
- C. Inspection of Materials
- D. Quality Control
- E. Costs of Inspection
- F. Acceptance Tests
- G. Failure to Comply with Contract

## 1.2 SUBMITTALS

- A. General: Provide all submittals, including the following, as specified in the individual material sections.
- B. Certificate Submittals: Furnish the ENGINEER authoritative evidence in the form of Certificates of Manufacture that the materials and equipment to be used in the Work have been manufactured and tested in conformity with the Contract Documents. Include copies of the results of physical tests and chemical analyses, where necessary, that have been made directly on the product or on similar products of the manufacturer.

## 1.3 INSPECTION SERVICES

A. COUNTY's Access: At all times during the progress of the Work, and until the date of final completion, afford the County Manager or designee and ENGINEER every reasonable, safe, and proper facility for inspecting the Work at the site. The observation and inspection of any work will not relieve the CONTRACTOR of any obligations to perform proper and satisfactory work as specified. Replace work rejected due to faulty design, inferior, or defective materials, poor workmanship, improper installation, excessive wear, or nonconformity with the requirements of the Contract Documents, with satisfactory work at no additional cost to the COUNTY. Replace as directed, finished or unfinished work found not

to be in strict accordance with the Contract, even though such work may have been previously approved and payment made therefor.

- B. Rejection: The County's Manager or designee has the right to reject materials and workmanship which are defective or require correction. Promptly remove rejected work and materials from the site.
- C. Inferior Work Discoveries: Failure or neglect on the part of the County Manager or designee to condemn or reject bad or inferior work or materials does not imply an acceptance of such work or materials. Neither is it to be construed as barring the County Manager or designee at any subsequent time from recovering damages or a sum of money needed to build anew all portions of the Work in which inferior work or improper materials were used.
- D. Removal for Examination: Should it be considered necessary or advisable by the County Manager or designee, at any time before final acceptance of the Work, to make examinations of portions of the Work already completed, by removing or tearing out such portions, promptly furnish all necessary facilities, labor, and material, to make such an examination. If such Work is found to be defective in any respect, defray all expenses of such examination and of satisfactory reconstruction. If, however, such work is found to meet the requirements of the Contract, the cost of examination and restoration of the Work will be considered a change in the Work to be paid for in accordance with applicable provisions of the Contract.
- E. Operation Responsibility: Assume full responsibility for the proper operation of equipment during tests and instruction periods. Make no claim, other than provided in the Contract Documents, for damage that may occur to equipment prior to the time when the County Manager or designee accepts the Work.
- F. Rejection Prior to Warranty Expiration: If at anytime prior to the expiration of any applicable warranties or guarantees, defective equipment is rejected by the County Manager or designee, repay to the COUNTY all sums of money received for the rejected equipment on progress certificates or otherwise on account of the Contract lump sum prices, and upon the receipt of the sum of money, County Manager or designee will execute and deliver a bill of sale of all its rights, title, and interest in and to the rejected equipment. Do not remove the equipment from the premises of the COUNTY until the County Manager or designee obtains from other sources, equipment to take the place of that rejected. The County Manager or designee hereby agrees to obtain other equipment within a reasonable time and the CONTRACTOR agrees that the COUNTY may use the equipment furnished by the CONTRACTOR without rental or other charge until the other new equipment is obtained.

## 1.4 INSPECTION OF MATERIALS

A. Premanufacture Notification: Give notice in writing to the ENGINEER sufficiently in advance of the commencement of manufacture or preparation of materials especially manufactured or prepared for use in or as part of the permanent construction. When required, notice to include a request for inspection, the date of commencement, and the expected date of completion of the manufacture or preparation of materials. Upon receipt of such notice, ENGINEER will arrange to have a representative present at such times during the manufacture or testing as may be necessary to inspect the materials, or will notify CONTRACTOR that the inspection will be made at a point other than the point of manufacture or testing, or that the inspection will be waived. Comply with these provisions before shipping any materials. Such inspection will not constitute a release from the responsibility for furnishing materials meeting the requirements of the Contract Documents.

- B. Testing Standards: Conduct tests of electrical and mechanical equipment and appliances in accordance with recognized, applicable test codes.
- 1.5 QUALITY CONTROL
  - A. Testing
    - 1. Field and Laboratory
      - a. Provide personnel to assist the ENGINEER in performing the following periodic observation and associated services.
        - (1) Soils: Observe and test excavations, placement and compaction of soils. Determine suitability of excavated material. Observe subgrade soils and foundations.
        - (2) Concrete: Observe forms and reinforcement; observe concrete placement; witness air entrainment tests, facilitate concrete cylinder preparation and assist with other tests performed by ENGINEER.
        - (3) Masonry: Sample and test mortar, bricks, blocks and grout; inspect brick and block samples and sample panels; inspect placement of reinforcement and grouting.
        - (4) Structural Steel: Verify that all welders are certified; visually inspect all structural steel welds; mechanically test high-tensile bolted connections.
      - b. When specified in the Contract Documents, provide an independent laboratory testing facility to perform required testing. Qualify the laboratory as having performed previous satisfactory work. Prior to use, submit to the ENGINEER for approval.
      - c. Cooperate with the ENGINEER and laboratory testing representatives. Provide at least 24 hours notice prior to when specified testing is

required. Provide labor and materials, and necessary facilities at the site as required by the ENGINEER and the testing laboratory.

- d. When an independent electrical testing agency is specified in the Contract Documents, provide a member of the National Electrical Testing Association to perform inspections and tests.
- 2. Equipment: Coordinate and demonstrate test procedures as specified in the Contract Documents and as required during the formal tests.
- 3. Pipeline and Other Testing: Conform to test procedures and requirements specified in the appropriate Specification Section.
- 4. Testing of Gravity Sanitary Sewer Lines
  - a. Watertight Construction: It is imperative that all sewers and force mains, manholes, and service connections be built watertight and that the CONTRACTOR adhere rigidly to the specifications for material and workmanship. Since all of the water and sewage in the lines will be treated at the treatment plant, special care and attention must be given to securing watertight construction. After completion, the sewers or sections thereof will be tested and gauged. If infiltration or exfiltration is above the limits specified, the sewer construction work will be rejected.
  - b. Cleaning: Exercise care during construction of the manhole to see that materials do not enter the sewer line. Keep the invert and shelf of the manhole clean of all mortar, broken brick, sand, or any other materials falling into the manhole. Immediately remove such material. Maintain this condition until final acceptance of the work. Prior to testing of gravity sanitary sewer lines, clean the lines using appropriate tools.
  - c. Gravity Sewers Visual Inspections: On completion of each block or section of sewer, or at such other times as the County Manger or designee may direct, the block or section of sewer is to be cleaned, tested and inspected. Each section of the sewer is to show, on examination from either end, a full circle of light between manholes. Each manhole, or other appurtenance to the system, shall be of the specified size and form, be watertight, neatly and substantially constructed, with the rim set permanently to design position and grade. All repairs shown necessary by the inspection are to be made; broken or cracked pipe replaced, all deposits removed and the sewers left true to line and grade, entirely clean and ready for use.

- d. Infiltration Limits: Provide the equipment necessary to check the lines for infiltration or exfiltration as directed by the County Manager or designee, before they are put in service. Infiltration in excess of fifty (50) gallons per day inch-mile of sewer will result in having the CONTRACTOR go over the lines, ascertain where the leakage exists, and repair the lines to the extent necessary to bring the infiltration down within acceptable limits. Observable inflow is not permitted.
- Exfiltration Limits: The length of sewer subject to an exfiltration test e. shall be the distance between two (2) adjacent manholes. Close the inlets of the upstream and downstream manholes with watertight plugs and the test section filled with water until the elevation of the water in the upstream manhole is two (2) feet above the crown of the pipe in the line being tested, or two (2) feet above the existing groundwater in the trench, whichever is higher. A standpipe may be used instead of the upstream manhole for providing the pressure head when approved by the County Manager or designee. Measure exfiltration by determining the amount of water required to maintain the initial water elevation for one (1) hour period from the start of the test. The maximum allowable leakage, including manholes, shall be 50 gallon per inch for diameter per mile of pipe per day.
- f. Air Testing: Air testing shall be required if, in the opinion of the County Manager or designee, conditions are such that infiltration measurements may be inconclusive. Conduct the test in the presence of the County Manager or designee and conform to the following requirements:
  - (a) Test pressure shall be 3.5 psi increased by the groundwater pressure above the top of the sewer.
  - (b) Pressure loss from shall not exceed 0.5 psi during the required testing time.
  - (c) Testing time in minutes shall be calculated as 0.625 x nominal pipe size (inches).
- g. Deformation Test
  - (a) Deformation tests shall be performed on all gravity sewer lines. The test shall be conducted after the final backfill has been in place at least 30 days to permit stabilization of the soil-pipe system.
  - (b) No pipe shall exceed a deformation of five percent (5%). If deformation exceeds 5%, mechanical methods to correct deformation may be used. If mechanical methods are unsuccessful, the pipe shall be excavated. Replacement

or correction shall be accomplished in accordance with requirements in the approved specifications.

(c) The rigid ball or mandrel used for the deflection test shall have a diameter not less than 95 percent of the base inside diameter or average inside diameter of the pipe depending on which is specified in the ASTM Specification, including the appendix, to which the pipe is manufactured. The test shall be performed without mechanical pulling devices.

# B. Reports

- 1. Certified Test Reports: Where transcripts or certified test reports are required by the Contract Documents, meet the following requirements:
  - Before delivery of materials or equipment submit and obtain approval а. of the ENGINEER for all required transcripts, certified test reports, certified copies of the reports of all tests required in referenced specifications or specified in the Contract Documents. Perform all testing in an approved independent laboratory or the manufacturer's Submit for approval reports of shop equipment tests laboratory. within thirty days of testing. Transcripts or test reports are to be accompanied by a notarized certificate in the form of a letter from the manufacturer or supplier certifying that tested material or equipment meets the specified requirements and the same type, quality, manufacture and make as specified. The certificate shall be signed by an officer of the manufacturer or the manufacturer's plant manager.
- 2. Certificate of Compliance: At the option of the ENGINEER, submit for approval a notarized Certificate of Compliance. The Certificates may be in the form of a letter stating the following:
  - a. Manufacturer has performed all required tests
  - b. Materials to be supplied meet all test requirements
  - c. Tests were performed not more than one year prior to submittal of the certificate
  - d. Materials and equipment subjected to the tests are of the same quality, manufacture and make as those specified
  - e. Identification of the materials

# 1.6 COSTS OF INSPECTION

- A. COUNTY's Obligation: Initial inspection and testing of materials furnished under this Contract will be performed by the County Manager or designee, or inspection bureaus without cost to the CONTRACTOR, unless otherwise expressly specified. If subsequent testing is necessary due to failure of the initial tests or because of rejection for noncompliance, reimburse the COUNTY for expenditures incurred in making such tests.
- B. CONTRACTOR's Obligation: Include in the Contract Price, the cost of all shop and field tests of equipment and other tests specifically called for in the Contract Documents, except those tests described above under "COUNTY's Obligation". The County Manager or designee may perform tests on any material or equipment furnished under this Contract at any time during the Contract. If tests performed by the County Manager or designee result in failure or rejection for noncompliance, reimburse the COUNTY for expenditures incurred in making such tests. Tests performed by the County Manager or designee shall prevail in determining compliance with Contract requirements.
- C. Reimbursements to the COUNTY:
  - 1. Materials and equipment submitted by the CONTRACTOR as the equivalent to those specifically named in the Contract may be tested by the County Manager or designee for compliance. Reimburse the COUNTY for expenditures incurred in making such tests on materials and equipment that are rejected for noncompliance.
  - 2. Reimburse the COUNTY for all costs associated with Witness Tests that exceed 5 Calendar Days per kind of equipment.

# 1.7 ACCEPTANCE TESTS

- A. Preliminary Field Tests: As soon as conditions permit, furnish all labor and materials and services to perform preliminary field tests of all equipment provided under this Contract. If the preliminary field tests disclose that any equipment furnished and installed under this Contract does not meet the requirements of the Contract Documents, make all changes, adjustments and replacements required prior to the acceptance tests.
- B. Final Field Tests: Upon completion of the Work and prior to final payment, subject all equipment, piping and appliances installed under this Contract to specified acceptance tests to demonstrate compliance with the Contract Documents.
  - 1. Furnish all labor, fuel, energy, water and other materials, equipment, instruments and services necessary for all acceptance tests.

- 2. Conduct field tests in the presence of the ENGINEER. Perform the field tests to demonstrate that under all conditions of operation each equipment item:
  - a. Has not been damaged by transportation or installation
  - b. Has been properly installed
  - c. Has been properly lubricated
  - d. Has no electrical or mechanical defects
  - e. Is in proper alignment
  - f. Has been properly connected
  - g. Is free of overheating of any parts
  - h. Is free of all objectionable vibration
  - i. Is free of overloading of any parts
  - j. Operates as intended
- 3. Operate work or portions of work for a minimum of 100 hours or 14 days continuous service, whichever comes first. For those items of equipment that would normally operate on wastewater or sludge, plant effluent may be used if available when authorized by ENGINEER. If water cannot properly exercise equipment, conduct 100-hour test after plant startup. Conduct test on those systems that require load produced by weather (heating or cooling) exercise only when weather will produce proper load.
- C. Failure of Tests: If the acceptance tests reveal defects in material or equipment, or if the material or equipment in any way fails to comply with the requirements of the Contract Documents, then promptly correct such deficiencies. Failure or refusal to correct the deficiencies, or if the improved materials or equipment, when tested again, fail to meet the guarantees or specified requirements, the County Manager or designee, notwithstanding its partial payment for work and materials or equipment, may reject said materials or equipment and may order the CONTRACTOR to remove the defective work from the site at no addition to the Contract Price, and replace it with material or equipment which meets the Contract Documents.

# 1.8 FAILURE TO COMPLY WITH CONTRACT

A. Unacceptable Materials: If it is ascertained by testing or inspection that the material or equipment does not comply with the Contract, do not deliver said material or equipment, or if delivered remove it promptly from the site or from the

Work and replace it with acceptable material without additional cost to the COUNTY. Fulfill all obligations under the terms and conditions of the Contract even though the County Manager or designee fail to ascertain noncompliance or notify the CONTRACTOR of noncompliance.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

# END OF SECTION

# NO TEXT FOR THIS PAGE

# **SECTION 015000**

# CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 GENERAL

## 1.1 SECTION INCLUDES

- A. General Requirements
- B. Related Sections
- C. Temporary Utilities
- D. Temporary Construction
- E. Barricades and Enclosures
- F. Fences
- G. Security
- H. Temporary Controls
- I. Traffic Regulation
- J. Field Offices and Sheds
- 1.2 RELATED SECTIONS
  - A. Section 011000 Summary of Work
  - B. Section 015526 Traffic Regulations and Public Safety
  - C. Section 020500 Connection to Existing Systems
  - D. Section 312319 Groundwater Control for Open Cut Excavation
  - E. Section 320117 Pavement Repair and Restoration
  - F. Section 330518 Laying and Jointing Buried Pipelines
- 1.3 GENERAL REQUIREMENTS
  - A. Plant and Facilities: Furnish, install, maintain and remove all false work, scaffolding, ladders, hoistways, braces, pumping plants, shields, trestles,

COLLIER COUNTY TECHNICAL SPECIFICATIONS roadways, sheeting, centering forms, barricades, drains, flumes, and the like, any of which may be needed in the construction of any part of the Work and which are not herein described or specified in detail. Accept responsibility for the safety and efficiency of such works and for any damage that may result from their failure or from their improper construction, maintenance or operation.

- B. First Aid: Maintain a readily accessible, completely equipped first aid kit at each location where work is in progress.
- C. Safety Responsibility: Accept sole responsibility for safety and security at the site. Indemnify and hold harmless the COUNTY and the County's Manager or designee, including the ENGINEER, for any safety violation, or noncompliance with governing bodies and their regulations, and for accidents, deaths, injuries, or damage at the site during occupancy or partial occupancy of the site by CONTRACTOR's forces while performing any part of the Work.
- D. Hazard Communication: Furnish two copies of the CONTRACTOR's Hazard Communication Program required under OSHA regulations before beginning on site activities. Furnish two copies of amendments to Hazard Communications Program as they are prepared.
- 1.4 TEMPORARY UTILITIES
  - A. Water: Provide all necessary and required water without additional cost, unless otherwise specified. If necessary, provide and lay water lines to the place of use; secure all necessary permits; pay for all taps to water mains and hydrants and for all water used at the established rates.
  - B. Light and Power: Provide without additional cost to the COUNTY temporary lighting and power facilities required for the proper construction and inspection of the Work. If, in the ENGINEER's opinion, these facilities are inadequate, do NOT proceed with any portion of the Work affected thereby. Maintain temporary lighting and power until the Work is accepted.
  - C. Heat: Provide temporary heat, whenever required, for work being performed during cold weather to prevent freezing of concrete, water pipes, and other damage to the Work or existing facilities.
  - D. Sanitary Facilities: Provide sufficient sanitary facilities for construction personnel. Prohibit and prevent nuisances on the site of the Work or on adjoining property. Discharge any employee who violates this rule. Abide by all environmental regulations or laws applicable to the Work.
- 1.5 TEMPORARY CONSTRUCTION
  - A. Bridges: Design and place suitable temporary bridges where necessary for the maintenance of vehicular and pedestrian traffic. Assume responsibility for the
sufficiency and safety of all such temporary work or bridges and for any damage that may result from their failure or their improper construction, maintenance, or operation. Indemnify and save harmless the COUNTY and the COUNTY's representatives from all claims, suits or actions, and damages or costs of every description arising by reason of failure to comply with the above provisions.

### 1.6 BARRICADES, LIGHTS AND ENCLOSURES

- A. Protection of Workmen and Public: Effect and maintain at all times during the prosecution of the Work, barriers, lights and enclosures necessary for the protection of workmen and the public. Perform all work within the County right-of-way in strict accordance with the COUNTY Maintenance of Traffic Policy and other applicable statutory requirements.
- B. Provide suitable barricades, lights, signs and watchmen at excavation sites and all other places where the Work causes obstructions to normal traffic or constitutes in any way a hazard to the public.

### 1.7 FENCES

- A. Existing Fences: Obtain written permission from property owner(s) prior to relocating or dismantling fences that interfere with construction operations. Reach agreements with the fence owner as to the period the fence may be left relocated or dismantled. Install adequate gates where fencing must be maintained. Keep gates closed and locked at all times when not in use.
- B. Restoration: Restore all fences to their original or better condition and to their original location on completion of the Work.

#### 1.8 SECURITY

- A. Preservation of Property:
  - 1. Preserve from damage, all property along the line of the Work, in the vicinity of or in any way affected by the Work, the removal or destruction of which is not called for by the Drawings. Preserve from damage, public utilities, trees, lawn areas, building monuments, fences, pipe and underground structures, and public streets. Note: Normal wear and tear of streets resulting from legitimate use by the CONTRACTOR are not considered as damage. Whenever damages occur to such property, immediately restore to its original condition. Costs for such repairs are incidental to the Contract.
  - 2. In case of failure on the part of the CONTRACTOR to restore property or make good on damage or injury, the County Manager or designee may, upon 24 hours written notice, proceed to repair, rebuild, or otherwise restore such property as may be deemed necessary, and the cost thereof will be deducted from any moneys due or which may become due the

CONTRACTOR under this Contract. If removal, repair or replacement of public or private property is made necessary by alteration of grade or alignment authorized by the County Manager or designee and not contemplated by the Contract Documents, the CONTRACTOR will be compensated, in accordance with the General Conditions, provided that such property has not been damaged through fault of the CONTRACTOR or the CONTRACTOR's employees.

- B. Public Utility Installations and Structures:
  - 1. Public utility installations and structures include all poles, tracks, pipes, wires, conduits, vaults, valves, hydrants, manholes, and other appurtenances and facilities, whether owned or controlled by public bodies or privately owned individuals, firms or corporations, used to serve the public with transportation, gas, electricity, telephone, storm and sanitary sewers, water, or other public or private utility services. Facilities appurtenant to public or private property that may be affected by the Work are deemed included hereunder.
  - 2. The Contract Documents contain data relative to existing public utility installations and structures above and below the ground surface. Existing public utility installations and structures are indicated on the Drawings only to the extent such information was made available to, or found by, the ENGINEER in preparing the Drawings. These data are not guaranteed for completeness or accuracy, and the CONTRACTOR is responsible for making necessary investigations to become fully informed as to the character, condition, and extent of all public utility installations and structures that may be encountered and that may affect the construction operations.
  - 3. Before starting construction, identify and mark all existing valves and maintain access to the valves at all times during construction.
  - 4. Contact utility locating service sufficiently in advance of the start of construction to avoid damage to the utilities and delays to the completion date.
  - 5. If existing utilities are damaged during the Work, immediately notify the owner of the affected utility. In coordination with or as directed by the owner, remove, replace, relocate, repair, rebuild, and secure any public utility installations and structures damaged as a direct or indirect result of the Work under this Contract. Costs for such work are incidental to the Contract. Be responsible and liable for any consequential damages done to or suffered by any public utility installations or structures. Assume and accept responsibility for any injury, damage, or loss that may result from or be consequent to interference with, or interruption or discontinuance of, any public utility service.

- 6. At all times in the performance of Work, employ proven methods and exercise reasonable care and skill to avoid unnecessary delay, injury, damage, or destruction to public utility installations and structures. Avoid unnecessary interference with, or interruption of, public utility services. Cooperate fully with the owners thereof to that end.
- 7. Provide notice to the County Manager or designee of any proposed connections to existing utilities, interruptions of service or shutdowns in accordance with Section 020500. Give written notice to the owners of all public utility installations and structures affected by proposed construction operations sufficiently in advance of breaking ground in any area or on any unit of the Work, to obtain their permission before disrupting the lines and to allow them to take measures necessary to protect their interests. Advise the Transportation Operations Department, Fire and Rescue Services of any excavation in public streets or the temporary shut-off of any water main. Provide at least 48 hours notice to all affected property owners whenever service connections are taken out of service.
- C. Work on Private Property: Work on this project will require operations on private property, rights of way or easements. The County Manager or designee has secured the appropriate easements or rights of entry from the affected property owners. Comply with all easement or rights of entry provisions. Conduct operations along rights-of-way and easements through private property to avoid damage to the property and to minimize interference with its ordinary use. Upon completion of the Work through such property, restore the surface and all fences or other structures disturbed by the construction as nearly as possible to the property without the consent of the property owner or responsible party in charge of such property. Hold the COUNTY harmless from any claim or damage arising out of or in connection with the performance of work across and through private property.
- D. Miscellaneous Structures: Assume and accept responsibility for all injuries or damage to culverts, building foundations and walls, retaining walls, or other structures of any kind met with during the prosecution of the Work. Assume and accept liability for damages to public or private property resulting therefrom. Adequately protect against freezing all pipes carrying liquid.
- E. Protection of Trees and Lawn Areas:
  - Protect with boxes, trees and shrubs, except those ordered to be removed. Do not place excavated material so as to cause injury to such trees or shrubs. Replace trees or shrubs destroyed by accident or negligence of the CONTRACTOR or CONTRACTOR's employees with new stock of similar size and age, at the proper season, at no additional cost to the COUNTY. If required by Contract Documents, provide preconstruction audio-video recording of project in accordance with the Technical Specifications.

2. Leave lawn areas in as good condition as before the start of the Work. Restore areas where sod has been removed by seeding or sodding.

### 1.9 TEMPORARY CONTROLS

- A. During Construction:
  - 1. Keep the site of the Work and adjacent premises free from construction materials, debris, and rubbish. Remove this material from any portion of the site if such material, debris, or rubbish constitutes a nuisance or is objectionable.
  - 2. Remove from the site all surplus materials and temporary structures when they are no longer needed.
  - 3. Neatly stack construction materials such as concrete forms and scaffolding when not in use. Store pipe to be incorporated into the Work in accordance with AWWA standards. Promptly remove splattered concrete, asphalt, oil, paint, corrosive liquids, and cleaning solutions from surfaces to prevent marring or other damage.
  - 4. Properly store volatile wastes in covered metal containers and remove from the site daily.
  - 5. Do not bury or burn on the site or dispose of into storm drains, sanitary sewers, streams, or waterways, any waste material. Remove all wastes from the site and dispose of in a manner complying with applicable ordinances and laws.
- B. Smoke Prevention:
  - 1. Strictly observe all air pollution control regulations.
  - 2. Open fires will be allowed only if permitted under current ordinances.
- C. Noises:
  - 1. In accordance with the COUNTY's Noise Ordinance, maintain acceptable noise levels in the vicinity of the Work. Limit noise production to acceptable levels by using special mufflers, barriers, enclosures, equipment positioning, and other approved methods.
  - 2. Supply written notification to the County Manager or designee sufficiently in advance of the start of any work that violates this provision. Proceed only when all applicable authorizations and variances have been obtained in writing.

- D. Hours of Operation:
  - 1. Operation of construction equipment is only permitted Monday through Saturday, 7:00 AM to 7:00 PM. Obtain written consent from the County Manager or designee for operation of construction equipment during any other period.
  - 2. Do not carry out non-emergency work, including equipment moves, on Sundays without prior written authorization by the County Manager or designee.
- E. Dust Control:
  - 1. Take measures to prevent unnecessary dust. Keep earth surfaces exposed to dusting moist with water or a chemical dust suppressant. Cover materials in piles or while in transit to prevent blowing or spreading dust.
  - 2. Adequately protect buildings or operating facilities that may be affected adversely by dust. Protect machinery, motors, instrument panels, or similar equipment by suitable dust screens. Include proper ventilation with dust screens.
- F. Temporary Drainage Provisions:
  - 1. Provide for the drainage of stormwater and any water applied or discharged on the site in performance of the Work. Provide adequate drainage facilities to prevent damage to the Work, the site, and adjacent property.
  - Supplement existing drainage channels and conduits as necessary to carry all increased runoff from construction operations. Construct dikes as necessary to divert increased runoff from entering adjacent property (except in natural channels), to protect the COUNTY's facilities and the Work, and to direct water to drainage channels or conduits. Provide ponding as necessary to prevent downstream flooding.
  - 3. Maintain excavations free of water. Provide, operate, and maintain pumping equipment. Dewater trenches in accordance with Sections 312319 and 330518.
- G. Pollution: Prevent the pollution of drains and watercourses by sanitary wastes, sediment, debris, and other substances resulting from construction activities. Do not permit sanitary wastes to enter any drain or watercourse other than sanitary sewers. Do not permit sediment, debris, or other substances to enter sanitary sewers. Take reasonable measures to prevent such materials from entering any drain or watercourse.

### 1.10 TRAFFIC REGULATION

- A. Parking: Provide and maintain suitable parking areas for the use of all construction workers and others performing work or furnishing services in connection with the Contract, to avoid any need for parking personal vehicles where they may interfere with public traffic or construction activities.
- B. Access: Conduct Work to interfere as little as possible with public travel, whether vehicular or pedestrian. Provide and maintain suitable and safe bridges, detours, or other temporary expedients for the accommodation of public and private travel. Whenever it is necessary to cross, obstruct, or close roads, driveways, and walks, whether public or private, give reasonable notice to owners of private drives before interfering with them. Such maintenance of traffic will not be required when the CONTRACTOR has obtained permission from the owner or tenant of private property, or from the authority having jurisdiction over the public property involved, to obstruct traffic at the designated point.

### PART 2 PRODUCTS

Not Used

### PART 3 EXECUTION

Not Used

# SECTION 015526

# TRAFFIC REGULATION AND PUBLIC SAFETY

### PART 1 GENERAL

### 1.1 SECTION INCLUDES:

- A. General Requirements
- B. Traffic Control
- C. Public Safety
- 1.2 RELATED SECTIONS
  - A. Section 015000 Construction Facilities and Temporary Controls
  - B. Section 320117 Pavement Repair and Restoration
  - C. Section 330201 Roadway Crossings by Open Cut

### 1.3 GENERAL REQUIREMENTS

- A. Perform all work within COUNTY rights-of-way in strict accordance with the County's Maintenance of Traffic Policy and other applicable statutory requirements to protect the public safety.
- B. Be responsible for providing safe and expeditious movement of traffic through construction zones. A construction zone is defined as the immediate areas of actual construction and all abutting areas which are used by the CONTRACTOR and which interfere with the driving or walking public.
- C. Remove temporary equipment and facilities when no longer required. Restore grounds to original or specified conditions.
- D. The requirements specified herein are in addition to the plan for Maintenance of Traffic as specified in Section 330201.

#### 1.4 TRAFFIC CONTROL

A. Include as necessary precautions, not to be limited to, such items as proper construction warning signs, signals, lighting devices, marking, barricades, channelization, and hand signaling devices. Be responsible for installation and maintenance of all devices and requirements for the duration of the Construction period.

- B. Provide notice, at least five (5) working days prior to construction, to the State or County Department of Transportation of the necessity to close any portion of a roadway carrying vehicles or pedestrians so that the final approval of such closings can be obtained at least 48 hours in advance. At no time will more than one (1) lane of roadway be closed to vehicles and pedestrians. With any such closings make adequate provision for the safe expeditious movement of each.
- C. Be responsible for notifying Transportation Operations Department, Police, Fire, and other Emergency Departments whenever construction is within roadways and of the alternate routes.
- D. Be responsible for removal, relocation, or replacement of any traffic control device in the construction area that exists as part of the normal pre-construction traffic control scheme.
- E. Immediately notify the County Manager or designee of any vehicular or pedestrian safety or efficiency problems incurred as a result of the construction of the project.
- F. Be responsible for notifying all residents of any road construction and limited access at least 72 hours in advance.
- 1.5 PUBLIC SAFETY (DURING CONSTRUCTION, ALTERATION OR REPAIR)
  - A. In areas of high vehicular traffic, provide a safe walkway around the work area.
  - B. Use barricades or other barriers to prevent any possibility of injury to the public caused by the CONTRACTOR's work.
  - C. Keep walk areas around the work areas clean of sand, stones, and any other material that could cause a pedestrian accident.
  - D. Barricade work areas left overnight. Install flashing warning lights in areas required by the COUNTY.
  - E. Unless an approved detour is provided at any open cut crossings, a minimum of one-way traffic will be maintained during the daylight hours and two-way traffic at night. All traffic detours will be restricted to limits of the Right-of-Way with necessary flagmen and/or marking devices. These detours shall be approved by the COUNTY. Detour of traffic outside of the Right-of-Way will be considered with the approval of local governmental agencies and private concerns involved.
  - F. Crossing and Intersections: Do not isolate residences and places of business. Provide access to all residences and places of business whenever construction interferes with existing means of access. Maintain access at all times. If pavement is disturbed, a cold mix must be applied at the end of the day.

# G. Detours

- 1. Construct and maintain detour facilities wherever it becomes necessary to divert traffic from any existing roadway or bridge, or wherever construction operations block the flow of traffic. The location of all detours will require prior approval of the COUNTY.
- 2. Furnishing of Devices and Barriers: Furnish all traffic control devices (including signs), warning devices and barriers. Costs of such devices shall be incidental to construction and included in unit prices bid.
- 3. Maintenance of Devices and Barriers: Keep traffic control devices, warning devices and barriers in the correct position, properly directed, clearly visible and clean, at all times. Immediately repair replace or clean damaged, defaced or dirty devices or barriers as necessary.
- H. Flagmen: Provide certified flagmen (flaggers) to direct traffic where one-way operation in a single lane is in effect and in other situations as may be required. Radios may be required if flagmen cannot maintain contact with each other.
- I. Utilize all necessary signs, flagmen, and other safety devices during construction.
- J. Perform all work with the requirements set forth by the Occupational Safety Health Administration.

PART 2 PRODUCTS

NOT USED.

PART 3 EXECUTION

NOT USED.

# NO TEXT FOR THIS PAGE

## SECTION 015713

## TEMPORARY EROSION AND SEDIMENTATION CONTROL

# FOR CONSTRUCTION ACTIVITIES IMPACTING LESS THAN ONE ACRE,

# INCLUDING CONSTRUCTION REQUIRING DEWATERING

#### PART 1 GENERAL

### 1.1 DESCRIPTION

- A. The work specified in this Section consists of designing, providing, maintaining and removing temporary erosion and sedimentation controls as necessary.
- B. Temporary erosion controls include, but are not limited to rip rap channels, road stabilization, grassing, mulching, setting, watering, and reseeding onsite surfaces and spoil and borrow area surfaces and providing interceptor ditches at ends of berms and at those locations which will ensure that erosion during construction will be either eliminated or maintained within acceptable limits as established by the COUNTY.
- C. Temporary sedimentation controls include, but are not limited to; silt dams, traps, barriers, public and private on- and off-site storm sewer inlets protectors, and appurtenances at the foot of sloped surfaces which will ensure that sedimentation pollution will be either eliminated or maintained within acceptable limits as established by the COUNTY.
- D. If required by regulation or COUNTY, CONTRACTOR is responsible for providing an approved Erosion Control Plan for effective temporary erosion and sediment control measures during construction or until final controls become effective.

### 1.2 REFERENCE DOCUMENTS

A. South Florida Building Code and Standard Building Code.

### PART 2 PRODUCTS

- 2.1 EROSION CONTROL
  - A. Sodding and Seeding is specified in Section 329200.
  - B. Rip Rap Channel.
  - C. Road Stabilization.

D. Netting - fabricated of material acceptable to the County Manager or designee.

# 2.2 SEDIMENTATION CONTROL

- A. Temporary Sediment Trap.
- B. Sediment Fence.
- C. Bales clean, seed free pine needle or cereal hay type.
- D. Netting fabricated of material acceptable to the County Manager or designee.
- E. Filter Stone crushed stone conforming to Florida Department of Transportation specifications.
- F. Concrete Block hollow, non-load-bearing type.
- G. Concrete exterior grade not less than one inch thick.

# PART 3 EXECUTION

- 3.1 EROSION CONTROL
  - A. Minimum procedures for grassing are:
    - 1. Scarify slopes to a depth of not less than six inches and remove large clods, rock, stumps, roots larger than 1/2 inch in diameter and debris.
    - 2. Sow seed within twenty-four (24) hours after the ground is scarified with either mechanical seed drills or rotary hand seeders.
    - 3. Apply mulch loosely and to a thickness of between 3/4 inch and 1-1/2 inches.
    - 4. Apply netting over mulched areas on sloped surfaces.
    - 5. Roll and water seeded areas in a manner which will encourage sprouting of seeds and growing of grass. Reseed areas that exhibit unsatisfactory growth (less than 70 percent coverage). Backfill and seed eroded areas, removing eroded material from effected drainage facilities.
  - B. Minimum procedures for rip rap channel are:
    - 1. Clear the foundation of all trees, stumps, and roots.

- 2. Excavate the bottom and sides of the channel 30 inches below grade at all points to allow for the placement of riprap as shown in the typical cross-section in the Standard Details.
- 3. Install extra strength filter fabric on the bottom and sides of the channel foundation, placing the upstream fabric over the downstream fabric with at least a 1 foot overlap on all joints. The fabric is to be securely held in place with metal pins.
- 4. Place riprap evenly to the lines and grades shown on the drawings and staked in the field. Place riprap immediately following the installation of the filter fabric.
- 5. Riprap shall meet the specification for F.D.O.T. Class 2 Riprap.
- 6. Restore all disturbed areas in accordance with a vegetation plan submitted in advance and approved by the County Manager or designee.
- C. Minimum Procedures for road stabilization are:
  - 1. Clear roadbed and parking areas of all vegetation, roots and other objectionable material.
  - 2. Provide surface drainage.
  - 3. Spread 6 inch course of lime rock evenly over the full width of road and parking area and smooth to avoid depressions.
  - 4. After grading, seed or resod all disturbed areas adjoining roads and parking areas conforming to existing conditions prior to construction.

#### 3.2 SEDIMENTATION CONTROL

- A. Install and maintain silt dams, traps, barriers, and appurtenances as required. Replace deteriorated hay bales and dislodged filter stone.
- B. Minimum requirements for sediment trap:
  - 1. Clear, grub and strip the area under the embankment of all vegetation and root mat.
  - 2. Clear retention area to elevation as approved by the County Manager or designee.
  - 3. Use fill material free of roots, woody vegetation and organic matter. Place fill in lifts not to exceed 9 inches and machine compact.

- 4. Construct dam and stone spillway to dimensions, slopes and elevations shown.
- 5. Ensure that the spillway crest is level and at least 18 inches below the top of the dam at all points.
- 6. Stone used for spillway section Class "B" erosion control stone.
- 7. Stone used on inside spillway face to control drainage #67 washed stone.
- 8. Extend stone outlet section to vegetated road ditch on zero grade with top elevation of stone level with bottom of drain.
- 9. Ensure that the top of the dam at all points is 6 inches above natural surrounding ground.
- 10. Stabilize the embankment and all disturbed area above the sediment pools as shown in the vegetation plan.
- C. Minimum requirements for sediment fence:
  - 1. Construct sediment fence on low side of topsoil stockpile to prevent sediment from being washed into the drainage system. Fence to extend around approximately 70 percent of the perimeter of the stockpile. Fence must be unobstructed so as to maintain a minimum of 75 percent of its design flow rate.
  - 2. Locate posts down slope of fabric to help support fencing.
  - 3. Bury toe of fence approximately 8 inches deep to prevent undercutting.
  - 4. When joints are necessary, securely fasten the fabric at a support post with overlap to the next post.
  - 5. Filter fabric shall be of nylon, polyester, propylene or ethylene yarn with extra strength 50 pounds per linear inch (minimum) and with a flow rate of at least 0.30 gallons per foot per minute. Fabric should contain ultraviolet ray inhibitors and stabilizers.
  - 6. Post to be 4-inch diameter pine with a minimum length of 4 feet.
- D. Minimum Requirement for stormwater facilities protection:

- 1. Public and private stormsewer facilities, both on and offsite, shall be protected at all inlets affected by construction. Stormsewer facilities include streets, inlets, pipes, ditches, swales, canals, culverts, control structures, and detention/retention areas.
- 2. Grated drop inlets shall be rapped with filter fabric in a manner that allows removal of accumulated sediment from the fabric before removing the grate.
- 3. Curb inlets shall be protected from sediment, turbid water from stormwater or dewatering activities; also construction debris, concrete mix and rinsate, and any other pollution.
- 4. Stormwater runoff entering such stormsewer inlets and stormwater detention/retention facilities with a turbidity greater than 50 NTU shall be considered to be in non-compliance with these regulations.

### 3.3 PERFORMANCE

A. Should any of the temporary erosion and sediment control measures employed fail to produce results which comply with the requirements of the State of Florida, immediately take steps necessary to correct the deficiency at no expense to the COUNTY. Sedimentation or turbid water violations to stormwater facilities on or offsite shall require the contractor to remove all sediment from the affected facilities.

NO TEXT FOR THIS PAGE

# **SECTION 016100**

# MATERIAL AND EQUIPMENT

### PART 1 GENERAL

### 1.1 SECTION INCLUDES

- A. Description
- B. Substitutions
- C. Manufacturer's Written Instructions
- D. Transportation and Handling
- E. Storage, Protection and Maintenance
- F. Manufacturer's Field Quality Control Services
- G. Post Startup Services
- H. Special Tools and Lubricating Equipment
- I. Lubrication

### 1.2 DESCRIPTION

- A. Proposed Manufacturers List: Within 15 calendar days of the date of the Notice to Proceed, submit to the ENGINEER a list of the names of proposed manufacturers, material men, suppliers and subcontractors, obtain approval of this list by the County Manager or designee prior to submission of any working drawings. Upon request submit evidence to ENGINEER that each proposed manufacturer has manufactured a similar product to the one specified and that it has previously been used for a like purpose for a sufficient length of time to demonstrate its satisfactory performance.
- B. All material and equipment designed or used in connection with a potable (drinking) water system shall conform to the requirements of the National Sanitation Foundation (NSF) Standard 61, "Drinking Water System Components – Health Effects."
- C. Furnish and install Material and Equipment which meets the following:
  - 1. Conforms to applicable specifications and standards.

- 2. Complies with size, make, type, and quality specified or as specifically approved, in writing, by ENGINEER.
- 3. Will fit into the space provided with sufficient room for operation and maintenance access and for properly connecting piping, ducts and services, as applicable. Make the clear spaces that will be available for operation and maintenance access and connections equal to or greater than those shown and meeting all the manufacturers' requirements. If adequate space is not available, the CONTRACTOR shall advise the ENGINEER for resolution.
- 4. Manufactured and fabricated in accordance with the following:
  - a. Design, fabricate, and assemble in accordance with best engineering and shop practices.
  - b. Manufacture like parts of duplicate units to standard sizes and gauges, to be interchangeable.
  - c. Provide two or more items of same kind identical, by same manufacturer.
  - d. Provide materials and equipment suitable for service conditions.
  - e. Adhere to equipment capabilities, sizes, and dimensions shown or specified unless variations are specifically approved, in writing, in accordance with the Contract Documents.
  - f. Adapt equipment to best economy in power consumption and maintenance. Proportion parts and components for stresses that may occur during continuous or intermittent operation, and for any additional stresses that may occur during fabrication or installation.
  - g. Working parts are readily accessible for inspection and repair, easily duplicated and replaced.
- 5. Use material or equipment only for the purpose for which it is designed or specified.

#### 1.3 SUBSTITUTIONS

- A. Substitutions:
  - Make any CONTRACTOR's requests for changes in equipment and materials from those required by the Contract Documents in writing, for approval by the COUNTY. Such requests are considered requests for substitutions and are subject to CONTRACTOR's representations and review provisions of the Contract Documents when one of following conditions are satisfied:

- a. Where request is directly related to an "or County approved equal" clause or other language of same effect in Specifications.
- b. Where required equipment or material cannot be provided within Contract Time, but not as result of CONTRACTOR's failure to pursue Work promptly or to coordinate various activities properly.
- c. Where required equipment or material cannot be provided in manner compatible with other materials of Work, or cannot be properly coordinated therewith.
- 2. CONTRACTOR'S Options:
  - a. Where more than one choice is available as options for CONTRACTOR's selection of equipment or material, select option compatible with other equipment and materials already selected (which may have been from among options for other equipment and materials).
  - b. Where compliance with specified standard, code or regulation is required, select from among products that comply with requirements of those standards, codes, and regulations.
  - c. Or County approved Equal: For equipment or materials specified by naming one or more equipment manufacturer(s) and "or County approved equal", submit request for substitution for any equipment or manufacturer not specifically named.
- B. Conditions Which are Not Substitution:
  - 1. Requirements for substitutions do not apply to CONTRACTOR options on materials and equipment provided for in the Specifications.
  - 2. Revisions to Contract Documents, where requested by the County Manager or designee or ENGINEER, are "changes" not "substitutions".
  - 3. CONTRACTOR's determination of and compliance with governing regulations and orders issued by governing authorities do not constitute substitutions and do not constitute basis for a Change Order, except as provided for in Contract Documents.

#### 1.4 MANUFACTURER'S WRITTEN INSTRUCTIONS

A. Instruction Distribution: When the Contract Documents require that installation, storage, maintenance and handling of equipment and materials comply with manufacturer's written instructions, obtain and distribute printed copies of such instructions to parties involved in installation, including six copies to ENGINEER.

- 1. Maintain one set of complete instructions at jobsite during storage and installation, and until completion of work.
- B. Manufacturer's Requirements: Store, maintain, handle, install, connect, clean, condition, and adjust products in accordance with manufacturer's written instructions and in conformity with Specifications.
  - 1. Should job conditions or specified requirements conflict with manufacturer's instructions, consult ENGINEER for further instructions.
  - 2. Do not proceed with work without written instructions.
- C. Performance Procedures: Perform work in accordance with manufacturer's written instructions. Do not omit preparatory steps or installation procedures, unless specifically modified or exempted by Contract Documents.

### 1.5 TRANSPORTATION AND HANDLING

- A. Coordination with Schedule: Arrange deliveries of materials and equipment in accordance with Construction Progress Schedules. Coordinate to avoid conflict with work and conditions at site.
  - 1. Deliver materials and equipment in undamaged condition, in manufacturer's original containers or packaging, with identifying labels intact and legible.
  - 2. Protect bright machined surfaces, such as shafts and valve faces, with a heavy coat of grease prior to shipment.
  - 3. Immediately upon delivery, inspect shipments to determine compliance with requirements of Contract Documents and approved submittals and that material and equipment are protected and undamaged.
- B. Handling: Provide equipment and personnel to handle material and equipment by methods recommended by manufacturer to prevent soiling or damage to materials and equipment or packaging.

#### 1.6 STORAGE, PROTECTION, AND MAINTENANCE

- A. On-site storage areas and buildings:
  - 1. Conform storage buildings to requirements of Section 015000.
  - 2. Coordinate location of storage areas with ENGINEER and the COUNTY.
  - 3. Arrange on site storage areas for proper protection and segregation of stored materials and equipment with proper drainage. Provide for safe

travel around storage areas and safe access to stored materials and equipment.

- 4. Store loose granular materials in a well-drained area on solid surfaces to prevent mixing with foreign matter.
- 5. Store materials such as pipe, reinforcing and structural steel, and equipment on pallets, blocks or racks, off ground.
- PVC Pipe may be damaged by prolonged exposure to direct sunlight, take necessary precautions during storage and installation to avoid this damage. Store pipe under cover, and install with sufficient backfill to shield it from the sun.
- 7. Store fabricated materials and equipment above ground, on blocking or skids, to prevent soiling or staining. Cover materials and equipment that are subject to deterioration with impervious sheet coverings; provide adequate ventilation to avoid condensation.
- B. Interior Storage:
  - 1. Store materials and equipment in accordance with manufacturer's instructions, with seals and labels intact and legible.
  - 2. Store materials and equipment, subject to damage by elements, in weathertight enclosures.
  - 3. Maintain temperature and humidity within ranges required by manufacturer's instructions.
- C. Accessible Storage: Arrange storage in a manner to provide easy access for inspection and inventory. Make periodic inspections of stored materials or equipment to assure that materials or equipment are maintained under specified conditions and free from damage or deterioration.
  - 1. Perform maintenance on stored materials of equipment in accordance with manufacturer's instructions, in presence of the County Manager or designee or ENGINEER.
  - 2. Submit a report of completed maintenance to ENGINEER with each Application for Payment.
  - 3. Failure to perform maintenance, to notify ENGINEER of intent to perform maintenance or to submit maintenance report may result in rejection of material or equipment.

- D. COUNTY's Responsibility: The COUNTY assumes no responsibility for materials or equipment stored in buildings or on-site. CONTRACTOR assumes full responsibility for damage due to storage of materials or equipment.
- E. CONTRACTOR's Responsibility: For COUNTY Capital Improvement Projects, the CONTRACTOR assumes full responsibility for protection of completed construction until facilities (or portions of facilities) are accepted for operation and placed in service. Repair and restore damage to completed Work equal to its original condition.
- F. Special Equipment: Use only rubber tired wheelbarrows, buggies, trucks, or dollies to wheel loads over finished floors, regardless if the floor has been protected or not. This applies to finished floors and to exposed concrete floors as well as those covered with composition tile or other applied surfacing.
- G. Surface Damage: Where structural concrete is also the finished surface, take care to avoid marking or damaging surface.
- 1.7 MANUFACTURER'S FIELD QUALITY CONTROL SERVICES
  - A. General:
    - 1. Provide manufacturer's field services in accordance with this subsection for those tasks specified in other sections.
    - 2. Include and pay all costs for suppliers' and manufacturers' services, including, but not limited to, those specified.
  - B. Installation Instruction: Provide instruction by competent and experienced technical representatives of equipment manufacturers or system suppliers as necessary to resolve assembly or installation procedures that are attributable to, or associated with, the equipment furnished.
  - C. Installation Inspection, Adjustments and Startup Participation:
    - 1. Provide competent and experienced technical representatives of equipment manufacturers or system suppliers to inspect the completed installation as follows.
      - a. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, or for other conditions that may cause damage.
      - b. Verify that tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.

- c. Verify that wiring and support components for equipment are complete.
- d. Verify that equipment or system is installed in accordance with the manufacturer's recommendations, approved shop drawings and the Contract Documents.
- e. Verify that nothing in the installation voids any warranty.
- 2. Provide manufacturer's representatives to perform initial equipment and system adjustment and calibration conforming to the manufacturer's recommendations and instructions, approved shop drawings and the Contract Documents.
- Start-up of Equipment: Provide prior written notice of proposed start-up to the County Manager or designee and ENGINEER. Obtain ENGINEER's approval before start-up of equipment. COUNTY's departmental representative must be on-site during start-up. Execute start-up under supervision of applicable manufacturer's representative in accordance with manufacturers' instructions.
- 4. Furnish ENGINEER with three copies of the following. When training is specified, furnish the copies at least 48 hours prior to training.
  - a. "Certificate of Installation, Inspection and Start-up Services" by manufacturers' representatives for each piece of equipment and each system specified, certifying:
    - (1) That equipment is installed in accordance with the manufacturers' recommendations, approved shop drawings, and the Contract Documents.
    - (2) That nothing in the installation voids any warranty.
    - (3) That equipment has been operated in the presence of the manufacturer's representative.
    - (4) That equipment, as installed, is ready to be operated by others.
  - b. Detailed report by manufacturers' representatives, for review by ENGINEER of the installation, inspection and start-up services performed, including:
    - (1) Description of calibration and adjustments if made; if not in Operation and Maintenance Manuals, attach copy.
    - (2) Description of any parts replaced and why replaced.

- (3) Type, brand name, and quantity of lubrication used, if any.
- (4) General condition of equipment.
- (5) Description of problems encountered, and corrective action taken.
- (6) Any special instructions left with CONTRACTOR or ENGINEER.
- D. Field Test Participation: Provide competent and experienced technical representatives of all equipment manufacturers and system suppliers as necessary to participate in field testing of the equipment specified in Section 014500.
- E. Trouble-Free Operation: Provide competent and experienced technical representatives of all equipment manufacturers and system suppliers as necessary to place the equipment in trouble-free operation after completion of start-up and field tests.

### 1.8 SPECIAL TOOLS AND LUBRICATING EQUIPMENT

- A. General: Furnish, per manufacturer's recommendations, special tools required for checking, testing, parts replacement, and maintenance. (Special tools are those which have been specially designed or adapted for use on parts of the equipment, and which are not customarily and routinely carried by maintenance mechanics.)
- B. Time of Delivery: Deliver special tools and lubricating equipment to the COUNTY when unit is placed into operation and after operating personnel have been properly instructed in operation, repair, and maintenance of equipment.
- C. Quality: Provide tools and lubricating equipment of a quality meeting equipment manufacturer's requirements.

#### 1.9 LUBRICATION

- A. General: Where lubrication is required for proper operation of equipment, incorporate in the equipment the necessary and proper provisions in accordance with manufacturer's requirements. Where possible, make lubrication automated and positive.
- B. Oil Reservoirs: Where oil is used, supply reservoir of sufficient capacity to lubricate unit for a 24-hour period.

### 1.10 WARRANTY

A. Provide copies of any warranties of materials or equipment to the County Manager or designee with documentation showing compliance with warranty requirements.

# PART 2 PRODUCTS

Not Used

# PART 3 EXECUTION

Not Used

<b>CERTIFICATE OF INSTALLATION, INSPECTION AND START-U</b>	P SERVICES
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Project

Equipment	
Specification S	Section
Contract	
I hereby certil Manufacturers	fy that the named equipment has been inspected, adjusted and operated by the s' Representative and further certify:
1.	That the equipment is installed in accordance with the manufacturer's recommendations, approved shop drawings, and the Contract Documents.
2.	That nothing in the installation voids any warranty.
3.	That equipment has been operated in the presence of the manufacturer's representative
4.	That equipment, as installed, is ready to be operated by others.
MANUFACTU	RERS' REPRESENTATIVE
Signature	Date
Name (print)	
Title	
Representing_	
CONTRACTC	)R
Signature	Date
Name (print)	
Title	
Attach the det	ailed report called for by Specification Section 016100.
Complete and specified.	d submit three copies of this form with the detailed report to ENGINEER as

Deciset	
Project Equipment	
Specification Section	
Contract	
I hereby certify the Manufacturers' calibrations, and that it is operating requirements. Detailed notation of im and attached to this form.	Representative has inspected this equipment, made adjustments a in conformance with the design, specifications, and manufacture proper operation with corresponding recommendations, if any, are ma
MANUFACTURERS' REPRESENTAT	IVE
Signature	Date
Name (print)	
Title	
Representing	
CONTRACTOR	
Signature	Date
Name (print)	
Title	
ENGINEER	
Signature	Date
Name (print)	

### **SECTION 017300**

### MISCELLANEOUS WORK AND CLEANUP

#### PART 1 GENERAL

#### 1.1 SCOPE OF WORK

- A. This Section includes operations that cannot be specified in detail as separate items but can be sufficiently described as to the kind and extent of work involved. Furnish all labor, materials, equipment and incidentals to complete the work under this Section.
- B. The work of this Section includes, but is not limited to, the following:
  - 1. Restoring of sidewalks, driveways, curbing and gutters.
  - 2. Crossing utilities.
  - 3. Relocation of existing water lines, low pressure, gas lines, telephone lines, electric lines, cable TV lines and storm drains as necessary, all as shown on the drawings.
  - 4. Restoring easements and rights-of-ways.
  - 5. Cleaning up.
  - 6. Incidental work.

#### 1.2 WORK SPECIFIED UNDER OTHER SECTIONS

A. Complete all work in a workmanlike manner by competent workmen in full compliance with all applicable sections of these Specifications.

#### PART 2 PRODUCTS

#### 2.1 MATERIALS

A. Materials required for this Section shall be of at least the same type and quality as materials that are to be restored. Where possible, reuse existing materials that are removed and then replaced, with the exception of paving.

#### PART 3 EXECUTION

### 3.1 RESTORING OF CURBING, FENCES, AND GUARD RAILS

A. Protect existing curbing. If necessary, remove curbing from joint to joint and replace after backfilling. Replace curbing that is damaged during construction with curbing of equal quality and dimension.

#### 3.2 CROSSING UTILITIES

- A. This item shall include any extra work required in crossing culverts, water courses, drains, water mains, and other utilities, including all sheeting and bracing, extra excavation and backfill, or any other work required for the crossing, whether or not shown on the drawings.
- 3.3 RELOCATIONS OR REPLACEMENT OF EXISTING GAS LINES, TELEPHONE LINES, ELECTRIC LINES, CABLE TV LINES AND DRAINAGE CULVERT
  - A. Notify the proper authority of the utility involved when relocation or replacement of these lines is required. Coordinate all work by the utility so that the progress of construction will not be hampered.
  - B. Reference all side drains, side ditches, swales, and storm sewers as to grade and location prior to construction, maintain them during construction, and repair them as necessary after construction. Where drainage structures are disturbed and must be replaced, the minimum size replacement shall be twelve inches (12"). All drainage culverts installed shall have mitered ends in conformance with the Collier County Standard Details. Place the culvert to the specified elevations and regrade or reshape the swale and road shoulders that have been disturbed or damaged during construction.

### 3.4 PROTECTION AND RESTORATION OF PROPERTY

Α. Protection and Restoration of Property: During the course of construction, take special care and provide adequate protection in order to minimize damage to vegetation, surfaced areas, and structures within the construction right-of-way, easement or site, and take full responsibility for the replacement or repair thereof. Immediately repair any damage to private property created by encroachment thereon. Should the removal or trimming of valuable trees, shrubs, or grass be required to facilitate the installation within the designated construction area, this work shall be done in cooperation with the County and/or local communities which the work takes place. Said valuable vegetation, removed or damaged, shall be replanted, if possible, or replaced by items of equal quality, and maintained until growth is re-established. Topsoil damaged in the course of work shall be replaced in kind with suitable material, graded to match existing grade. Following construction completion, the work area along the route of the installation shall be finish grade to elevations compatible with the adjacent surface, with grassing or hand raking required within developed areas.

B. Existing lawn surfaces damaged by construction shall be re-graded and re-sodded or re-seeded. These areas shall be maintained until all work under this Contract has been completed and accepted.

### 3.5 CLEANING UP

- A. Remove all construction material, excess excavation, buildings, equipment and other debris remaining on the job as a result of construction operations and shall render the site of the work in a neat and orderly condition.
- B. Work site clean-up shall follow construction operations without delay and in accordance with Section 017423.
- 3.6 INCIDENTAL WORK
  - A. Do all incidental work not otherwise specified, but obviously necessary for the proper completion of the Contract as specified and as shown on the drawings.

# NO TEXT FOR THIS PAGE

### SECTION 017416

### SITE CLEARING

#### PART 1 GENERAL

#### 1.1 SUMMARY

- A. Section Includes: Requirements for clearing of all areas within the Contract limits and other areas shown, including work designated in permits and other agreements, in accordance with the requirements of Division 1.
- B. Related Work Specified in Other Sections Includes:
  - 1. Section 024100 Demolition
  - 2. Section 312316 Excavation Earth and Rock
  - 3. Section 312323 Backfilling
  - 4. Section 329200 Restoration by Sodding or Seeding

### 1.2 DEFINITIONS

- A. Clearing: Clearing is the removal from the ground surface and disposal, within the designated areas, of trees, brush, shrubs, down timber, decayed wood, other vegetation, rubbish and debris as well as the removal of fences.
- B. Grubbing: Grubbing is the removal and disposal of all stumps, buried logs, roots larger than 1-1/2 inches, matted roots and organic materials.

PART 2 PRODUCTS

Not Used

#### PART 3 EXECUTION

- 3.1 PROTECTION OF EXISTING UTILITIES
  - A. Prior to site clearing, locate and mark all existing utilities in coordination with the COUNTY and other affected owners. Protect all existing utilities and markings from damage. In case of damage to existing utilities caused by construction activities, contact the owner of the utility or appropriate COUNTY department (Water or Wastewater) immediately. Repair any damage to existing utilities or markings caused by construction activities in coordination with or as directed by the owner of the utility.

### 3.2 TREE REMOVAL

- A. Tree Removal Within Right-of-Way Limits: Remove trees and shrubs within the right-of-way unless otherwise indicated.
  - 1. Remove trees and shrubs to avoid damage to trees and shrubs designated to remain.
  - 2. Grub and remove tree stumps and shrubs felled within the right-of-way to an authorized disposal site. Fill depressions created by such removal with material suitable for backfill as specified in Section 312323.
- B. Tree Removal Outside Right-of-Way Limits: Do not cut or damage trees outside the right-of-way unless plans show trees to be removed or unless written permission has been obtained from the property owner. Furnish three copies of the written permission before removal operations commence.
- C. If the landowner desires the timber or small trees, cut and neatly pile it in 4 foot lengths for removal by the owner; otherwise, dispose of it by hauling it away from the project site. If hauled timber is of merchantable quality, credit shall accrue to the CONTRACTOR.
- 3.3 TREES AND SHRUBS TO BE SAVED
  - A. Protection: Protect trees and shrubs within the work limits that are so delineated or are marked in the field to be saved from defacement, injury and destruction.
    - 1. Work within the limits of the tree drip line with extreme care using either hand tools or equipment that will not cause damage to trees.
      - a. Do not disturb or cut roots unnecessarily. Do not cut roots 1-1/2 inches and larger unless approved.
      - b. Immediately backfill around tree roots after completion of construction in the vicinity of trees.
      - c. Do not operate any wheeled or tracked equipment within drip line.
    - 2. Protect vegetation from damage caused by emissions from engine-powered equipment.
    - 3. During working operations, protect the trunk, foliage and root system of all trees to be saved with boards or other guards placed as shown and as required to prevent damage, injury and defacement.
      - a. Do not pile excavated materials within the drip line or adjacent to the trunk of trees.

- b. Do not allow runoff to accumulate around trunk of trees.
- c. Do not fasten or attach ropes, cables, or guy wires to trees without permission. When such permission is granted, protect the tree before making fastening or attachments by providing burlap wrapping and softwood cleats.
- d. The use of axes or climbing spurs for trimming will not be permitted.
- e. Provide climbing ropes during trimming.
- 4. Remove shrubs to be saved, taking a sufficient earth ball with the roots to maintain the shrub.
  - a. Temporarily replant if required, and replace at the completion of construction in a condition equaling that which existed prior to removal.
  - b. Replace in kind if the transplant fails.
- 5. Have any tree and shrub repair performed by a tree surgeon properly licensed by the State of Florida and within 24 hours after damage occurred.

### 3.4 CLEARING AND GRUBBING

- A. Clearing: Clear all items specified to the limits shown and remove cleared and grubbed materials from the site.
  - 1. Do not start earthwork operations in areas where clearing and grubbing is not complete, except that stumps and large roots may be removed concurrent with excavation.
  - 2. Comply with erosion, sediment control and storm management measures as specified in Division 1.
- B. Grubbing: Clear and grub areas to be excavated, areas receiving less than 3 feet of fill and areas upon which structures are to be constructed.
  - 1. Remove stumps and root mats in these areas to a depth of not less than 18 inches below the subgrade of sloped surfaces.
  - 2. Fill all depressions made by the removal of stumps or roots with material suitable for backfill as specified in Section 312323.
- C. Limited Clearing: Clear areas receiving more than 3 feet of fill by cutting trees and shrubs as close as practical to the existing ground. Grubbing will not be required.

- D. Dispose of all material and debris from the clearing and grubbing operation by hauling such material and debris away to an approved dump. The cost of disposal (including hauling) of cleared and grubbed material and debris shall be considered a subsidiary obligation of the CONTRACTOR; include the cost in the bid for the various classes of work.
- 3.5 TOPSOIL
  - A. Stripping: Strip existing topsoil from areas that will be excavated or graded prior to commencement of excavating or grading and place in well-drained stockpiles in approved locations.
# CLEANING

### PART 1 GENERAL

- 1.1 SECTION INCLUDES:
  - A. General Requirements
  - B. Disposal Requirements
- 1.2 GENERAL REQUIREMENTS
  - A. Execute cleaning during progress of the work and at completion of the work.
- 1.3 DISPOSAL REQUIREMENTS
  - A. Conduct cleaning and disposal operations to comply with codes, ordinances, regulations, and anti-pollution laws.

# PART 2 PRODUCTS

NOT USED

### PART 3 EXECUTION

- 3.1 DURING CONSTRUCTION
  - A. Execute daily cleaning to keep the work, the site, and adjacent properties free from accumulations of waste materials, rubbish, and windblown debris, resulting from construction operations.
  - B. Provide onsite containers for the collection of waste materials, debris and rubbish. All waste materials including containers, food debris and other miscellaneous materials must be disposed of daily in onsite containers.
  - C. Remove waste materials, debris and rubbish from the site periodically and dispose of at legal disposal areas away from the site.

### 3.2 FINAL CLEANING

- A. Requirements: At the completion of work and immediately prior to final inspection, clean the entire project as follows:
  - 1. Thoroughly clean, sweep, wash, and polish all work and equipment provided under the Contract, including finishes. Leave the structures and site in a complete and finished condition to the satisfaction of the ENGINEER.
  - 2. Direct all subcontractors to similarly perform, at the same time, an equivalent thorough cleaning of all work and equipment provided under their contracts.
  - 3. Remove all temporary structures and all debris, including dirt, sand, gravel, rubbish and waste material.
  - 4. Should the CONTRACTOR not remove rubbish or debris or not clean the buildings and site as specified above, the OWNER reserves the right to have the cleaning done at the expense of the CONTRACTOR.
- B. Employ experienced workers, or professional cleaners, for final cleaning.
- C. Use only cleaning materials recommended by manufacturer of surface to be cleaned.
- D. In preparation for substantial completion or occupancy, conduct final inspection of sight-exposed interior and exterior surfaces, and of concealed spaces.
- E. Remove grease, dust, dirt, stains, labels, fingerprints, and other foreign materials from sight-exposed interior and exterior finished surfaces. Polish surfaces so designated to shine finish.
- F. Repair, patch, and touch up marred surfaces to specified finish, to match adjacent surfaces.
- G. Replace air-handling filters if units were operated during construction.
- H. Clean ducts, blowers, and coils, if air-handling units were operated without filters during construction.
- I. Vacuum clean all interior spaces, including inside cabinets.
- J. Handle materials in a controlled manner with as few handlings as possible. Do not drop or throw materials from heights.
- K. Schedule cleaning operations so that dust and other contaminants resulting from cleaning process will not fall on wet, newly-painted surfaces.

- L. Clean interior of all panel cabinets, pull boxes, and other equipment enclosures.
- M. Wash and wipe clean all lighting fixtures, lamps, and other electrical equipment that may have become soiled during installation.
- N. Perform touch-up painting.
- O. Broom clean exterior paved surfaces; rake clean other surfaces of the grounds.
- P. Remove erection plant, tools, temporary structures and other materials.
- Q. Remove and dispose of all water, dirt, rubbish or any other foreign substances.

# 3.3 FINAL INSPECTION

A. After cleaning is complete the final inspection may be scheduled. The inspection will be done with the OWNER and ENGINEER.

NO TEXT FOR THIS PAGE

COLLIER COUNTY TECHNICAL SPECIFICATIONS Section 017423 CLEANING Page 4 of 4

#### PROJECT RECORD DOCUMENTS

#### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

Requirements for preparation, maintenance and submittal of project record documents. The Contractor's attention is specifically directed to Part 3.2.B. of this Section, which requires use of a Florida licensed surveyor to sign and seal all record drawings.

- 1.2 RELATED SECTIONS
  - A. Section 014500 Quality Control
  - B. Section 022100 Lines and Grades

#### 1.3 SUBMITTALS

- A. General: Provide all submittals as specified.
- B. At Contract close out, three (3) sets of signed and sealed Record Drawings for the potable water OR non-potable irrigation water OR wastewater systems to be conveyed shall be submitted to the County or District. If potable water AND wastewater, AND/OR non-potable irrigation water systems or portion(s) thereof are being conveyed, five (5) sets of signed and sealed Record Drawings shall be submitted to the County.
- C. Provide electronic submittal as specified in Part 3.02.B of this Section.
- 1.4 REQUIREMENTS (For County Capital Projects Only)

Contractor shall maintain at the site for the County one record copy of:

- A. Drawings
- B. Specifications
- C. Addenda
- D. Change orders and other modifications to the Contract
- E. Design Engineer's field orders or written instructions
- F. Approved shop drawings, working drawings and samples
- G. Field test records

#### PART 2 PRODUCTS (not used)

#### PART 3 EXECUTION

#### 3.1 MAINTENANCE OF DOCUMENTS AND SAMPLES

- A. Project record documents shall be stored in Contractor's field office or other location approved by the County apart from documents used for construction
- B. Maintain documents in a clean, dry, legible condition and in good order. Do not use record documents for construction purposes.
- C. Make documents and samples available at all times for inspection by the County.

#### 3.2 RECORDING

- A. General
  - 1. Record Drawings shall accurately depict the constructed configuration of all potable water, non-potable irrigation water and/or wastewater systems or portion(s) thereof. All revisions to County staff approved construction drawings shall be precisely identified and illustrated on the Record Drawings. All Record Drawings of utility systems or portion(s) thereof that are not being conveyed to the Board shall bear, on the cover sheet, a prominently displayed DISCLAIMER, in bold lettering at least one-quarter (1/4) inch high, stating: "All on-site potable water, non-potable irrigation and/or wastewater systems shall be owned, operated and maintained by the private owner(s) and/or the master condominium/homeowners' association, successors or assigns" (or other comparable private ownership).
  - 2. Label each document "PROJECT RECORD" or similar text in neat, large printed letters.
  - 3. Survey information can be obtained as needed by the use of 2-inch PVC labeled pipes installed over underground improvements by the contractor during construction. This method is an adequate process for obtaining record information.
  - 4. Record information in red ink.
- B. Record Drawings
  - 1. The Record Drawings require signed and sealed as-built information, including above and below ground improvements including underground piping, valves and ductbanks, by a Florida Licensed Land Surveyor.
  - 2. The Record Drawings shall identify the entity that provided the record data.
  - 3. Drawings shall be referenced to and tie-in with the state plane coordinate system, with a Florida East Projection, and a North American Datum 1983/1990 (NAD 83/90 datum), and with United States Survey Feet (USFEET) units, and North American Vertical Datum 1988 (NAVD 88), as established by a registered Florida surveyor and mapper.

- 4. Files shall be also submitted in two digital file formats, specifically Drawing File (DWG) format in AutoCAD Release 2004 or later version as well as PDF format (latest version).
- 5. Record drawings shall be submitted to the County staff within 60 days of the final construction completion date.
- 6. The following items shall be accurately depicted in vertical and horizontal directions on the Record Drawings:
  - a) All associated rights-of-way and utility easements whether shown on the Contract Drawings, found during construction or added during the Work.
  - b) Sewer system inverts, pipe slopes, manhole rims and run lengths.
  - c) Sewer lateral locations stationed from the nearest downstream manhole.
  - d) Sewer main stub extension inverts at both ends, pipe slope, run length and location.
  - e) Tie-ins to all valves, air release assemblies, fire hydrants, manholes, blowoffs, etc.
  - f) Top elevations of treatment plant structures and tanks.
  - g) Manhole center for sanitary sewers and storm sewers as related to utility improvements.
  - h) Pipe changes in direction or slope.
  - i) Buried valves, tees and fittings.
  - j) Pipe invert, or centerline, elevations at crossing with other pipe.
  - k) Invert, or centerline, elevations and coordinates of existing exposed pipe at crossing with underground pipe installed under this project.
  - I) Other horizontal and vertical record data pertinent to completed Work.
- 7. Each pipe elevation shall be clearly identified as to whether it is top of pipe, centerline of pipe or invert of pipe.
- 8. For County Capital Projects only, Record Drawings shall indicate all deviations from Contract Drawings including:
  - a) Field changes.
  - b) Changes made by Change Order.
  - c) Details, utilities, piping or structures not on original Contract Drawings.
  - d) Equipment and piping relocations.
- C. Specifications and Addenda (For County Capital Projects Only)

Legibly mark each Section to record:

- 1. Manufacturer, trade name, catalog number and supplier of each product and item of equipment actually installed.
- 2. Changes made by Field Order or Change Order.

- D. Shop Drawings (For County Capital Projects Only)
  - 1. Keep one copy of the final, approved shop drawing with the Record Documents.
  - 2. Record documents should include all shop drawing information submitted. Additional information submitted during the review process should be filed with the appropriate submittal.

# CONNECTIONS TO EXISTING SYSTEMS

### PART 1 GENERAL

### 1.1 SECTION INCLUDES

- A. General Requirements
- B. Submittals
- C. Scheduling of Shutdown
- 1.2 RELATED SECTIONS
  - A. Section 011000 Summary of Work
  - B. Section 015000 Construction Facilities and Temporary Controls
  - C. Section 015526 Traffic Regulations and Public Safety
  - D. Section 320117 Pavement Repair and Restoration
- 1.3 GENERAL REQUIREMENTS
  - A. Be responsible for all connection to existing systems, cutting, fitting and patching, including attendant excavation and backfill, required to complete the work or to:
    - 1. Make its several parts fit together properly.
    - 2. Uncover portions of the work to provide for installation of ill-timed work.
    - 3. Remove and replace defective work.
    - 4. Remove and replace work not conforming to requirements of Contract Documents.
  - B. Coordination: Before connection is performed, verify and provide for any pipe restraint that may be required for the new connection. Perform all cutting, fitting or patching of the Work that may be required to make the several parts thereof join in accordance with the Contract Documents. Perform restoration with competent workmen skilled in the trade.
  - C. If changes to a "looped" water distribution system occurring during construction result in dead ends to any new or relocated water mains, connect such dead

ends to the nearest water main. In cases where no nearby water main is available, provide a flushing device in coordination with the COUNTY at no additional cost to the COUNTY.

- D. Improperly Timed Work: Perform all cutting and patching required to install improperly timed work, to remove samples of installed materials for testing, and to provide for alteration of existing facilities or for the installation of new Work in the existing construction.
- E. Limitations: Except when the cutting or removal of existing construction is specified or indicated, do not undertake any cutting or demolition, which may affect the structural stability of the Work or existing facilities without the ENGINEER's concurrence.
- F. Collier County Damage Prevention Policy:
  - 1. This policy has been put in place to avoid damage to Collier County underground utilities. A minimum distance of five feet (5') horizontally and eighteen inches (18") vertically must be maintained away from Collier County utilities (in accordance with pipe separation criteria located in the Design Criteria section). Any and all variations from this order must be approved by the Water or Wastewater Department.
  - 2. Before commencement of any excavation, the existing underground utilities in the area affected by the work must be marked by Sunshine One Call, in accordance with State Statute Chapter 556 "Underground Facility Damage Prevention and Safety", after proper notification to them by either calling 811 in Florida or toll free at 1-800-432-4770. Visit <u>www.callsunshine.com</u> for more information. Before commencing excavation for the work, potholing of all potential conflicts must be performed.
  - 3. All lines in conflict must be physically located by the contractor and verified by Collier County Locate Department personnel before performing work. Utilities under concrete or pavement may require soft dig vacuum locates which also is the contractor's responsibility to perform. All utilities will be field marked per Sunshine State One Call's statutes and guidelines. For line verification or any other information concerning locates, please call the Locate Department at 239-252-5922 during normal business hours. For line verification or emergency locates after hours, call emergency numeric pager at 239-890-0809. In the event the potholing and/or vacuum soft dig does not locate the marked utility, work must be stopped and the affected utility owner contacted. Failure to comply with this policy and obtain required signature(s) may result in delay or denial of permit.

### 1.4 SUBMITTALS

A. Submit a written request to the ENGINEER well in advance of executing any cutting or alteration which affects:

- 1. Work of the COUNTY or any separate contractor.
- 2. Structural value or integrity of any element of the project or work.
- 3. Integrity or effectiveness of weather-exposed or moisture-resistant elements or systems.
- 4. Efficiency, operational life, maintenance or safety of operational elements.
- 5. Visual qualities of sight-exposed elements.
- B. Include in request:
  - 1. Identification of the work.
  - 2. Description of affected work.
  - 3. The necessity for cutting, alteration or excavation.
  - 4. Effect on work of the COUNTY or any separate contract, or on structural or weatherproof integrity of work.
  - 5. Description of proposed work:
    - a. Scope of cutting, patching, alteration, or excavation.
    - b. Trades who will execute the work.
    - c. Products proposed to be used.
    - d. Extent of refinishing to be done.
  - 6. Alternatives to cutting and patching.
  - 7. Cost proposal, when applicable.
  - 8. Written permission of any separate contractor whose work will be affected.
- C. SUBMIT WRITTEN NOTICE TO THE ENGINEER DESIGNATING THE DATE AND THE TIME THE WORK WILL BE UNCOVERED.
- 1.5 SCHEDULING OF SHUTDOWN
  - A. Connections to Existing Facilities: If any connections, replacement, or other work requiring the shutdown of an existing facility is necessary, schedule such work at times when the impact on the COUNTY's normal operation is minimal. If shutdown involves the water distribution or transmission system, provide notice to

the COUNTY Water Department at least two (2) weeks prior to the proposed shutdown, including date, time and anticipated length of interruption of service. Overtime, night and weekend work without additional compensation from the COUNTY, may be required to make these connections, especially if the connections are made at times other than those specified. The connection of new or existing pipelines is prohibited from starting until CONTRACTOR assures that the system can receive the new flow.

- B. Interruptions of Service: Perform cut-ins into lines at a time approved in writing by the County Manager or designee. Whenever it is required to turn off valves which may interrupt the water supply of residents or businesses, notify all concerned parties or agencies with personal contact, door hangers or written notice at least forty-eight (48) hours in advance of such cut-off, after having obtained the approval of the County Manager or designee. Provide a copy of the written notice to the Water Distribution Section by fax. <u>ONLY COUNTY PERSONNEL MAY OPERATE COUNTY-OWNED VALVES</u>. Maintain water service to existing connections during construction, under any and all conditions and at no additional cost to the COUNTY. Thoroughly clean and swab all pipe and fittings for cut-ins with a concentrated solution of calcium hypochlorite.
- C. Request for Water System Shutdowns: When plans call for connection to existing water distribution facilities or the CONTRACTOR plans to shut down existing utilities or where damage to such facilities is likely in order to complete construction of items under this contract, furnish the County Manager or designee with a written request for connection. The COUNTY Water Distribution Section will identify the locations of all water valves needed to isolate the point of connection. Identify in the request means which the CONTRACTOR proposes to use in order to provide effective shutdown of the system. Include in a connection and shutdown schedule details of shutdown time and duration. No connections to existing utilities or construction where shutdown of, or damage to, existing utilities may occur shall commence prior to County Manager or designee approval of the connection and shutdown plan and schedule.
- D. Request for Wastewater Diversion: Submit a request for each diversion necessary during construction to the County Manager or designee and the ENGINEER sufficiently in advance of any required diversion. Identify in the request the valves, bypass piping, portable pumper trucks or any other means which the CONTRACTOR proposes to use in order to provide effective shutdown of the system. Include in a connection and shutdown schedule details of shutdown time and duration. No connections to existing utilities or construction where shutdown of, or damage to, existing utilities may occur shall commence prior to County Manager or designee approval of the connection and shutdown plan and schedule.

# PART 2 PRODUCTS

### 2.1 MATERIALS

A. Comply with specifications and standards for each specific product involved.

#### PART 3 EXECUTION

#### 3.1 INSPECTION

- A. Inspect existing conditions of projects, including elements subject to damage or to movement during cutting and patching.
- B. After uncovering work, inspect conditions affecting installation of products, or performance of the work.
- C. Report unsatisfactory or questionable conditions to the ENGINEER in writing; do not proceed with work until the ENGINEER has provided further instructions.

#### 3.2 PREPARATION

- A. In cases where service to utility customers is interrupted, provide adequate equipment with backup onsite to assure prompt restoration of service.
- B. Provide adequate temporary support as necessary to assure structural value or integrity or affected portion of work.
- C. Provide devices and methods to protect other portions of project from damage.
- D. Provide protection from elements for that portion of the project that may be exposed by cutting and patching work, and maintain excavations free from water.
- E. Material Removal: Cut and remove all materials to the extent shown or as required to complete the work. Remove materials in a careful manner with no damage to adjacent facilities. Remove materials that are not salvageable from the site.

### 3.3 PERFORMANCE

- A. Execute cutting and demolition by methods that will prevent damage to other work, and will provide proper surfaces to receive installation of repairs.
- B. Execute excavating and backfilling by methods which will prevent settlement or damage to other work.
- C. Employ original installer or fabricator to perform cutting and patching for:
  - 1. Weather-exposed or moisture-resistant elements.
  - 2. Sight-exposed finished surfaces.
- D. Execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances, and finishes.

- E. Restore work, which has been cut or removed; install new products to provide completed work in accord with requirements of contract documents.
- F. Fit work airtight to pipes, sleeves, ducts, conduit and other penetrations through surfaces.
- G. Refinish entire surfaces as necessary to provide an even finish to match adjacent finishes:
  - 1. For continuous surfaces, refinish to nearest intersection.
  - 2. For an assembly, refinish entire unit.
- 3.4 PAVEMENT RESTORATION
  - A. Restore all pavement or roadway surfaces in accordance with Section 320117 Pavement Repair and Restoration.
  - B. Restore, replace or rebuild existing street paving, including underdrains, if any are encountered, where damaged, using the same type of construction as was in the original. Be responsible for restoring all such work, including subgrade, base courses, curb and gutter or other appurtenances where present. The County Manager or designee will obtain the permits listed in the Contract Documents. Obtain and pay for at CONTRACTOR's expense any additional local or other governmental permits as may be required for the opening of streets and be satisfied as to any requirements other than those herein set forth which may effect the type, quality and manner of carrying on the restoration of surfaces by reason of jurisdiction of such governmental bodies.
  - C. This section does not describe the construction of new road surfaces or the complete resurfacing of existing pavements.
  - D. In all cases, the CONTRACTOR will be required to maintain, without additional compensation, all permanent replacement of street paving, done by him under this Contract for a period of 12 months after the acceptance of the Contract, including the removal and replacement of such work wherever surface depressions or underlying cavities result from settlement of trench backfill.
  - E. Perform all the final resurfacing or repaving of streets or roads, over the excavations made and be responsible for relaying paving surfaces of roads that have failed or been damaged at any time before the termination of the maintenance period on account of work done by him. Resurface or repave over any tunnel jacking, or boring excavation that settles or breaks the surface, repave to the satisfaction of the County Manager or designee and at the CONTRACTOR's expense. Conform backfilling of trenches and the preparation of subgrades to the requirements of excavation and backfilling of pipeline trenches.

F. Where pipeline construction crosses paved streets, driveways or sidewalks, the CONTRACTOR may elect, at no additional cost to the COUNTY, to place the pipe by the jacking and boring, horizontal direction drilling, or tunneling method in lieu of cutting and patching of the paved surfaces. Such work shall be accomplished in accordance with all applicable sections of the Contract Documents.

# NO TEXT FOR THIS PAGE

# LINES AND GRADES

### PART 1 GENERAL

- 1.1 SECTION INCLUDES
  - A. General
  - B. Surveys
  - C. Datum Plane
  - D. Protection of Survey Data
- 1.2 GENERAL
  - A. Construct all work in accordance with the lines and grades shown on the Drawings. Assume full responsibility for keeping all alignment and grade.

### 1.3 SURVEYS

- A. Reference Points: The COUNTY will provide reference points for the work as described in the General Conditions. Base horizontal and vertical control points will be designated by the ENGINEER and used as datum for the Work. Perform all additional survey, layout, and measurement work.
  - 1. Keep ENGINEER informed, sufficiently in advance, of the times and places at which work is to be performed so that base horizontal and vertical control points may be established and any checking deemed necessary by ENGINEER may be done, with minimum inconvenience to the ENGINEER and at no delay to CONTRACTOR. It is the intention not to impede the Work for the establishment of control points and the checking of lines and grades set by the CONTRACTOR. When necessary, however, suspend working operations for such reasonable time as the ENGINEER may require for this purpose. Costs associated with such suspension are deemed to be included in the Contract Price, and no time extension or additional costs will be allowed.
  - 2. Provide an experienced survey crew including an instrument operator, competent assistants, and any instruments, tools, stakes, and other materials required to complete the survey, layout, and measurement of work performed by the CONTRACTOR.

### 1.4 DATUM PLANE

A. All elevations indicated or specified refer to the North American Vertical Datum 1988 (NAVD 88), of the United States Coast and Geodetic Survey and are expressed in feet and decimal parts thereof, or in feet and inches.

### 1.5 PROTECTION OF SURVEY DATA

- A. General: Safeguard all points, stakes, grade marks, known property corners, monuments, and benchmarks made or established for the Work. Reestablish them if disturbed, and bear the entire expense of checking reestablished marks and rectifying work improperly installed.
- B. Records: Keep neat and legible notes of measurements and calculations made in connection with the layout of the Work. Furnish copies of such data to the ENGINEER for use in checking the CONTRACTOR's layout. Data considered of value to the County Manager or designee will be transmitted to the County Manager or designee by the ENGINEER with other records on completion of the Work.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

# PRE-CONSTRUCTION AUDIO-VIDEO RECORDING

### PART 1 GENERAL

### 1.1 DESCRIPTION OF WORK

A. The work specified in this section includes the requirements for pre-construction audio-video recordings necessary to document existing conditions on public and private property.

### PART 2 PRODUCTS

### 2.1 CONTRACTOR REQUIREMENTS

- A. The Contractor shall provide color videos showing pre-construction site conditions of all public and private property within the scope of construction. The videos shall be on DVD and electronic format indicating on the beginning and front of each DVD, the date, job title and location where the video was taken. The videos shall be clear and shall thoroughly document all existing structures and landscaping.
- B. Two copies of the DVD and one electronic copy (on a USB flash drive or other appropriate device) shall be delivered to the County Manager or designee for review.

### PART 3 EXECUTION

### 3.1 INSPECTION

A. Construction on private property shall not commence until the County Manager or designee has reviewed and approved the audio-video recording.

### 3.2 PERFORMANCE

A. The Contractor may be required to restore private properties to conditions better than existing, at no additional cost to the COUNTY, if the Contractor fails to sufficiently document existing conditions.

NO TEXT FOR THIS PAGE

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# LEAKAGE TESTS

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. Section Includes: Testing for any signs of leakage in all pipelines and structures required to be watertight.
  - 1. Test gravity sewers and drain lines by infiltration/exfiltration testing.
  - 2. Test all other pipelines with water under the specified pressures.
- B. Operation of Existing Facilities: Conduct all tests in a manner to minimize as much as possible any interference with the day-to-day operations of existing facilities or other contractors working on the site.

### 1.2 PERFORMANCE REQUIREMENTS

- A. Written Notification of Testing: Provide written notice when the work is ready for testing, and make the tests as soon thereafter as possible.
  - 1. Personnel for reading meters, gauges, or other measuring devices, will be furnished.
  - 2. Furnish all other labor, equipment, air, water and materials, including meters, gauges, smoke producers, blower, pumps, compressors, fuel, water, bulkheads and accessory equipment.

### 1.3 REFERENCES

- A. Codes and standards referred to in this Section are:
  - 1. AWWA C 600 Installation of Ductile-Iron Water Mains and Their Appurtenances

### 1.4 SUBMITTALS

- A. General: Provide all submittals, including the following, as specified in Division 1.
- B. Testing Report: Prior to placing the sewer system in service submit for review and approval a detailed report summarizing the leakage test data, describing the test procedure and showing the calculations on which the leakage test data is based.
  - 1. Reference Sewer Line Data

- a. For Low Pressure Testing
  - (1) The length and diameter of the section of line tested (MH to MH), including any laterals.
  - (2) A complete description of the test procedure, including:
    - (a) Trench backfilling and sewer cleaning status
    - (b) Type of plugs used and where
    - (c) Depth of sewer, and ground water pressure over sewer pipe
    - (d) Stabilization time period and air pressure
    - (e) Actual air test pressures used if ground water is present
    - (f) The time allowed by specifications
    - (g) The actual test time
    - (h) The air pressure at beginning and end of test
  - (3) The name of the inspector/tester and the date(s) and time(s) of all testing performed, including any retesting.
  - (4) A description of any repairs made.

# PART 2 PRODUCTS

Not Used

# PART 3 EXECUTION

### 3.1 LEAKAGE TESTING

- A. All new sewer and water pipelines installed shall be tested for leakage. The test used will be Hydrostatic Testing for pressure lines and Infiltration/Exfiltration Testing for gravity lines. Tests to be performed will be indicated by the ENGINEER and witnessed by the ENGINEER and the County Manager or designee.
  - 1. Flushing

- a. Full-bore flush all mains to remove all sand and other foreign matter. Flushing shall be terminated at the direction of the ENGINEER. Dispose of the flushing water without causing nuisance or property damage. Full bore flushes on force mains shall only be required where sufficiently sized water mains are present.
- b. Install temporary flush out connections on all dead end water mains at the locations shown on plans and in accordance with the Collier County Standard Details.
- 2. Hydrostatic Testing for DIP and PVC Pipelines:

Perform hydrostatic testing of the system as set forth in the following, and conduct said tests in the presence of the County Manager or designee and other authorized agencies, with 48 hours advance notice provided.

Piping and appurtenances to be tested shall be within sections between valves unless alternate methods have received prior approval from the County Manager or designee. Testing shall not proceed until concrete thrust blocks are in place and cured, or other restraining devices installed. Thoroughly clean and flush all piping prior to testing to clear the lines of all foreign matter. While the piping is being filled with water care shall be exercised to permit the escape of air from extremities of the test section, with additional release cocks provided if required.

Perform hydrostatic testing with a sustained minimum pressure of 150 psi for a period of not less than two (2) hours. If sustained pressure goes 5 psi above or below 150 psi during the first two (2) hours, the test fails (AWWA regulation). After two (2) hours, use the AWWA formula if less than 5 psi to determine whether test fails. Testing shall be in accordance with the applicable provisions as set forth in the most recent edition of AWWA Standards C600 for Ductile Iron Pipe and C605 for PVC Pipe. The allowable rate of leakage shall be less than the number of gallons per hour determined by the following formula:

$$L = \frac{SD (P)^{1/2}}{133,200}$$

Where,

- L = Allowable leakage in gallons per hour;
- S = Length of pipe tested in feet;
- D = Nominal diameter of pipe in inches;
- P = Average test pressure maintained during the leakage test in pounds per square inch

For 150 psi, L = (9.195 x 10<sup>-5</sup>) SD

The testing procedure shall include the continued application of the specified pressure to the test system, for the one-hour period, by way of a pump taking supply from a container suitable for measuring water loss. The amount of loss shall be determined by measuring the volume displaced for the said container.

Should the test fail, repair the fault and repeat the test until results are within the established limits. Furnish the necessary labor, water, pumps, and gauges at specified location(s) and all other items required to conduct the required testing and perform necessary repairs.

<u>General</u> - All sanitary sewers and associated service lines shall be constructed watertight to prevent infiltration and/or exfiltration.

3. Hydrostatic Testing for HDPE Pipelines:

Perform hydrostatic testing of all HDPE pipelines as set forth in the following, and conduct said tests in the presence of the County Manager or designee and other authorized agencies, with 48 hours advance notice provided.

Provide all labor, equipment and material required for testing the pipeline upon completion of installation, pipe laying and backfilling operations, and placement of any required temporary roadway surfacing.

Disinfect all HDPE potable water mains prior to testing in accordance with the requirements of Section 025400 – Disinfection.

Test pipelines at 150 psi.

Field test all HDPE pipelines for leakage in accordance with manufacturer's recommendations for the size and class of pipeline installed. Unless other procedures recommended by the manufacturer are approved by the County Manager or designee, pressure test the pipeline as follows:

- a. Fill pipeline slowly with water. Maintain flow velocity less than two (2) feet per second.
- b. Expel air completely from the line during filling and again before applying test pressure. Expel air by means of taps at points of highest elevation.
- c. Apply initial test pressure and allow to stand without makeup pressure for two (2) to three (3) hours, to allow for diametric expansion or pipe stretching to stabilize.

- d. After this equilibrium period, apply the specified test pressure and turn the pump off. The final test pressure shall be held for not less than two (2) hours.
- e. Upon completion of the test, the pressure shall be bled off from the location other than the point where the pressure is monitored. The pressure drop shall be witnessed by the County Manager or designee at the point where the pressure is being monitored.

Allowable amount of makeup water for expansion of the pipeline during the pressure test shall conform to Table III, Test Phase Make-up Amount, contained in the manual "Inspections, Test and Safety Considerations" published by the Plastics Pipe Institute, Inc.

If any test of pipeline installed exceeds the amount of makeup water as allowed above, locate and repair the cause of leakage and retest the pipeline, without additional cost to the COUNTY. Repair all visible leaks regardless of the amount of leakage.

4. Force Main Pressure Testing: All force mains shall be subject to pressure testing at 150 PSI.

Allowable leakage on force mains shall be computed utilizing the standards for water loss in conformance with AWWA C600, the latest revision thereof.

5. Infiltration/Exfiltration Testing for Gravity Lines

The allowable limits of infiltration or exfiltration for the entire system, or any portion thereof, shall not exceed a rate of 50 gallons per inch of inside pipe diameter per mile of pipe per 24 hours. No additional allowance shall be made for house service lines. Any part of or all of the system shall be tested for infiltration or exfiltration, as directed by the ENGINEER or as required by the County Manager or designee. The procedures and limitations for conducting infiltration/exfiltration tests shall be established at the preconstruction conference on a project-by-project basis. Air testing of gravity sewer mains may be required. All testing shall be run continuously for 24 hours, unless the County Inspector can visually verify that this test duration is not required due to the observed infiltration/exfiltration rate. The amounts of infiltration or exfiltration shall be determined by pumping water into or out of calibrated drums, or by other methods approved by the Public Utilities Division, such as in-line V-notch weirs. Where infiltration or exfiltration exceeds the allowable limits specified herein, locate and repair the defective pipe, joints or other faulty construction at no additional cost to the COUNTY. If the defective portions cannot be located, remove and reconstruct as much of the work as is necessary in order to conform to the specified allowable All visible leaks shall be repaired regardless of the amount of limits. leakage. Provide all labor, equipment and materials required and conduct all testing required under the direction of the ENGINEER.

- a. Infiltration: Prior to testing for infiltration, the system shall be pumped out so that normal infiltration conditions exist at the time of testing. The cumulative results of the entire collection system results shall not be a satisfactory method for gauging infiltration compliance. Each sewer section between manholes must permit infiltration no greater than the maximum allowable, as specified above.
- b. Exfiltration: The exfiltration test, when required due to groundwater levels, will be conducted by filling the portion of the system being tested with water to a level 2 feet above the uppermost manhole invert in the section being tested. The cumulative results of the entire collection system results shall not be a satisfactory method for gauging exfiltration compliance. Each sewer section between manholes must permit exfiltration no greater than the maximum allowable, as specified above.
- 6. Low Pressure Air Testing

Contractor shall conduct air testing in accordance with ASTM specifications:

- a. ASTM C-828 for clay pipes.
- b. ASTM C-924 for concrete pipes.
- c. ASTM F-1417 for plastic pipes.

When low pressure air testing of gravity sewer mains is specifically required, all testing shall be run continuously for 24 hours, unless the County Inspector can visually verify that this test duration is not required due to the observed infiltration/exfiltration rate.

When air testing is specifically required, after completing backfill of a section of gravity sewer line, conduct a Line Acceptance Test using low pressure air. The test shall be performed using the below stated equipment, according to state procedures and under the supervision of the ENGINEER and in the presence of the County Manager or designee, with 48 hours advanced notice.

- d. Equipment:
  - (1) Pneumatic plugs shall have a sealing length equal to or greater than the diameter of the pipe to be inspected.
  - (2) Pneumatic plugs shall resist internal bracing or blocking.
  - (3) All air used shall pass through a single control panel.

- (4) Three individual hoses shall be used for the following connections:
  - (a) From control panel to pneumatic plugs for inflation.
  - (b) From control panel to sealed line for introducing the low-pressure air.
  - (c) From sealed line to control panel for continually monitoring the air pressure rise in the sealed line.
- e. Procedure:

All pneumatic plugs shall be seal tested before being used in the actual test installation. One length of pipe shall be laid on the ground and sealed at both ends with the pneumatic plugs to be checked. Air shall be introduced into the plugs to 25 psi. The sealed pipe shall be pressurized to 5 psi. The plugs shall hold against this pressure without bracing and without movement of the plugs out of the pipe.

After a manhole-to-manhole reach of pipe has been backfilled and cleaned and the pneumatic plugs are checked by the above procedure, the plugs shall be placed in the line at each manhole and inflated to 25 psi. Low-pressure air shall be introduced into this sealed line until the internal air pressure reaches <u>4 psi greater than</u> the average back pressure of any ground water that may be over the pipe. At least two (2) minutes shall be allowed for the air pressure in the pipe), the air hose from the control panel to the air supply shall be disconnected. The portion of the line being tested shall be termed "Acceptable", if the time required in minutes for the pressure to decrease from 3.5 to 2.5 psi (greater than the average back pressure of any ground water that may be over the pipe) is greater than the time shown for the given diameters in the following table:

Pipe Diameter In Inches	<u>Minutes</u>
8	4.0
10	5.0
12	5.5
16	7.5
18	8.5
24	11.5

Time in Minutes = 0.472 D D = Diameter of pipe in inches

In areas where ground water is known to exist, install capped pipe adjacent to the top of the sewer lines. This shall be done at the time of the sewer line is installed. Immediately prior to the performance of the Line Acceptance Test, the ground water shall be determined by removing the pipe cap, and a measurement of the height in feet of water over the invert of the pipe shall be taken. The height in feet shall be <u>divided by 2.3 to establish the pounds of pressure</u> that will be added to all readings. (For example, if the height of water is 11-1/2 feet, then the added pressure will be 5 psi. This increases the 3.5 psi to 8.5 psi, and the 2.5 psi to 7.5 psi. The allowable drop of one pound and the timing remain the same).

If the installation fails to meet this requirement, determine the source of the leakage and repair or replace all defective materials and/or workmanship, all at no additional cost to the COUNTY.

B. DEP approval is required to use reclaimed (IQ) water for flushing and pressure testing of irrigation mains and potable water mains. The requirements for submitting a request to DEP are available from the County PUED.

# 3.2 LEAKAGE TESTS FOR STRUCTURES

- A. Structure Leakage Testing: Perform leakage tests of manholes, wet wells, tanks, vaults and similar purpose structures before backfilling, by filling the structure with water to the overflow water level and observing the water surface level for the following 24 hours.
  - 1. Make an inspection for leakage of the exterior surface of the structure, especially in areas around construction joints.
  - 2. If visible leaks appear, repair the structure by removing and replacing the leaking portions of the structure, waterproofing the inside, or by other methods approved.

3. Water for testing will be provided by the COUNTY at the CONTRACTOR's expense.

NO TEXT FOR THIS PAGE

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### DEMOLITION

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. Section Includes: All work necessary for the removal and disposal of structures, foundations, piping, equipment and roadways, or any part thereof including masonry, steel, reinforced concrete, plain concrete, electrical facilities, and any other material or equipment shown or specified to be removed.
- B. Basic Procedures and Schedule: Carry out demolition so that adjacent structures, which are to remain, are not endangered. Schedule the work so as not to interfere with the day-to-day operation of the existing facilities. Do not block doorways or passageways in existing facilities.
- C. Additional Requirements: Provide dust control and make provisions for safety.
- D. Related Work Specified in Other Sections Includes:
  - 1. Section 017416 Site Clearing
  - 2. Section 020500 Connection to Existing Systems

#### 1.2 SUBMITTALS

- A. Provide all submittals, including the following, as specified in Division 1.
- B. Site Inspection: Visit the site and inspect all existing structures. Observe and record any defects that may exist in buildings or structures adjacent to but not directly affected by the demolition work. Provide the County Manager or designee with a copy of this inspection record and obtain the ENGINEER's and the County's Manager or designee approval prior to commencing the demolition.

### 1.3 QUALITY ASSURANCE

A. Limits: Exercise care to break concrete well for removal in reasonably small masses. Where only parts of a structure are to be removed, cut the concrete along limiting lines with a suitable saw so that damage to the remaining structure is held to a minimum.

### PART 2 PRODUCTS

Not Used

COLLIER COUNTY TECHNICAL SPECIFICATIONS

# PART 3 EXECUTION

### 3.1 EXAMINATION OF EXISTING DRAWINGS

A. Available drawings of existing structures and equipment will be available for inspection at the office of the ENGINEER.

#### 3.2 PROTECTION

- A. General Safety: Provide warning signs, protective barriers, and warning lights as necessary adjacent to the work as approved or required. Maintain these items during the demolition period.
- B. Existing Services: Undertake no demolition work until all mechanical and electrical services affected by the work have been properly disconnected. Cap, reroute or reconnect interconnecting piping or electrical services that are to remain in service either permanently or temporarily in a manner that will not interfere with the operation of the remaining facilities.
- C. Hazards: Perform testing and air purging where the presence of hazardous chemicals, gases, flammable materials or other dangerous substances is apparent or suspected, and eliminate the hazard before demolition is started.

#### 3.3 DEMOLITION REQUIREMENTS

- A. Explosives: The use of explosives will not be permitted.
- B. Protection: Carefully protect all mechanical and electrical equipment against dust and debris.
- C. Removal: Remove all debris from the structures during demolition and do not allow debris to accumulate in piles.
- D. Abandoned Pipelines: Fill all abandoned pipelines using grout in accordance with Section 033100.
- E. Access: Provide safe access to and egress from all working areas at all times with adequate protection from falling material.
- F. Protection: Provide adequate scaffolding, shoring, bracing railings, toe boards and protective covering during demolition to protect personnel and equipment against injury or damage. Cover floor openings not used for material drops with material substantial enough to support any loads placed on it. Properly secure the covers to prevent accidental movement.
- G. Lighting: Provide adequate lighting at all times during demolition.

- H. Closed Areas: Close areas below demolition work to anyone while removal is in progress.
- I. Material Drops: Do not drop any material to any point lying outside the exterior walls of the structure unless the area is effectively protected.
- J. Chemicals: All chemicals used during project construction or furnished for project operation, whether herbicide, pesticide, disinfectant, polymer, reactant or of other classification must show approval of either EPA or USDA. Use of all such chemicals and disposal of residues shall be in strict conformance with manufacturer's instructions or government regulations as applicable.

### 3.4 ASBESTOS-CONCRETE (AC) PIPE

- A. If existing asbestos-cement pipe is encountered during the course of construction, remove the AC pipe and replace it with C900 PVC pipe having a pressure rating as required elsewhere in these specifications. Replace the AC pipe with PVC pipe for a distance of 10 feet each way from the centerline of the pipe under construction or 5 feet beyond the length of AC pipe exposed by trench excavation, whichever is greater. A change order will be issued for required replacement of AC pipe not shown on the drawings.
- B. Coordinate the shutdown of the AC pipeline with the County Manager or designee in accordance with Section 020500, including proper notice to the County Manager or designee and any customers that may be affected by the shutdown as required by these specifications and/or current Water Department policy. In the event of an unanticipated encounter with AC pipe, immediately recover and protect the pipe and notify the COUNTY Water Department.
- C. Perform cutting of AC pipe by means of cutting wheels mounted in a chain wrapped around the pipe barrel. Do not use power driven saws with abrasive discs or any other means that produce concentrations of airborne asbestos dust.

# 3.5 DISPOSAL OF MATERIALS

A. Final Removal: Dispose of AC pipe in accordance with COUNTY special handling requirements and coordination with Collier County Solid Waste Management Department. Remove all other debris, rubbish, scrap pieces, equipment, and materials resulting from the demolition. Take title to all demolished materials and remove such items from the site.

NO TEXT FOR THIS PAGE

### DISINFECTION

### PART 1 GENERAL

#### 1.1 SUMMARY

A. Section Includes: Disinfection of all pipelines, tanks, structures, conduits and equipment that are to store, handle or carry potable water. Furnish all labor, water, chemicals and equipment, including taps, corporation stops, temporary pumps and other items necessary to perform the Work, except as otherwise specified.

### 1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
  - 1. AWWA C651 Disinfecting Water Mains
  - 2. AWWA C652 Disinfection of Water-Storage Facilities

#### 1.3 QUALITY ASSURANCE

- A. Disinfection Standards: Disinfect in accordance with AWWA C651 for water mains and AWWA C652 for water storage facilities and equipment.
- B. Chlorinated Water Disposal: Dispose of old highly chlorinated water in accordance with applicable regulations.
- PART 2 PRODUCTS

Not Used

### PART 3 EXECUTION

- 3.1 FLUSHING
  - A. After coordination with the COUNTY Water Distribution Section, perform all flushes, pigging or swabbing, disinfection and post flushes in the presence of Water department personnel. Fill all water lines with potable water, pig or swab and perform a line flushing. All lines larger than 12 inches in diameter shall be pigged to clear debris prior to flushing. Use a swab-type pig for HDPE pipe. Use a 5- to 7-lb. density poly-jacketed bullet style pig for all other pipe material. Under no circumstances is a pig or swab considered reusable. A section of pipe shall be

inserted in the gap specified in the jumper shown in the Standard Details to connect the new construction to the existing facilities for the purpose of accomplishing the full-bore flush. Immediately after completion of the flush, remove the connection. The facilities shall be capped and returned to the jumper connection shown in the Standard Details until final connection is permitted by County Manager or designee at the completion of construction and after finalization of all test procedures and bacterial clearance for new water facilities.

### 3.2 WATER MAIN DISINFECTION

- A. Following acceptable pressure testing, disinfect all sections of the water distribution system and receive approval thereof from the appropriate agencies, prior to placing in service. Provide advance notice of 48 hours to the County Manager or designee before disinfecting procedures start. The disinfection shall be accomplished in accordance with the applicable provisions of AWWA Standard C651, "Disinfecting Water Mains" and all appropriate approval agencies.
- B. The disinfecting agent shall be free chlorine in aqueous solution with sustained concentration for 48 hours of not less than 50 parts per million. After 48 hours, if chlorine solution contains at least 25 parts per million of chlorine, the line may then be flushed and samples taken at various points. Chlorine may be derived from Chlorine gas, or 70% (high test) calcium hypochlorite (HTH or Perchloron, or equal). Administration may be by any of the several methods described in AWWA Standard C651 as proposed by the CONTRACTOR and approved by the ENGINEER. Proposals as to method must be made prior to commencement of the disinfection process.
- C. Following contact with chlorine solution, the system shall be thoroughly flushed out. Schedule water sampling in coordination with the COUNTY Water Distribution Section. The COUNTY Water Department will obtain all water samples for analysis.
- D. If samples do not demonstrate satisfactory results, the line shall be flushed and a resample taken. If the samples fail on the second attempt, redisinfection per AWWA standards must be repeated until two satisfactory samples are obtained. The period between samples must be a minimum of 24 hours.
- E. After approval of the samples, and before placing the system in service, perform another flushing of the water lines to remove any stagnant water.
- 3.3 WATER MAIN DISINFECTION (FOR FIRE LINE CONNECTIONS WITH NO TEMPORARY JUMPER)
  - A. In configurations where 20 feet or less of new pipe is installed between the existing COUNTY water main and the permanent above ground fire assembly, the temporary gap configuration assembly may be omitted if the following requirements are met:
- 1. The full interior of all new pipe between the existing COUNTY water main and the permanent above ground fire assembly shall be swabbed and disinfected using a chlorine solution with a concentration of not less than 200 parts per million.
- 2. The pipe must be flushed and bacteriological samples must be collected in accordance with this specification.
- 3. The tapping valve on the COUNTY water main shall remain closed until bacteriological clearance is achieved.

# 3.4 DISINFECTION PROCEDURES FOR TANKS

- A. Disinfect potable water storage tanks and equipment in accordance with AWWA C652, Method 2 or 3, using sodium hypochlorite.
  - 1. In Method 2, spray method, spray the entire interior surface of the tank with chlorinated water containing 200 mg/l of available chlorine. After spraying, allow the tank to stand at least two hours before filling with fresh water.
- B. After disinfection, allow the tanks and equipment to overflow until the chlorine residual is approximately 2 mg/l.
- 3.5 BACTERIAL SAMPLE POINTS
  - A. For the purpose of new water main construction, bacterial sampling points shall be positioned at the beginning of each new system, at 1000-foot intervals and all dead ends unless otherwise directed. These sampling points will be utilized by Utilities personnel for water main bacterial clearance procedures. At the completion of the project, when authorization is given by the County Manager or designee, permanent sampling points shall remain every 3000 feet or one at 2/3 of the length from the point of connection to the COUNTY system if the line is less than 3000 feet long. All others shall be removed down to the main and properly capped by the CONTRACTOR. The permanent sampling points shall be constructed as shown in the Utility Detail Drawings. Collier County staff will review the permanent sampling point locations during final plans review.

# END OF SECTION

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Section 025400 DISINFECTION Page 4 of 4

## SECTION 312316

## EXCAVATION - EARTH AND ROCK

#### PART 1 GENERAL

#### 1.1 SUMMARY

- A. Section Includes: Requirements for performing opencut excavations to the widths and depths necessary for constructing structures and pipelines, including excavation of any material necessary for any purpose pertinent to the construction of the Work.
- B. Related Work Specified In Other Sections Includes:
  - 1. Section 017416 Site Clearing
  - 2. Section 033100 Concrete, Masonry, Mortar and Grout
  - 3. Section 312319 Groundwater Control for Open Cut Excavation
  - 4. Section 312323 Backfilling
  - 5. Section 314000 Shoring, Sheeting and Bracing

#### 1.2 DEFINITIONS

- A. Earth: "Earth" includes all materials which, in the opinion of the ENGINEER, do not require blasting, barring, wedging or special impact tools for their removal from their original beds, and removal of which can be completed using standard excavating equipment. Specifically excluded are all ledge and bedrock and boulders or pieces of masonry larger than one cubic yard in volume.
- B. Rock: "Rock" includes all materials which, in the opinion of the ENGINEER, require blasting, barring, wedging and/or special impact tools such as jack hammers, sledges, chisels, or similar devices specifically designed for use in cutting or breaking rock for removal from their original beds and which have compressive strengths in their natural undisturbed state in excess of 300 psi. Boulders or masonry larger than one cubic yard in volume are classed as rock excavation.

## 1.3 SUBMITTALS

A. General: Provide all submittals, including the following, as specified in Division 1.

- B. Engage the services of a Professional Engineer who is registered in the State of Florida to design all cofferdam and sheeting and bracing systems which the CONTRACTOR feels necessary for the execution of his work. Submit to the ENGINEER a signed statement that he has been employed by the CONTRACTOR to design all sheeting and bracing systems. After the systems have been installed, furnish to the ENGINEER an additional signed statement that the cofferdams and sheeting and bracing systems have been installed in accordance with his design.
- C. If a detour is required, submit a traffic control plan for approval to County Manager or designee and/or the Florida Department of Transportation as described in Section 015526.

## 1.4 SITE CONDITIONS

- A. Geotechnical Investigation: A geotechnical investigation may have been prepared by the COUNTY and ENGINEER in preparing the Contract Documents.
  - 1. The geotechnical investigation report may be examined for what ever value it may be considered to be worth. However, this information is not guaranteed as to its accuracy or completeness.
  - 2. The geotechnical investigation report is not part of the Contract Documents.
- B. Actual Conditions: Make any geotechnical investigations deemed necessary to determine actual site conditions.
- C. Underground Utilities and Collier County Damage Prevention Policy:
  - 1. This policy has been put in place to avoid damage to Collier County underground utilities. A minimum distance of five feet (5') horizontally and eighteen inches (18") vertically must be maintained away from Collier County utilities. Any and all variations from this order must be the Water or Wastewater Department.
  - 2. Before commencement of any excavation at road crossings or any boring or any drilling, the contractor shall mark the proposed run alignment with white paint or flags. Subsequent to placement of the white markings, the existing underground utilities in the area affected by the work must be marked by Sunshine One Call after proper notification to them by either calling 811 in Florida or toll free at 1-800-432-4770. Visit <u>www.callsunshine.com</u> for more information. Before commencing excavation for the work, potholing of all potential conflicts must be performed.
  - 3. All lines in conflict must be physically located by the contractor and verified by Collier County Locate Department personnel before performing work. Utilities under concrete or pavement may require soft dig vacuum locates which also is the contractor's responsibility to perform. All utilities will be field marked per Sunshine State One Call's statutes and guidelines. For line verification or any

other information concerning locates, please call the Locate Department at 239-252-5922 during normal business hours. For line verification or emergency locates after hours, call emergency numeric pager at 239-890-0809. In the event the potholing and/or vacuum soft dig does not locate the marked utility, work must be stopped and the affected utility owner contacted. Failure to comply with this policy and obtain required signature(s) may result in delay or denial of permit.

- 4. The contractor must comply with all provisions of Florida Statute 556, the Underground Facility Damage Prevention and Safety Act.
- D. Quality and Quantity: Make any other investigations and determinations necessary to determine the quality and quantities of earth and rock and the methods to be used to excavate these materials.

## PART 2 PRODUCTS

Not Used

- PART 3 EXECUTION
- 3.1 GENERAL
  - A. Clearing: Clear opencut excavation sites of obstructions preparatory to excavation. Clearing in accordance with Section 017416, includes removal and disposal of vegetation, trees, stumps, roots and bushes, except those specified to be protected during trench excavation.
  - B. Banks: Shore or slope banks to the angle of repose to prevent slides or cave-ins in accordance with Section 314000.
  - C. Safety: Whenever an excavation site or trench is left unattended by the CONTRACTOR or when an area is not within 100 feet of observation by the CONTRACTOR, the excavation site or trench shall be filled and/or, at the County's Manager or designee discretion, protected by other means to prevent accidental or unauthorized entry. Include barricades and other protection devices requested by the ENGINEER or County Manager or designee, including temporary fencing, snow fencing, or temporary "structure" tape. Such safety items shall not relieve the CONTRACTOR of any site safety requirements or liabilities established by Federal, State and local laws and agencies, including OSHA, but is intended as additional safety measures to protect the general public.
  - D. Hazardous Materials: If encountered, take care of hazardous materials not specifically shown or noted in accordance with Section 015000.

E. During excavation and any site work, take storm water pollution prevention measures to ensure that water quality criteria are not violated in the receiving water body and all state and local regulatory requirements are met.

# 3.2 STRUCTURE EXCAVATION

- A. Excavation Size: Provide excavations of sufficient size and only of sufficient size to permit the Work to be economically and properly constructed in the manner and of the size specified.
- B. Excavation Shape: Shape and dimension the bottom of the excavation in earth or rock to the shape and dimensions of the underside of the structure or drainage blanket wherever the nature of the excavated material permits.
- C. Compaction: Before placing foundation slabs, footings or backfill, proof roll the bottom of the excavations to detect soft spots.
  - 1. For accessible areas, proof roll with a ten wheel tandem axle dump truck loaded to at least 15 tons or similarly loaded construction equipment.
  - 2. For small areas, proof roll with a smooth-faced steel roller filled with water or sand, or compact with a mechanical tamper.
  - 3. Make one complete coverage, with overlap, of the area.
  - 4. Overexcavate soft zones and replace with compacted select fill.

## 3.3 TRENCH EXCAVATION

- A. Preparation: Properly brace and protect trees, shrubs, poles and other structures which are to be preserved. Unless shown or specified otherwise, preserve all trees and large shrubs. Hold damage to the root structure to a minimum. Small shrubs may be preserved or replaced with equivalent specimens.
- B. Adequate Space: Keep the width of trenches to a minimum, however provide adequate space for workers to place, joint and backfill the pipe properly.
  - 1. The minimum width of the trench shall be equal to at least 3.5 feet or the outside diameter of the pipe at the joint plus 8-inches for unsheeted trench or 12 inches for sheeted trench, whichever is greater. Conform the trench walls to OSHA Regulations.
  - 2. In sheeted trenches, measure the clear width of the trench at the level of the top of the pipe to the inside of the sheeting.
- C. Depth:

- 1. Excavate trenches to a minimum depth of 8 inches, but not more than 12 inches, below the bottom of the pipe so that bedding material can be placed in the bottom of the trench and shaped to provide a continuous, firm bearing for pipe barrels and bells.
- 2. Standard trench grade shall be defined as the bottom surface of the utility to be constructed or placed within the trench. Trench grade for utilities in rock or other non-cushioning material shall be defined as additional undercuts backfilled with crushed stone compacted in 6-inch lifts, below the standard 8-inches minimum trench undercut. Backfill excavation below trench grade not ordered in writing by the ENGINEER with acceptable Class I, II or III embedment material to trench grade and compact to density equal to native soil.
- D. Unstable or Unsuitable Materials: If unstable or unsuitable material is exposed at the level of the bottom of the trench excavation, excavate the material in accordance with the subsection headed "Authorized Additional Excavation".
  - 1. Remove material for the full width of the trench and to the depth required to reach suitable foundation material.
  - 2. When in the judgment of the ENGINEER the unstable or unsuitable material extends to an excessive depth, the ENGINEER may advise, in writing, the need for stabilization of the trench bottom with additional select fill material, crushed stone, washed shell, gravel mat or the need to provide firm support for the pipe or electrical duct by other suitable methods.
  - 3. Crushed stone, washed shell and gravel shall be as specified in Section 312323.
  - 4. Payment for such trench stabilization will be made under the appropriate Contract Items or where no such items exist, as a change in the Work.
- E. Length of Excavation: Keep the open excavated trench preceding the pipe laying operation and the unfilled trench, with pipe in place, to a minimum length which causes the least disturbance. Provide ladders for a means of exit from the trench as required by applicable safety and health regulations.
- F. Excavated Material: Neatly deposit excavated material to be used for backfill at the sides of the trenches where space is available. Where stockpiling of excavated material is required, obtain the sites to be used and maintain operations to provide for natural drainage and not present an unsightly appearance.
- G. Water: Allow no water to rise in the trench excavation until sufficient backfill has been placed to prevent pipe flotation. Provide trench dewatering in accordance with Section 312319.

#### 3.4 EXCAVATION FOR JACKING AND AUGERING

A. Jacking and Augering Requirements: Allow adequate length in jacking pits to provide room for the jacking frame, the jacking head, the reaction blocks, the jacks, auger rig, and the jacking pipe. Provide sufficient pit width to allow ample working space on each side of the jacking frame. Allow sufficient pit depth such that the invert of the pipe, when placed on the guide frame, will be at the elevation desired for the completed line. Tightly sheet the pit and keep it dry at all times.

#### 3.5 ROCK EXCAVATION

- A. Rock Excavation: Excavate rock within the boundary lines and grades as shown, specified or required.
  - 1. Rock removed from the excavation becomes the property of the CONTRACTOR. Transport and dispose of excavated rock at an off site disposal location. Obtain the off site disposal location.
  - 2. Remove all shattered rock and loose pieces.
- B. Structure Depths: For cast-in-place structures, excavate the rock only to the bottom of the structure, foundation slab, or drainage blanket.
- C. Trench Width: Maintain a minimum clear width of the trench at the level of the top of the pipe of the outside diameter of the pipe barrel plus 2 feet, unless otherwise approved.
- D. Trench Depth: For trench excavation, in which pipelines are to be placed, excavate the rock to a minimum depth of 8 inches below the bottom of the pipe or duct encasement. Provide a cushion of sand or suitable crushed rock. Refill the excavated space with pipe bedding material in accordance with Section 312323. Include placing, compacting and shaping pipe bedding material in the appropriate Contract Items.
- E. Manhole Depths: For manhole excavation, excavate the rock to a minimum depth of 8 inches below the bottom of the manhole base for pipelines 24 inches in diameter and larger and 6 inches below the bottom manhole base for pipelines less than 24 inches in diameter. Refill the excavated space with pipe bedding material in accordance with Section 312323. Include placing, compacting and shaping pipe bedding material for manhole bases in the appropriate Contract Items.
- F. Over-excavated Space: Refill the excavated space in rock below structures, pipelines, conduits and manholes, which exceeds the specified depths with 2,500 psi concrete, crushed stone, washed shell, or other material as directed. Include refilling of over-excavated space in rock as part of the rock excavation.

- G. Other Requirements: Follow, where applicable, the requirements of the subsections on "Trench Excavation" and "Structure Excavation".
- H. Payment: No additional payment will be made for rock excavation.
- 3.6 FINISHED EXCAVATION
  - A. Finish: Provide a reasonably smooth finished surface for all excavations, which is uniformly compacted and free from irregular surface changes.
  - B. Finish Methods: Provide a degree of finish that is ordinarily obtainable from bladegrade operations and in accordance with Section 312323.
- 3.7 PROTECTION
  - A. Traffic and Erosion: Protect newly graded areas from traffic and from erosion.
  - B. Repair: Repair any settlement or washing away that may occur from any cause, prior to acceptance. Re-establish grades to the required elevations and slopes.
  - C. It shall be the CONTRACTOR's responsibility to acquaint himself with all existing conditions and to locate all structures and utilities along the proposed utility alignment in order to avoid conflicts. Where actual conflicts are unavoidable, coordinate work with the facility owner and perform work so as to cause as little interference as possible with the service rendered by the facility disturbed in accordance with Section 020500. Repair and/or replace facilities or structures damaged in the prosecution of the work immediately, in conformance with current standard practices of the industry, or according to the direction of the owner of such facility, at the CONTRACTOR's expense.
  - D. Other Requirements: Conduct all Work in accordance with the environmental protection requirements specified in Division 1.

#### 3.8 AUTHORIZED ADDITIONAL EXCAVATION

- A. Additional Excavation: Carry the excavation to such additional depth and width as authorized in writing, for the following reasons:
  - 1. In case the materials encountered at the elevations shown are not suitable.
  - 2. In case it is found desirable or necessary to go to an additional depth, or to an additional depth and width.
- B. Refill Materials: Refill such excavated space with either authorized 2500 psi concrete or compacted select fill material, in compliance with the applicable provisions of Section 312323.

- C. Compaction: Compact fill materials to avoid future settlement. As a minimum, backfill layers shall not exceed 6-inches in thickness for the full trench width and compaction shall equal 95% of maximum density, or 98% if under paved area of roadway, as determined by using ASTM D 1557. Perform compaction density tests at all such backfill areas with spacing not to exceed 100 feet apart and on each 6-inch compacted layer.
- D. Payment: Additional earth excavations so authorized and concrete or select fill materials authorized for filling such additional excavation and compaction of select fill materials will be paid for under the appropriate Contract Items or where no such items exist, as a change in the Work.

## 3.9 UNAUTHORIZED EXCAVATION

- A. Stability: Refill any excavation carried beyond or below the lines and grades shown, except as specified in the subsection headed "Authorized Additional Excavation", with such material and in such manner as may be approved in order to provide for the stability of the various structures.
- B. Refill Materials: Refill spaces beneath all manholes, structures, pipelines, or conduits excavated without authority with 2500 psi concrete or compacted select fill material, as approved.
- C. Payment: Refill for unauthorized excavation will not be measured and no payment will be made therefor.

## 3.10 SEGREGATION STORAGE AND DISPOSAL OF MATERIAL

- A. Stockpiling Suitable Materials: Stockpile topsoil suitable for final grading and landscaping and excavated material suitable for backfilling or embankments separately on the site in approved locations.
- B. Stockpile Locations: Store excavated and other material a sufficient distance away from the edge of any excavation to prevent its falling or sliding back into the excavation and to prevent collapse of the wall of the excavation. Provide not less than 2 feet clear space between the top of any stockpile and other material and the edge of any excavation.
- C. Excess Materials: Be responsible for transport and disposal of surplus excavated material and excavated material unsuitable for backfilling or embankments at an off site disposal location secured by the CONTRACTOR.

#### 3.11 REMOVAL OF WATER

A. Water Removal: At all times during the excavation period and until completion and acceptance of the WORK at final inspection, provide ample means and equipment with which to remove promptly and dispose of properly all water entering any excavation or other parts of the WORK.

- B. Dry Excavations: Keep the excavation dry, in accordance with Section 312319.
- C. Water Contact: Allow no water to rise over or come in contact with masonry and concrete until the concrete and mortar have attained a set and, in any event, not sooner than 12 hours after placing the masonry or concrete.
- D. Discharge of Water: Dispose of water pumped or drained from the Work in a safe and suitable manner without damage to adjacent property or streets or to other work under construction.
- E. Protection: Provide adequate protection for water discharged onto streets. Protect the street surface at the point of discharge.
- F. Sanitary Sewers: Discharge no water into sanitary sewers.
- G. Storm Sewers: Discharge no water containing settleable solids into storm sewers.
- H. Repair: Promptly repair any and all damage caused by dewatering the Work.

END OF SECTION

# NO TEXT FOR THIS PAGE

## SECTION 312319

## GROUNDWATER CONTROL FOR OPEN CUT EXCAVATION

#### PART 1 GENERAL

## 1.1 DESCRIPTION OF REQUIREMENTS

A. This section provides for furnishing all permits, labor, materials, equipment, power and incidentals for performing all operations necessary to dewater, depressurize, drain and maintain excavations as described herein and as necessary for installation of pipeline and appurtenances. Included are installing, maintaining, operating and removing dewatering systems and other approved devices for the control of surface and groundwater during the construction of pipelines and appurtenances, open cut excavations, directional drilling. Included also are protecting work against rising waters and repair of any resulting damage.

## 1.2 CONTRACTOR'S RESPONSIBILITY

- A. It is the sole responsibility of the CONTRACTOR to identify groundwater conditions and to provide any and all labor, material, equipment, techniques and methods to lower, control and handle the groundwater as necessary for his construction methods and to monitor the effectiveness of this installed system and its effect on adjacent facilities.
- B. Operate, maintain and modify the system(s) as required to conform to these Specifications. Upon completion of the Construction, remove the system(s). The development, drilling and abandonment of all wells used in the dewatering system shall comply with regulations of the Florida Department of Environmental Protection and the governing Water Management District.
- C. Assume sole responsibility for dewatering systems and for all loss or damage resulting from partial or complete failure of protective measures and any settlement or resultant damage caused by the dewatering operation.

#### 1.3 PLANS AND OTHER DATA TO BE SUBMITTED

- A. Prior to commencement of work, submit complete drawings, details and layouts showing the proposed dewatering plans in sufficient detail (i.e., general arrangements, procedures to be used, etc.) so as to allow the ENGINEER to evaluate the proposed dewatering systems. Include the following, as required by the CONTRACTOR's proposed operation:
  - 1. Names of equipment suppliers.
  - 2. Names of installation subcontractors.

- 3. Plan for dewatering at access shafts and control of surface drainage.
- 4. Plan for dewatering for cut-and-cover excavations, or otherwise controlling groundwater.
- 5. Eductor system layout and details.
- 6. Deep well locations and details.
- 7. Well point system layout and details.
- 8. Installation reports for eductors, deep wells and well points.
- 9. Water level readings from piezometers or observation wells, and method of maintenance.
- 10. As part of his request for approval of a dewatering system, demonstrate the adequacy of the proposed system and well point filler sand by means of a test installation.

## PART 2 PRODUCTS

A. Select equipment including but not limited to pumps, eductors, well points and piping and other material desired.

## PART 3 EXECUTION

## 3.1 DEWATERING EXCAVATIONS

- A. Obtain all permits necessary for dewatering operations and file a copy of all such permits with the County Manager or designee and ENGINEER.
- B. Furnish, install, operate and maintain all necessary equipment for dewatering the various parts of the Work and for maintaining free of water the excavations and such other parts of the Work as required for Construction operations. Dewatering system should provide for continuous operation including nights, weekends, holidays, etc. Provide appropriate backup if electrical power is primary energy source for dewatering system.
- C. Continue dewatering in all required areas, until the involved work is completed, including the placing and compaction of backfill materials.
- D. Provide a uniform diameter for each pipe drain run constructed for dewatering. Remove the pipe drain when it has served its purpose. If removal of the pipe is impractical, provide grout connections at 50-foot intervals, and fill the pipe with clay grout or cement and sand grout when the pipe has served its purpose.

# 3.2 DEWATERING TRENCH

- A. Dewatering Excavation Plan: Develop an excavation dewatering plan that considers site ground and groundwater conditions, the type and arrangement of the equipment to be used and the proper method of groundwater disposal. Prepare the dewatering plan before beginning excavations below groundwater. Maintain one copy of the dewatering plan at the project site to be available for inspection while all dewatering operations are underway.
- B. Do not lay any pipeline in a trench in the presence of water. Remove all water from the trench sufficiently ahead of the pipeline placing operation. The ENGINEER shall have full and final authority to require dewatering of the trench to ensure a dry, firm bed on which to place the pipeline. As a minimum, maintain water levels at least 6 inches below the bottom of the trench. Continue to dewater trench until trench backfilling operations have been completed.
  - 1. If a dry trench bottom has not been obtained with usual methods of trench dewatering, then the order to excavate below grade and place sufficient select fill material, crushed stone, or 2500 psi concrete over the trench bottom may be given.
  - 2. If all efforts fail to obtain a stable dry trench bottom, and it is determined that the trench bottom is unsuitable for pipe foundation, present an alternate system for stabilization to the Engineer of Record for approval by the County Manager or designee on a case-by-case basis.
- C. Removal of water may be accomplished by pumping in connection with well point installation as the particular situation may warrant.
- D. If the soils encountered at the trench grade are suitable for the passage of water, without destroying the sides or utility foundation of the trench, sumps may be provided at intervals at the side of the main trench excavation. Use pumps to lower the water level by taking their suction from said sumps.

## 3.3 REQUIREMENTS FOR EDUCTOR, WELL POINTS OR DEEP WELLS

- A. Eductor, well points or deep wells, where used, must be furnished, installed and operated by a reputable CONTRACTOR regularly engaged in this business, and approved.
- 3.4 DURATION OF DRAINAGE
  - A. In areas where concrete is to be placed, carry out the foundation drainage so that the required lowering of the water table will be effected prior to placing reinforcing steel. Keep foundation beds free from water to the same levels for 3 days after placing concrete.

# 3.5 PROTECTION OF STRUCTURES

- A. Provide adequate protection for all structures to avoid damage to concrete.
- B. Operate construction equipment over completed concrete slabs or structures only with approval. Rubber tire equipment heavier than 5 tons and crawlers heavier than 7 tons will require adequate load spreading by sand fill or other means.

## 3.6 DISCHARGE OF WATER

- A. Do not discharge pumped drainage water into the sanitary sewer system or inhibit pedestrian or vehicular traffic with the groundwater control system.
- B. Discharge pumped drainage water into the storm sewer system or drainage ditch by direct means (i.e., discharge hose to inlet, burying header, etc.). Monitor the discharged water to determine that soil particles are not being removed.
- C. Conform all discharge to current South Florida Water Management District and Collier County Department of Stormwater Management rules, regulations, procedures and regulatory permits and if discharged into receiving waters, shall not exceed 29 N.T.U.'s above background.

## 3.7 REPAIR OF DAMAGE

A. Assume full responsibility for all loss and damage due to flooding, rising water or seepage resulting from dewatering operations in any part of the work. Repair any damage to partially completed work from these or other causes, including the removal of slides, repair of foundation beds and performance of any other work necessitated by lack of adequate dewatering or drainage facilities.

# END OF SECTION

## SECTION 312323

#### BACKFILLING

#### PART 1 GENERAL

#### 1.1 SUMMARY

- A. General Requirements: Backfill all excavation to the original surface of the ground or to such other grades as may be shown or required. For areas to be covered by topsoil, leave or stop backfill (12) inches below the finished grade. Obtain approval for the time elapsing before backfilling against masonry structures. Remove from all backfill, any compressible, putrescible, or destructible rubbish and refuse and all lumber and braces from the excavated space before backfilling is started. Leave sheeting and bracing in place or remove as the work progresses.
- B. Equipment Limitations: Do not permit construction equipment used to backfill to travel against and over cast-in-place concrete structures until the specified concrete strength has been obtained, as verified by concrete test cylinders. In special cases where conditions warrant, the above restriction may be modified providing the concrete has gained sufficient strength, as determined from test cylinders, to satisfy design requirements for the removal of forms and the application of load.
- C. Related Work Specified In Other Sections Includes:
  - 1. Section 017416 Site Clearing
  - 2. Section 312316 Excavation Earth and Rock

#### 1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
  - 1. ASTM D 1557 Standard Test Methods for Moisture-Density Relations of Soil and Soil-Aggregate Mixtures Using 10 lb Rammer and 18 in Drop

#### PART 2 PRODUCTS

- 2.1 BACKFILL MATERIAL GENERAL
  - A. General: Refer to Utilities Standards and Procedures Ordinance Section 9.1.2 for laying and backfilling requirements. Backfill with sound materials, free from waste, organic matter, rubbish, boggy or other unsuitable materials. Acceptable backfill shall not contain rocks or stones larger than 2 inches in size.

COLLIER COUNTY TECHNICAL SPECIFICATIONS

- B. General Materials Requirements: Conform materials used for backfilling to the requirements specified. Follow common fill requirements whenever drainage or select fill is not specified. Determine and obtain the approval of the appropriate test method where more than one compaction test method is specified.
- C. Classification of Approved Embedment Materials: Embedment materials listed here include a number of processed materials plus the soil types defined according to the Unified Soil Classification System (USCS) in ASTM D2487. These materials are grouped into 5 broad categories according to their suitability for this application.
  - 1. Class I: Angular, 0.25 inch to 1.5 inch (6 to 40 mm) graded stone, including a number of fill materials that have regional significance such as coral, slag, cinders, crushed shells and crushed stone. (Note: The size range and resulting high void ratio of Class I material makes it suitable for use to dewater trenches during pipe installation. This permeable characteristic dictates that its use be limited to locations where pipe support will not be lost by migration of fine grained natural material from the trench walls and bottom or migration is possible, the material's minimum size range should be reduced to finer than 0.25 inch (6 mm) and the gradation properly designed to limit the size of the voids. An alternative to modifying the gradation is to use a geotextile fabric as a barrier to migration to fines.)
  - 2. Class II: Coarse sands and gravels with maximum particle size of 1.5 inches (40 mm), including variously graded sands and gravels containing small percentages of fines, generally granular and non-cohesive, either wet or dry. Soil Types GW, GP, SW and SP are included in this class. (Note: Sands and gravels, which are clean or borderline between clean and with fines, should be included. Coarse-grained soils with less than 12 percent, but more than 5 percent fines are neglected in ASTM D2487 and the USCS, but should be included. The gradation of Class II material influences its density and pipe support strength when loosely placed. The gradation of Class II material may be critical to the pipe support and stability of the foundation and embedment, if the material is imported and is not native to the trench excavation. A gradation other than well graded, such as uniformly graded or gap graded, may permit loss of support by migration into void spaces of a finer grained natural material from the trench wall and bottom. An alternative to modifying the gradation is to use a geotextile fabric as a barrier to migration of fines.)
  - 3. Class III: Fine sand and clayey (clay filled) gravels, including fine sands, sand-clay mixtures and gravel-clay mixtures. Soil Types GM, GC, SM and SC are included in this class.

- 4. Class IV: Silt, silty clays and clays, including inorganic clays and silts of medium to high plasticity and liquid limits. Soil Types MH, ML, CH and CL are included in this class. (Note: Use caution in the design and selection of the degree and method of compaction for Class IV soils because of the difficulty in properly controlling the moisture content under field conditions. Some Class IV soils with medium to high plasticity and with liquid limits greater than 50 percent (CH, MH, CH-MH) exhibit reduced strength when wet and should only be used for bedding, haunching and initial backfill in arid locations where the pipe embedment will not be saturated by groundwater, rainfall or exfiltration from the pipe. Class IV soils with low to medium plasticity and with liquid limits lower than 50 percent (CL, ML, CL-ML) also require careful consideration in design and installation to control moisture content, but need not be restricted in use to arid locations.)
- 5. Class V: This class includes the organic soils OL, OH and PT as well as soils containing frozen earth, debris, rocks larger than 1.5 inches (40 mm) in diameter and other foreign materials. Do not use these materials for bedding, haunching or backfill.
- 2.2 SELECT FILL
  - A. Materials for Select Fill: Use clean gravel, crushed stone, washed shell, or other granular or similar material as approved which can be readily and thoroughly compacted to 95 percent of the maximum dry density obtainable by ASTM D 1557.

1.	Allowed Materials:	Grade select fill between the following lim	nits:
		5	

U.S. Standard	Percent Passing	
Sieve	By Weight	
2 inch	100	
1-1/2 inch	90-100	
1 inch	75-95	
1/2 inch	45-70	
#4	25-50	
#10	15-40	
#200	5-15	

2. Unallowed Materials: Very fine sand, uniformly graded sands and gravels, sand and silt, soft earth, or other materials that have a tendency to flow under pressure when wet are unacceptable as select fill.

## 2.3 COMMON FILL

- A. Materials for Common Fill: Material from on-site excavation may be used as common fill provided that it can be readily compacted to 90 percent of the maximum dry density obtainable by ASTM D 1557, and does not contain unsuitable material. Select fill may be used as common fill at no change in the Contract Price.
- B. Granular Materials On-Site: Granular on-site material, which is fairly well graded between the following limits may be used as granular common fill:

U.S. Standard	Percent Passing
Sieve	by Weight
2 inch	100
#10	50-100
#60	20-90
#200	0-20

- C. Cohesive Materials On-Site: Cohesive site material may be used as common fill.
  - 1. The gradation requirements do not apply to cohesive common fill.
  - 2. Use material having a liquid limit less than or equal to 40 and a plasticity index less than or equal to 20.
- D. Material Approval: All material used as common fill is subject to approval. If there is insufficient on-site material, import whatever additional off-site material is required which conforms to the specifications and at no additional cost.

## 2.4 UTILITY PIPE BEDDING

- A. Gradation for Small Piping: For pipe 18 inches or less in diameter, use pipe bedding of material 90 percent of which will be retained on a No. 8 sieve and 100 percent of which will pass a 1/2-inch sieve and be well graded between those limits.
- B. Gradation for Large Piping: For pipe larger than 18 inches in diameter, use the same pipe bedding material as specified for smaller pipe or use a similar well graded material 90 percent of which will be retained on a No. 8 sieve and 100 percent of which will pass a 1-inch sieve.
- Provide a minimum of six (6) inches bedding material under all gravity sewer piping. In areas where poor soil conditions or rock exist, provide a minimum of six (6) inches of pipe bedding material under water or force main pressure pipe.

## PART 3 EXECUTION

#### 3.1 PRECAST MANHOLE BEDDING

- A. Bedding Compaction: Bed all precast manholes in well graded, compacted 12inch layer of crushed stone. Compact bedding thickness no less than 6 inches for precast concrete manhole bases.
- B. Concrete Work Mats: Cast cast-in-place manhole bases and other foundations for structures against a 2500 psi concrete work mat in clean and dry excavations.
- C. Bedding Placement: Place select fill used for bedding beneath precast manhole bases, in uniform layers not greater than 9 inches in loose thickness. Thoroughly compact in place with suitable mechanical or pneumatic tools to not less than 95 percent of the maximum dry density as determined by ASTM D 1557.
- D. Use of Select Fill: Bed existing underground structures, tunnels, conduits and pipes crossing the excavation with compacted select fill material. Place bedding material under and around each existing underground structure, tunnel, conduit or pipe and extend underneath and on each side to a distance equal to the depth of the trench below the structure, tunnel, conduit or pipe.

#### 3.2 PIPE BEDDING AND INITIAL BACKFILL

- A. Placement: Place backfill for initial pipe backfill from top of bedding to 1 foot over top of pipes in uniform layers not greater than 8 inches in loose thickness. Tamp under pipe haunches and thoroughly compact in place the backfill with suitable mechanical or pneumatic tools to not less than 98 percent of the maximum dry density as determined by ASTM D 1557.
- B. Foundation Bedding: Place bedding, to a depth specified by the County Manager or designee, as a foundation in wet, yielding or mucky locations. Construct foundation bedding by removal of the wet, yielding or mucky material and replacement with sufficient Class I material to correct soil instability.
- C. Stone Placement: Do not place large stone fragments in the pipe bedding or backfill within 2 feet over or around pipelines, or nearer than 2 feet at any point from any casing pipe, conduit or concrete wall.
- D. Machine Compaction: Machine Compaction of initial backfill is prohibited unless adequate cover as deemed by the County Manager or designee is provided. In no case shall adequate cover be less than 12 inches.
- E. Unallowed Materials: Pipe bedding containing very fine sand, uniformly graded sands and gravels, sand and silt, soft earth, or other materials that have a tendency to flow under pressure when wet is unacceptable.

## 3.3 TRENCH BACKFILL

- A. General: Backfill trenches from 1 foot over the top of the pipe, from the top of electrical duct bedding or as shown to the bottom of pavement base course, subgrade for lawns or lawn replacement, to the top of the existing ground surface or to such other grades as may be shown or required.
- B. Materials: All backfill material shall be acceptable dry materials, and shall be free from cinders, ashes, refuse, vegetable or organic material, boulders, rocks, or stones, or other deleterious material which in the opinion of the County Manager or designee is unsuitable.
- C. Depth of Placement Place trench backfill in uniform layers not greater than 12 inches in loose thickness and that can be thoroughly compacted in place using suitable mechanical or pneumatic equipment to not less than 98 percent of the maximum dry density as determined by ASTM D 1557.
- D. Depth of Placement Undeveloped Areas: In nondeveloped areas and where select fill material or hand-placed backfill are not specified or required, place suitable job-excavated material or other approved backfill in lifts not exceeding 12 inches in loose thickness. Lifts of greater thickness may be permitted by the County Manager or designee if the CONTRACTOR demonstrates compliance with required densities. When the trench is full, consolidate the backfill by jetting, spading, or tamping to ensure complete filling of the excavation. Mound the top of the trench approximately 12 inches to allow for consolidation of backfill.
- E. Compaction: Compact backfill as a percentage of the maximum density at optimum moisture content as determined by the standard proctor test, ASTM D698 as demonstrated in the following table:

Area	(Mod.) ASTM D1557
Around and 1' (Min) above top of pipe	98
Remaining Trench	98
Pavement Sub-Grade and Shoulders (Last 3' of Fill)	98
Base Material and Pavement	98
Adjacent to Structures (Areas not Paved)	98
Under Structures	98
Sub-Base	98

- F. Density Tests: Density tests will be made at the request of the County Manager or designee. Deficiencies will be corrected at the expense of the CONTRACTOR.
- G. Dropping of Material on Work: Do trench backfilling work in such a way as to prevent dropping material directly on top of any conduit or pipe through any great vertical distance.

H. Distribution of Large Materials: Break lumps up and distribute any stones, pieces of crushed rock or lumps which cannot be readily broken up, throughout the mass so that all interstices are solidly filled with fine material.

## 3.4 STRUCTURE BACKFILL

- A. Use crushed stone underneath all structures, and adjacent to structures where pipes, connections and structural foundations are to be located within this fill. Use crushed stone beneath all pavements, walkways, and railroad tracks, and extend to the bottom of pavement base course or ballast.
  - 1. Place backfill in uniform layers not greater than 8 inches in loose thickness and thoroughly compact in place with suitable approved mechanical or pneumatic equipment.
  - 2. Compact backfill to not less than 95 percent of the maximum dry density as determined by ASTM D 1557.
- B. Use of Common Fill: Use common granular fill adjacent to structures in all areas not specified above. Select fill may be used in place of common granular fill at no additional cost.
  - 1. Extend such backfill from the bottom of the excavation or top of bedding to the bottom of subgrade for lawns or lawn replacement, the top of previously existing ground surface or to such other grades as may be shown or required.
  - 2. Place backfill in uniform layers not greater than 8 inches in loose thickness and thoroughly compact in place with suitable equipment, as specified above.
  - 3. Compact backfill to not less than 90 percent of the maximum dry density as determined by ASTM D 1557.

#### 3.5 COMPACTION EQUIPMENT

- A. Equipment and Methods: Carry out all compaction with suitable approved equipment and methods.
  - 1. Compact clay and other cohesive material with sheep's-foot rollers or similar equipment where practicable. Use hand held pneumatic tampers elsewhere for compaction of cohesive fill material.
  - 2. Compact low cohesive soils with pneumatic-tire rollers or large vibratory equipment where practicable. Use small vibratory equipment elsewhere for compaction of cohesionless fill material.

3. Do not use heavy compaction equipment over pipelines or other structures, unless the depth of fill is sufficient to adequately distribute the load.

## 3.6 FINISH GRADING

- A. Final Contours: Perform finish grading in accordance with the completed contour elevations and grades shown and blend into conformation with remaining natural ground surfaces.
  - 1. Leave all finished grading surfaces smooth and firm to drain.
  - 2. Bring finish grades to elevations within plus or minus 0.10 foot of elevations or contours shown.
- B. Surface Drainage: Perform grading outside of building or structure lines in a manner to prevent accumulation of water within the area. Where necessary or where shown, extend finish grading to ensure that water will be carried to drainage ditches, and the site area left smooth and free from depressions holding water.

## 3.7 RESPONSIBILITY FOR AFTERSETTLEMENT

A. Aftersettlement Responsibility: Take responsibility for correcting any depression which may develop in backfilled areas from settlement within one year after the work is fully completed. Provide, as needed, backfill material, pavement base replacement, permanent pavement, sidewalk, curb and driveway repair or replacement, and lawn replacement, and perform the necessary reconditioning and restoration work to bring such depressed areas to proper grade as approved.

#### 3.8 INSPECTION AND TESTING OF BACKFILLING

- A. Sampling and Testing: Provide sampling, testing, and laboratory methods in accordance with the appropriate ASTM Standard Specification. Subject all backfill to these tests.
- B. Correction of Work: Correct any areas of unsatisfactory compaction by removal and replacement, or by scarifying, aerating or sprinkling as needed and recompaction in place prior to placement of a new lift.
- C. Testing Schedule:
  - 1. Compaction Schedule
  - 2. Optimum Moisture Content (Proctor Test)

END OF SECTION

## **SECTION 314000**

## SHORING, SHEETING AND BRACING

#### PART 1 GENERAL

#### 1.1 SUMMARY

- A. Section Includes: Work required for protection of an excavation or structure through shoring, sheeting, and bracing.
- B. Related Work Specified In Other Sections Includes:
  - 1. Section 312316 Excavation Earth and Rock
  - 2. Section 312323 Backfilling

#### 1.2 SUBMITTALS

- A. General: Provide all submittals, including the following, as specified in Division 1.
- B. CONTRACTOR's Submittals: All sheeting and bracing shall be the responsibility of the CONTRACTOR to retain qualified design services for these systems, and to be completed with strict adherence to OSHA Regulations. Submit complete design calculations and working drawings of proposed shoring, sheeting and bracing which have been prepared, signed and sealed by a Licensed Professional Engineer experienced in Structural Engineering and registered in the State of Florida, before starting excavation for jacking pits and structures. Use the soil pressure diagram shown for shoring, sheeting and bracing design. ENGINEER's review of calculations and working drawings will be limited to confirming that the design was prepared by a licensed professional engineer and that the soil pressure diagram shown was used.

#### 1.3 REFERENCES

- A. Design: Comply with all Federal and State laws and regulations applying to the design and construction of shoring, sheeting and bracing.
- B. N.B.S. Building Science Series 127 "Recommended Technical Provisions for Construction Practice in Shoring and Sloping Trenches and Excavations."

#### 1.4 QUALITY ASSURANCE

A. Regulatory Requirements: Do work in accordance with the U.S. Department of Labor Safety and Health Regulations for construction promulgated under the Occupational Safety Act of 1970 (PL 91-596) and under Section 107 of the Contract Work Hours and Safety Standards Act (PL 91-54), and the Florida Trench Safety Act. Observe 29 CFR 1910.46 OSHA regulations for Confined Space Entry.

#### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS AND MATERIALS

- A. Material Recommendations: Use manufacturers and materials for shoring, sheeting and bracing as recommended by the Licensed Professional Engineer who designed the shoring, sheeting, and bracing.
  - 1. Wood Materials: Oak, or treated fir or pine for wood lagging.

## PART 3 EXECUTION

#### 3.1 SHORING, SHEETING AND BRACING INSTALLATION

- A. General: Provide safe working conditions, to prevent shifting of material, to prevent damage to structures or other work, to avoid delay to the work, all in accordance with applicable safety and health regulations. Properly shore, sheet, and brace all excavations which are not cut back to the proper slope and where shown. Meet the general trenching requirements of the applicable safety and health regulations for the minimum shoring, sheeting and bracing for trench excavations.
  - 1. CONTRACTOR's Responsibility: Sole responsibility for the design, methods of installation, and adequacy of the shoring, sheeting and bracing.
- B. Arrange shoring, sheeting and bracing so as not to place any strain on portions of completed work until the general construction has proceeded far enough to provide ample strength.
- C. If ENGINEER is of the opinion that at any point the shoring, sheeting or bracing are inadequate or unsuited for the purpose, resubmission of design calculations and working drawings for that point may be ordered, taking into consideration the observed field conditions. If the new calculations show the need for additional shoring, sheeting and bracing, it should be installed immediately.
- D. Monitoring: Periodically monitor horizontal and vertical deflections of sheeting. Submit these measurements for review.
- E. Accurately locate all underground utilities and take the required measures necessary to protect them from damage. Keep all underground utilities in service at all times as specified in Division 1.

- F. Driven Sheeting: Drive tight sheet piling in that portion of any excavation in paved or surface streets City collector and arterial streets and in State and County highways below the intersection of a one-on-one slope line from the nearest face of the excavation to the edge of the existing pavement or surface.
- G. Sheeting Depth: In general drive or place sheeting for pipelines to a depth at elevation equal to the top of the pipe as approved.
  - 1. If it is necessary to drive sheeting below that elevation in order to obtain a dry trench or satisfactory working conditions, cut the sheeting off at the top of the pipe and leave in place sheeting below the top of the pipe.
  - 2. Do not cut the sheeting until backfill has been placed and compacted to the top of the pipe.
- H. Sheeting Removal: In general, remove sheeting and bracing above the top of the pipe as the excavation is refilled in a manner to avoid the caving in of the bank or disturbance to adjacent areas or structures. Remove sheeting as backfilling progresses so that the sides are always supported or when removal would not endanger the construction of adjacent structures. When required to eliminate excessive trench width or other damages, shoring or bracing shall be left in place and the top cut off at an elevation 2.5 feet below finished grade, unless otherwise directed.
  - 1. Carefully fill voids left by the withdrawal of the sheeting by jetting, ramming or otherwise.
  - 2. No separate payment will be made for filling of such voids.

END OF SECTION

# NO TEXT FOR THIS PAGE

## SECTION 320117

#### PAVEMENT REPAIR AND RESTORATION

#### PART 1 GENERAL

#### 1.1 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals required and remove and replace pavements over trenches excavated for installation of pipelines as shown on the drawings and/or specified herein.

#### 1.2 GENERAL

- A. Repair all damage, as a result of work under this project, done to existing pavement, driveways, paved areas, curbs and gutters, sidewalks, shrubbery, grass, trees, utility poles, utility pipe lines, conduits, drains, catch basins, or stabilized areas or driveways and including all obstructions not specifically named herein, in a manner satisfactory to the ENGINEER. Include in the bid price, the furnishing of all labor, materials, equipment, and incidentals necessary for the cutting, repair, and restoration of the damaged areas unless pay items for specific types of repair are included in the Bid Form.
- B. Keep the surface of the backfilled area of excavation in a safe condition and level with the remaining pavement until the pavement is restored in the manner specified herein. All surface irregularities that are dangerous or obstructive to traffic are to be removed. Conform the repair to applicable COUNTY or State requirements for pavement repair and as described herein.
- C. The COUNTY reserves the right to require soil bearing or loading tests or materials tests, should the adequacy of the foundation or the quality of materials used be questionable. Costs of these tests shall be the responsibility of the COUNTY, if found acceptable; the costs of all failed tests shall be the responsibility of the CONTRACTOR.
- D. Make all street and road repair in accordance with the details indicated on the drawings and in accordance with the applicable requirements of these Specifications and meeting the permit requirements and approval of the governing Department of Transportation agencies.
- E. Replace pavement or roadway surfaces cut or damaged in equal or better condition than the original, including stabilization, base course, surface course, curb and gutter or other appurtenances. Obtain the necessary permits prior to any roadway work. Provide advance notice to the appropriate authority, as required, prior to construction operations.

- 1. Roadway Restoration (within Collier County Department of Transportation & Engineering jurisdiction): Perform restoration in accordance with the requirements set forth in the "Right-of-Way Utility Construction Activities Policy" and these Standards. Obtain prior approval from Collier County DOT for the materials of construction and method of installation, along with the proposed restoration design for items not referred or specified herein.
  - a. Where existing pavement is to be removed, mechanical saw cut the surface prior to trench excavation, leaving a uniform and straight edge parallel or perpendicular to the roadway centerline with minimum disturbance to the remaining adjacent surfacing. Provide minimal width of cut for this phase of existing pavement removal.
  - b. Immediately following the specified backfilling and compaction, apply a temporary sand seal coat surface to the cut areas. For this temporary surfacing, provide a smooth traffic surface with the existing roadway and maintain until final restoration. Ensure that surfacing remains for a minimum of ten (10) days in order to assure the stability of the backfill under normal traffic conditions. Thirty (30) days following this period and prior to sixty (60) days after application: remove the temporary surfacing and perform final roadway surface restoration.
  - c. In advance of final restoration, remove the temporary surfacing and mechanically saw the existing pavement straight and clean to the stipulated dimensions, if needed. Following the above operation, proceed immediately with final pavement restoration in accordance with the requirements set forth by Collier County Department of Transportation.
  - d. No layer shall be greater than two inches (2") when compacted. Where a surface course is constructed to a thickness greater than two inches (2"), construct it in approximately equal layers, each not exceeding two inches (2").
  - e. Where necessitated by traffic conditions, lay mixture in strips in such manner as to provide for the passage of traffic. Where the road is closed to traffic, mixture may be laid to the full width, by machines traveling in parallel.
- 2. Roadway Restoration (outside Collier County Department of Transportation jurisdiction) Conform work within the rights-of-way of public thoroughfares which are not under jurisdiction of Collier County to the requirements of the Governmental agency having jurisdiction or the Florida Department of Transportation, if no governmental agencies have jurisdiction. Work within State Highway right-of-way shall be in full compliance with all requirements of the permit drawings, and to the satisfaction of the Florida Department of Transportation.

## 1.3 QUALITY ASSURANCE

A. Applicable provisions of the latest version of the Florida Department of Transportation "Standard Specifications for Road and Bridge Construction", and Supplemental Specifications hereunder govern the work under this Section. The Florida Department of Transportation will hereafter be referred to as FDOT.

## PART 2 PRODUCTS

## 2.1 MATERIALS

A. Use materials for flexible base pavement and base course as specified in the latest version of the Florida Department of Transportation "Standard Specifications for Road and Bridge Construction".

## PART 3 EXECUTION

## 3.1 CUTTING PAVEMENT

- A. Cut and remove pavement to straight edges, 6 inches outside each edge of proposed trench to avoid pavement damage during installation of the new pipelines and appurtenances and for making connections to existing pipelines.
- B. Before removing pavement, mark the pavement for cuts nearly paralleling pipelines and existing street lines. Cut asphalt pavement along the markings with a jackhammer, rotary saw, or other suitable tool.
- C. No pavement shall be machine pulled until completely broken and separated along the marked cuts.
- D. The pavement adjacent to pipeline trenches shall neither be disturbed nor damaged. If the adjacent pavement is disturbed or damaged, irrespective of cause, remove the damaged pavement replace it at CONTRACTOR's expense.

#### 3.2 GENERAL RESTORATION

- A. Restore, replace or rebuild existing street paving, driveways, etc., using the same type of construction as was in the original. Be responsible for restoring all such work, including sub-grade and base courses where present. Obtain and pay for such local or other governmental permits as may be necessary for the opening of streets. Meet any requirements other than those herein set forth which may affect the type, quality and manner of carrying on the restoration of surfaces by reason of jurisdiction of such governmental bodies.
- B. In all cases, maintain, without additional compensation, all permanent replacement of street paving, done by him under this Contract until accepted by the County Manager or designee, including the removal and replacement of such

work wherever surface depressions or underlying cavities result from settlement of trench backfill.

- C. Complete all the final resurfacing or re-paving of streets or roads, over the excavations and relay paving surfaces of roadbed that have failed or been damaged prior to acceptance by the County Manager or designee. Conform backfilling of trenches and the preparation of sub-grades to the requirements of Section 312323.
- D. Do all re-paving or resurfacing in accordance with Florida Department of Transportation Specifications, to which the following requirement of trench backfill will be added: Where pipeline construction crosses paved areas such as streets, backfill the top 24 inches of trench below the road bases or concrete slabs with compacted A-4 or better material that will provide a bearing value of not less than 75 when tested by the Florida Department of Transportation Soil Bearing Test Methods.

## 3.3 PRIME AND TACK COATS

A. Apply bituminous prime and tack coats on the previously prepared base course in accordance with Section 300 of the FDOT Specifications.

#### 3.4 WEARING COURSE

A. Use plant-mixed hot bituminous pavement to the thickness indicated in the drawings conforming to Type III asphaltic concrete in accordance with Section 333 of the FDOT Specifications. The requirements for plant and equipment are specified in Section 320 and the general construction requirements for asphaltic concrete pavement are contained in Section 330 of the FDOT specifications.

#### 3.5 TESTING

A. Perform all field-testing at an independent laboratory employed by the COUNTY. Test and certify all materials by the producer. Repeat tests of sub-grade or base not meeting specified compaction at the CONTRACTOR's expense.

#### 3.6 MISCELLANEOUS RESTORATION

A. Restore sidewalks, cut or damaged by construction, in full sections or blocks to a minimum thickness of four inches. Restore concrete curb or curb gutter to the existing height and cross section in full sections or lengths between joints. Concrete shall be as specified on the drawings. Restore grassed yards, shoulders and parkways to match the existing sections with grass seed or sod of a type matching the existing grass.

# 3.7 CLEANUP

A. After all repair and restoration or paving has been completed, remove all excess asphalt, dirt, and other debris from the roadways. Check and clean all existing storm sewers and inlets of any construction debris.

END OF SECTION

# NO TEXT FOR THIS PAGE

## **SECTION 329200**

## RESTORATION BY SODDING OR SEEDING

#### PART 1 GENERAL

#### 1.1 DESCRIPTION OF REQUIREMENTS

A. The work in this section consists of furnishing all labor, material and equipment to restore all areas disturbed during construction to match preconstruction conditions. Establish a stand of grass within the areas disturbed by furnishing and placing grass sod where required, or by seeding and mulching areas not requiring sod.

#### 1.2 REFERENCE DOCUMENTS

- A. Use materials conforming to the requirements of Florida Department of Transportation Standard Specifications for Road and Bridge Construction as follows:
  - 1. Section 570 Grassing (by Seeding)
  - 2. Section 575 Sodding
  - 3. Section 981 Grassing and Sodding Materials
  - 4. Section 982 Commercial Fertilizer
  - 5. Section 983 Water for Grassing

#### 1.3 SUBMITTALS

A. Submit certifications and identification labels for all sodding supplied in accordance with General Conditions.

#### PART 2 PRODUCTS

- 2.1 SODDING
  - A. Types: Sod may be of either St. Augustine or Argentine Bahia grass or as that disturbed, as established prior to construction. Use well matted sod with roots. When replacing sod in areas that are already sodded, use sod of the same type as the existing sod.

- B. Provide sod as required in accordance with Florida Department of Transportation Specifications 575 and 981. Furnish sod equal to and similar in type as that disturbed. Place and water in accordance with FDOT Specifications Section 575.
- C. Use sod in commercial-size rectangles, preferably 12-inch by 24-inch or larger, except where 6-inch strip sodding is called for.
- D. Use sod that is sufficiently thick to secure a dense stand of live grass. Use sod that is live, fresh and uninjured at the time of planting, having a soil mat of sufficient thickness adhering firmly to the roots to withstand all necessary handling. It shall be reasonably free of weeds and other grasses. Plant sod as soon as possible after being dug, and shade and keep moist from the time it is dug until it is planted.
- E. Handle sod in a manner to prevent breaking or other damage. Do not handle by dumping from trucks or other vehicles. Use care at all times to retain the native soil on the roots of each sod roll during stripping and handling. Sod that has been damaged by handling during delivery, storage or installation will be rejected.
- F. Swales: Place sod to the proper grade and cross section in all flow areas to ensure the design flow of water in the ditch. In excavating for the placement of sod, provide a minimum of 3 inches of undercut.

#### 2.2 FERTILIZER

- A. Supply chemical fertilizer in suitable bags with the net weight certification of the shipment. Fertilizer shall be 12-8-8 and comply with Section 982 of the FDOT Standard Specification for Road and Bridge Construction.
- B. The numerical designations for fertilizer indicate the minimum percentages (respectively) of (1) total nitrogen, (2) available phosphoric acid and (3) water soluble potash, contained in the fertilizer.
- C. The chemical designation of the fertilizer shall be 12-8-8, with at least 50 percent of the nitrogen from a nonwater-soluble organic source. The nitrogen source may be a unreaformaldehyde source provided it is not derived from a waste product of the plastic industry.
- 2.3 EQUIPMENT
  - A. Spread fertilizer uniformly at the specified rate.
- 2.4 NETTING
  - A. See County Approved Product List, Appendix F.
# 2.5 SEEDING

- A. Seed all unpaved areas disturbed during construction that do not require sod. Complete all seeding in conformance with FDOT Specifications Sections 570 and 981. Mulch and fertilize the grassed areas shall be mulched and fertilized in accordance with FDOT Specifications.
- B. Provide mulch material free of weeds. Mulch shall be oat straw or rye, Pangola, peanut, Coastal Bermuda, or Bahia grass hay.
- C. All seeds must have been tested within 6 months of planting. Submit a seed bag tag with final payment requests from each type or mixture of seed used.

# 2.6 TOPSOIL

- A. Topsoil stockpiled during excavation may be used. If additional topsoil is required to replace topsoil removed during construction, it shall be obtained off site at no additional cost to the COUNTY. Topsoil shall be fertile, natural surface soil, capable of producing all trees, plants, and grassing specified herein.
- 2.7 MULCH
  - A. Furnish small grain straw mulch. Apply mulch at a rate of 1.5 tons per acre, corresponding to a depth not less than 1-inch or more than 3-inches according to texture and moisture content of mulch material. Apply asphalt emulsion at a rate of 150 gallons per ton of straw to anchor the straw applied.

#### 2.8 WATER

A. It is the CONTRACTOR'S responsibility to supply all water to the site, as required during seeding and sodding operations and through the maintenance period and until the work is accepted. Make whatever arrangements may be necessary to ensure an adequate supply of water to meet the needs for the work. Furnish all necessary hose, equipment, attachments, and accessories for the adequate irrigation of lawns and planted areas as may be required. Water shall be suitable for irrigation and free from ingredients harmful to plant life.

#### 2.9 SOIL IMPROVEMENTS

A. Apply lime at the rate of 1 to 1.5 tons per acre. Apply 10-10-10 commercial fertilizer at the rate of 800 pounds per acre and work well into the top inch of topsoil.

# PART 3 EXECUTION

#### 3.1 SOD BED PREPARATION

- A. Clear areas to be sodded and/or seeded of all rough grass, weeds, and debris, and bring soil to an even grade.
- B. Thoroughly till soil to a minimum 4-inch depth.
- C. Bring area to proper grade, free of sticks, stones, or other foreign matter over 1inch in diameter or dimension. The surface shall conform to finish grade, less the thickness of sod, free of water-retaining depressions, the soil friable and of uniformly firm texture.

#### 3.2 INSPECTION

- A. Verify that soil preparation and related preceding work has been completed.
- B. Do not start work until conditions are satisfactory.
- 3.3 SOD HANDLING AND INSTALLATION
  - A. During delivery, prior to planting, and during the planting of sod areas, protect the sod panels at all times from excessive drying and unnecessary exposure of the roots to the sun. Stack sod during construction and planting so as not to be damaged by sweating or excessive heat and moisture.
  - B. After completion of soil conditioning as specified above, lay sod panels tightly together so as to make a solid sodded lawn area. On mounds and other slopes, the long dimension of the sod shall be laid perpendicular to the slope. Immediately following sod laying, roll the lawn areas with a lawn roller customarily used for such purposes, and then thoroughly water.
  - C. Place sod at all areas where sod existed prior to construction, on slopes of 3 horizontal to 1 vertical (3:1) or greater, in areas where erosion of soils will occur, and as directed by the ENGINEER. On areas where the sod may slide, due to height and slope, the ENGINEER may direct that the sod be pegged, with pegs driven through the sod blocks into firm earth, at suitable intervals.

#### 3.4 USE OF SOD ON ROADWAY PROJECTS

- A. In accordance with the FDOT District One Standard Practice, establish permanent green grass at the completion of roadway construction and maintenance work. The following shall apply to all restoration involving State or County roadways:
  - 1. Use sod in lieu of seed and mulch on all roadways with urban (raised curb) typical sections.

- 2. One inch water per week shall be required for a minimum of four (4) consecutive weeks for the purpose of establishing sod. This can be waived during construction, if and only if there is a minimum of one inch of rain per week on all sod on the project.
- 3. Placed sod on slopes 1:3 or greater. Stake sod on slopes 1:2 or greater.
- 4. On all curves with superelevation, place sod from the edge of pavement to the toe of slope on the downhill side(s) for the entire length of the superelevated roadway. On multi-lane divided rural facilities, place sod in the median and on the inside of the curve in the superelevated areas. This does not apply to reverse crowns.
- 5. Use sod for all projects with less than 10,000 square yards grass area.
- 6. On tangent sections and on outside of curves, use sod between the edge of pavement and a point 4 feet beyond the shoulder break point.
- 7. The entire width of sod should not exceed 15 feet from the edge of pavement.
- 8. Sod is to be used to eliminate narrow seed and mulch areas. Sod areas less than 6 feet in width.
- 9. Place sod around drainage structures as per the standard Indexes and extend to the edge of pavement.

#### 3.5 SOD MAINTENANCE

- A. The sod shall produce a dense, well-established growth. Repair and re-sod all eroded or bare spots until project acceptance. Repair to sodding shall be accomplished as in the original work.
- B. Perform sufficient watering to maintain adequate moisture for optimum development of the seeded and sodded areas, and no less than 1.5 inches of water per week for at least 2 weeks. Thereafter, apply water for a minimum of 60 days as needed until the sod takes root and starts to grow or until final acceptance, whichever is latest.

#### 3.6 GUARANTEE

A. Guarantee a live and vigorous stand of permanent grass at the time of acceptance of the work consisting of 80 percent minimum coverage for seeded grass areas with no bare spots greater than 5 square feet.

#### 3.7 CLEANING

A. Remove debris and excess materials from the project site.

END OF SECTION

#### SECTION 330201

# ROADWAY CROSSINGS BY OPEN CUT

#### PART 1 GENERAL

#### 1.1 SCOPE OF WORK

Provide all labor, materials, equipment, supervision and incidentals required to install the pipeline as shown on the Drawings in Collier County Streets by method of open cut.

Note: Open cutting of existing pavement will generally not be allowed, but may be considered under one or more of the following conditions:

- 1. Subsurface obstructions including rock;
- 2. Extreme high water table;
- 3. Limited space for jack and bore pits;
- 4. Condition of roadway surface including imminent resurfacing and rebuilding, provided inspection and approval beforehand is made by the affected Transportation Department; or
- 5. Extreme economic hardship is proven with adequate supportive data.

#### 1.2 SUBMITTAL

- A. Submit shop drawings to the ENGINEER for review.
- B. Before starting work, submit to the Collier County Department of Transportation, with copy to the ENGINEER, a detailed schedule of his operations a minimum of fourteen (14) days prior to beginning work for approval. This shall include, but not be limited to, type and extent of temporary paving, and drawings and lists describing materials and traffic control methods to be used. Approval shall not relieve the CONTRACTOR of his obligation to provide a safe and proper crossing.
- C. If a detour is required, submit a traffic control plan for approval to Collier County and/or the Florida Department of Transportation.
- D. Submit a plan for maintenance of traffic in accordance with Index 600 through 650 of the Florida Department of Transportation Specifications.

#### PART 2 PRODUCTS

- 2.1 MATERIALS
  - A. Use materials specified in other applicable portions of this Specification.

#### PART 3 EXECUTION

#### 3.1 GENERAL

- A. Trench dimensions for open cutting of road crossings are shown on the Standard Details.
- B. Where possible, limit the completion of the open-cut road crossing to a 24-hour period. Perform all work in accordance with the approved traffic control plan.
- C. Notify Collier County DOT forty-eight (48) hours in advance of starting construction.
- 3.2 INSTALLATION
  - A. Temporary Roadways
    - 1. For temporary roadways required for traffic relocation use materials meeting the requirements of the FDOT. Use temporary roadways when crossing a state highway right-of-way or at the direction of the ENGINEER.
    - 2. Maintain temporary roadways in good condition throughout their use.
    - 3. Maintain drainage through all existing ditches by the use of culvert pipe as necessary.
    - 4. Submit drawings indicating the type and location of temporary roadways for approval prior to beginning work.
    - 5. Provide all necessary barricades and signs where detours are permitted as required to divert the flow of traffic. Notify Collier County DOT and ENGINEER in advance of planned detours. While traffic is detoured, expedite construction operations to minimize the period of detour.
    - 6. Perform and complete all work at the roadway crossing in a manner fully satisfactory to Collier County DOT.
  - B. Maintenance of Traffic
    - 1. The requirements specified herein are in addition to the plan for Maintenance of Traffic as specified in Section 015526.

- 2. Furnish during construction and any subsequent maintenance within State secondary road right-of-ways and Collier County streets, proper signs, signal lights, flagmen, and other warning devices for the protection of traffic all in conformance with the latest <u>Manual on Uniform Traffic Control and Safe Streets and Highways</u>, and the <u>Florida Manual of Traffic Control and Safe Practices for Street and Highway Construction</u>, <u>Maintenance and Utility Operations</u>. Information as to the above may be obtained from FDOT Division engineers. The ENGINEER, County Engineer, or FDOT Manager of the right-of-way of their representatives reserves the right to stop any work for non-compliance.
- 3. Take precautions to prevent injury to the public due to open trenches. Night watchmen may be required where special hazards exist, or police protection provided for traffic while work is in progress. Be fully responsible for damage or injuries whether or not police protection has been provided.
- 4. Unless permission to close a County street is received in writing from the proper authority, place all excavated material so that vehicular and pedestrian traffic may be maintained at all times. Repair the road surface, provide temporary ways, erect wheel guards or fences, or take other measures for safety satisfactory to the ENGINEER if the CONTRACTOR's operations cause traffic hazards.
- 5. Be fully responsible for the installation of adequate safety precautions, for maintenance of the channelization devices, and for the protection of the traveling public.
- 6. Maintain at all open cut crossings, a minimum of one-way traffic during the daylight hours, and two-way traffic at night.
- C. Installation of Pipeline
  - 1. Meet the requirements of the applicable portions of this specification for pavement removal, sheeting, shoring and bracing, excavation and backfill, and dewatering.
  - 2. Install the pipe in accordance with Division 2 of these Specifications.
  - 3. Backfill the trench in accordance with the requirements of Section 312323.
  - 4. Replace pavement in accordance with the requirements of Section 320117.

# END OF SECTION

# NO TEXT FOR THIS PAGE

# SECTION 330502

# HIGH DENSITY POLYETHYLENE (HDPE) PIPE AND FITTINGS

#### PART 1 GENERAL

#### 1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment, and incidentals required to install High Density Polyethylene (HDPE) pressure pipe, fittings, and appurtenances as shown on the Drawings and specified in the Contract Documents.
- B. High Density Polyethylene (HDPE) Collier County Utilities has the option of approving the use of HDPE for pipeline crossings of roadways, ditches, canals, and environmentally sensitive lands. HDPE mains shall have the same equivalent internal diameter and equivalent pressure class rating as the corresponding PVC pipe, unless otherwise approved by the County Manager or designee. For all roadway crossings requiring casing pipe, a steel or DR 11 HDPE casing pipe must be provided. The Department of Transportation having jurisdiction of said road and right-of-way must grant specific approval.

#### 1.2 REFERENCED STANDARDS

A. All standard specifications, i.e., Federal, ANSI, ASTM, etc., made a portion of these Specifications by reference, shall be the latest edition and revision thereof.

#### 1.3 QUALIFICATIONS

A. Furnish all HDPE pipe, fittings, and appurtenances by a single manufacturer who is fully experienced, reputable and qualified in the manufacture of the items to be furnished.

#### 1.4 SUBMITTALS

- A. Submit to the ENGINEER, a list of materials to be furnished, the names of the suppliers, and the appropriate shop drawings for all HDPE pipe and fittings.
- B. Submit the pipe manufacturer's certification of compliance with the applicable sections of the Specifications.
- C. Submit shop drawings showing installation method and the proposed method and specialized equipment to be used.

# 1.5 INSPECTIONS AND TESTS

A. All work shall be inspected by the County Manager or designee who shall have the authority to halt construction if, in his opinion, these specifications or standard construction practices are not being followed. Whenever any portion of these specifications is violated, the County Manager or designee, may order further construction to cease until all deficiencies are corrected.

# 1.6 WARRANTY AND ACCEPTANCE

- A. Warrant all work to be free from defects in workmanship and materials for a period of one year from the date of completion of all construction. If work meets these specifications, a letter of acceptance, subject to the one year warranty period, shall be given at the time of completion. A final acceptance letter shall be given upon final inspection at the end of the one year warranty period, provided the work still complies with these specifications. In the event deficiencies are discovered during the warranty period, the CONTRACTOR shall correct them without additional charge to the COUNTY before final acceptance. During the warranty period, the ENGINEER will determine if warranty repairs or replacement work shall be performed by the CONTRACTOR. The decision of the ENGINEER shall be binding upon the CONTRACTOR.
- B. Installer Certification for The CONTRACTOR installing thermal butt fused HDPE pipe.

# PART 2 PRODUCTS

# 2.1 POLYETHYLENE PIPE AND FITTINGS

- A. Provide polyethylene pressure pipe manufactured from PE3408 polyethylene meeting AWWA C906 standards. When specified by the ENGINEER on the construction drawings, as an alternate to PVC, HDPE (ductile iron pipe sized) piping can be used for buried applications. Iron pipe sized (IPS) HDPE piping can be used for below-ground applications as determined by the ENGINEER.
- B. The diameter of DR 11 HDPE casing pipe provided for roadway crossings or other purposes shall conform to the following.

For HDPE pressure carrier pipes, casing spacers are not required when HDPE DR11 (or DR17 for 42" to 54" or DR21 for 63") casing is used. The casing inside diameter shall be a minimum of two inches larger than the carrier pipe's outside diameter.

C. HDPE to HDPE pipe connections shall be by thermal butt fusion. Thermal fusion shall be accomplished in accordance with the pipe manufacturer and fusion equipment supplier specifications. The CONTRACTOR installing thermal butt

fused HDPE pipe shall be certified in this type of work and have a minimum of five years experience performing this type of work. The CONTRACTOR shall provide certification to the Engineer of Record, who will provide the Engineering Review Services Department with the certification.

- D. Qualification of Manufacturer: The Manufacturer shall have manufacturing and quality control facilities capable of producing and assuring the quality of the pipe and fittings required by these specifications. The Manufacturer's production facilities shall be open for inspection by the County Manager or designee. Qualified manufacturers shall be approved by the County Manager or designee.
- E. See the County Approved Product List, Appendix F, for manufacturers that are qualified. Products from other manufacturers proposed for the work must receive approval from the County Manager or designee prior to ordering.
- F. Materials: Materials used for the manufacture of polyethylene pipe and fittings shall be PE3408 high density polyethylene meeting cell classification 345434C or 345434E per ASTM D3350; and meeting Type III, Class B or Class C, Category 5, Grade P34 per ASTM D1248; and shall be listed in the name of the pipe and fitting manufacturer in PPI (Plastics Pipe Institute) TR-4, <u>Recommended Hydrostatic Strengths and Design Stresses for Thermoplastic Pipe and Fittings Compounds</u>, with a standard grade rating of 1600 psi at 73°F. The Manufacturer shall certify that the materials used to manufacture pipe and fittings meet these requirements.
- G. Polyethylene Pipe: Polyethylene pipe shall be manufactured in accordance with ASTM F714, Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter or ASTM D3035, Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter and shall be so marked. Each production lot of pipe shall be tested for (from material or pipe) melt index, density, % carbon, (from pipe) dimensions and either quick burst or ring tensile strength (equipment permitting).
- H. Color Identification: HDPE must have at least three equally spaced horizontal colored marking stripes. Permanent identification of piping service shall be provided by adhering to the following colors.

Blue – potable water (Underground HDPE pipe shall be one of the following:

- a. Solid-wall blue pipe;
- b. Co-extruded blue external skin; or
- c. White or black pipe with blue stripes incorporated into, or applied to, the pipe wall.

White – raw water Green – wastewater, sewage Pantone Purple – non-potable irrigation, reclaimed or reuse water

- I. Polyethylene Fittings and Custom Fabrications: Polyethylene fittings and custom fabrications shall be molded or fabricated by the pipe manufacturer. Butt fusion outlets shall be made to the same outside diameter, wall thickness, and tolerances as the mating pipe. All fittings and custom fabrications shall be fully rated for the same internal pressure as the mating pipe. Pressure de-rated fabricated fittings are prohibited.
- J. Molded Fittings: Molded fittings shall be manufactured in accordance with ASTM D3261, <u>Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing</u>, and shall be so marked. Each production lot of molded fittings shall be subjected to the tests required under ASTM D3261.
- K. X-Ray Inspection: The Manufacturer shall submit samples from each molded fittings production lot to x-ray inspection for voids, and shall certify that voids were not found.
- L. Fabricated Fittings: Fabricated fittings shall be made by heat fusion joining specially machined shapes cut from pipe, polyethylene sheet stock, or molded fittings. Fabricated fittings shall be rated for internal pressure service equivalent to the full service pressure rating of the mating pipe. Directional fittings 16" IPS and larger such as elbows, tees, crosses, etc., shall have a plain end inlet for butt fusion and flanged directional outlets. Part drawings shall be submitted for the approval of the ENGINEER.
- M. Polyethylene Flange Adapters: Flange adapters shall be made with sufficient through-bore length to be clamped in a butt fusion joining machine without the use of a stub-end holder. The sealing surface of the flange adapter shall be machined with a series of small v-shaped grooves to provide gasketless sealing, or to restrain the gasket against blow-out.
- N. Back-up Rings and Flange Bolts: Flange adapters shall be fitted with lap joint flanges pressure rated equal to or greater than the mating pipe. The lap joint flange bore shall be chamfered or radiused to provide clearance to the flange adapter radius. Flange bolts and nuts shall be Grade 2 or higher.

#### 2.2 MANUFACTURER'S QUALITY CONTROL

A. The pipe and fitting manufacturer shall have an established quality control program responsible for inspecting incoming and outgoing materials. Incoming polyethylene materials shall be inspected for density, melt flow rate, and contamination. The cell classification properties of the material shall be certified by the supplier, and verified by Manufacturer's Quality Control. Incoming materials shall be approved by Quality Control before processing into finished goods. Outgoing materials shall be checked for:

- 1. Outside diameter, wall thickness, and eccentricity as per ASTM D2122 at a frequency of at least once/hour or once/coil, whichever is less frequent.
- 2. Out of Roundness at frequency of at least once/hour or once/coil, whichever is less frequent.
- 3. Straightness, inside and outside surface finish, markings and end cuts shall be visually inspected as per ASTM F714 on every length of pipe.
- B. Quality Control shall verify production checks and test for:
  - 1. Density as per ASTM D1505 at a frequency of at least once per extrusion lot.
  - 2. Melt Index as per ASTM D1238 at a frequency of at least once per extrusion lot.
  - 3. Carbon content as per ASTM D1603 at a frequency of at least once per day per extrusion line.
  - 4. Quick burst pressure (sizes thru 4-inch) as per ASTM D1599 at a frequency of at least once per day per line.
  - 5. Ring Tensile Strength (sizes above 4-inch equipment permitting) as per ASTM D2290 at a frequency of at least once per day per line.
  - 6. ESCR (size permitting) as per ASTM F1248 at a frequency of at least once per extrusion lot.
- C. X-ray inspection shall be used to inspect molded fittings for voids, and knit line strength shall be tested. All fabricated fittings shall be inspected for joint quality and alignment.

#### 2.3 COMPLIANCE TESTS

- A. In case of conflict with Manufacturer's certifications, the CONTRACTOR, ENGINEER, or County Manager or designee may request re-testing by the manufacturer or have re-tests performed by an outside testing service. All retesting shall be at the requestor's expense, and shall be performed in accordance with the Specifications.
- B. Installation shall be in accordance with Manufacturer's recommendations and this specification. All necessary precautions shall be taken to ensure a safe working environment in accordance with the applicable codes and standards.

#### PART 3 EXECUTION

# 3.1 INSTALLATION OF HIGH DENSITY POLYETHYLENE PRESSURE PIPE AND FITTINGS

A. Install all high density polyethylene (HDPE) pressure pipe by direct bury, directional bore, or a method approved by the COUNTY or ENGINEER prior to construction. If directional bore is used, or if directed by the County Manager or designee or ENGINEER, surround the entire area of construction by silt barriers.

Install all high density polyethylene pressure pipe and fittings in accordance with Manufacturer's recommendations, and this specification. Take all necessary precautions to ensure a safe working environment in accordance with the applicable codes and standards.

#### 3.2 HEAT FUSION JOINING

A. Make joints between plain end pipes and fittings by butt fusion, and joints between the main and saddle branch fittings by using saddle fusion using only procedures that are recommended by the pipe and fitting Manufacturer. Ensure that persons making heat fusion joints have received training and certification for heat fusion in the Manufacturer's recommended procedure. Maintain records of trained personnel, and shall certify that training was received not more than 12 months before commencing construction. External and internal beads shall not be removed.

#### 3.3 MECHANICAL JOINING

A. HDPE pipe and fittings shall be fused together by heat welding when possible. HDPE pipe and fittings may be joined together or to other materials by means of flanged connections with back-up rings, by mechanical joint adapter with glands, or mechanical couplings designed for joining HDPE pipe or for joining HDPE pipe to another material. A stainless steel sleeve insert shall be used with a mechanical coupling. Mechanical couplings shall be fully pressure rated and fully thrust restrained such that when installed in accordance with manufacturer's recommendations, a longitudinal load applied to the mechanical coupling will cause the pipe to yield before the mechanical coupling disjoins.

#### 3.4 BRANCH CONNECTIONS

A. Make branch connections to the main with saddle fittings or tees. Saddle fuse polyethylene saddle fittings to the main pipe.

#### 3.5 EXCAVATION

A. Excavate trenches in conformance to this specification, the plans and drawings, or as authorized in writing by the County Manager or designee, and in accordance

with all applicable codes. Remove excess groundwater. Where necessary, shore or reinforce trench walls.

# 3.6 LARGE DIAMETER FABRICATED FITTINGS

A. Butt fuse fabricated directional fittings 16" IPS and larger to the end of a pipe. Make up the flanged directional outlet connections in the trench.

# 3.7 MECHANCIAL JOINT AND FLANGE INSTALLATION

A. Install mechanical joints and flange connections in accordance with the Manufacturer's recommended procedure. Center and align flange faces to each other before assembling and tightening bolts. Do not use the flange bolts to draw the flanges into alignment. Lubricate bolt threads, and fit flat washers under the flange nuts. Tighten bolts evenly according to the tightening pattern and torque step recommendations of the Manufacturer. At least one hour after initial assembly, re-tighten flange connections following the tightening pattern and torque step recommendations of the Manufacturer. The final tightening torque shall be 100 ft-lbs or less as recommended by the Manufacturer.

# 3.8 FOUNDATION AND BEDDING

A. Lay pipe on grade and on a stable foundation. Remove unstable or mucky trench bottom soils, and install a 6-inch foundation or bedding of compacted Class I material to pipe bottom grade. Remove excess groundwater from the trench before laying the foundation or bedding and the pipe. A trench cut in rock or stony soil shall be excavated to 6 inches below pipe bottom grade, and brought back to grade with compacted Class I bedding. Remove all ledge rock, boulders, and large stones.

# 3.9 PIPE HANDLING

A. When lifting with slings, use only wide fabric choker slings to lift, move, or lower pipe and fittings. Do not use wire rope or chain. Slings shall be of sufficient capacity for the load, and shall be inspected before use. Do not use worn or defective equipment.

# 3.10 TESTING

A. Hydrostatic Pressure Testing: Pressure test and flush HDPE pipes after swabbing in accordance with Section 022501 and 025400.

# END OF SECTION

# NO TEXT FOR THIS PAGE

# **SECTION 330504**

# DUCTILE IRON PIPE (DIP) AND FITTINGS

# PART 1 GENERAL

- 1.1 SCOPE OF WORK
  - A. Furnish all labor, materials, equipment, and incidentals required, and install ductile iron pipe, fittings and appurtenances as shown on the Drawings and as specified herein.
- 1.2 RELATED WORK SPECIFIED ELSEWHERE
  - A. Section 330518 Laying and Jointing Buried Pipe
- 1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS
  - A. Commercial Standards: (Latest Revision)

1.	ANSI/AWWA C104/A21.4	Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
2.	ANSI/AWWA C105/A21.5	Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids.
3.	ANSI/AWWA C110/A21.10	Ductile-Iron Fittings, 3 in. Through 48 Inches, for Water and Other Liquids. (C110 2-48 inches).
4.	ANSI/AWWA C111/A21.11	Rubber Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
5.	ANSI/AWWA C115/A21.15	Flanged Ductile-Iron Pipe with Threaded Flanges.
6.	ANSI/AWWA C150/A21.50	Thickness Design of Ductile-Iron Pipe.
7.	ANSI/AWWA C151/A21.51	Ductile-Iron Pipe, Centrifugally Cast for Water or Other Liquids.
8.	ANSI/AWWA C153/A21.53	Ductile-Iron Compact Fittings
9.	AWWA C600	Installation of Ductile Iron Water Mains and Their Appurtenances.
10.	Collier County	Utilities Standards and Procedures Ordinance

# 1.4 CONTRACTOR SUBMITTALS

- A. Shop Drawings: Submit shop drawings of pipe and fittings in accordance with the requirements in the General Conditions, the requirements of the referenced standards and the following supplemental requirements as applicable:
  - 1. Certified dimensional drawings of all valves, fittings, and appurtenances.
  - 2. In all cases, a line layout to indicate the limits of each reach of restrained joints or of concrete encasement shall be supplied. (NOTE: Obtain COUNTY Water Director's approval of all proposed concrete encasement of ductile iron pipe.)
- B. Certifications: Furnish a certified affidavit of compliance for all pipe and other products or materials furnished under this Section of the Specifications, which indicates that all tests have been made and that all results comply with the requirements of AWWA C151, including but not necessarily limited to the following:
  - 1. Acceptance Tests.
  - 2. Hydrostatic Tests.
  - 3. Impact Tests.
- C. Additional Documentation: Upon request, furnish foundry records in the form of written transcripts.
- D. All expenses incurred for certification, testing, and data submittal shall be borne by the CONTRACTOR or the Supplier.
- 1.5 QUALITY ASSURANCE
  - A. Inspection: All pipe shall be available for inspection at the place of manufacture prior to shipping in accordance with the provisions of the referenced standards. Notify the ENGINEER in writing not less than 10 calendar days prior to the shipping of the pipe.
  - B. The ENGINEER shall be given access to all areas where manufacturing and testing is performed and shall be permitted to make all inspections necessary to confirm manufacturer compliance with these Specifications.
  - C. Tests: Except as modified herein, all materials used in the manufacture of the pipe shall be tested in accordance with the requirements of the referenced standards as applicable.
  - D. Provide data on material tests at no additional cost to the COUNTY.

E. In addition to those tests specifically required, the ENGINEER may request additional samples of any material including lining and coating samples for testing by the COUNTY. Furnish the additional samples at no additional cost to the COUNTY.

# 1.6 CORROSION PROTECTION

- A. If specifically approved by Collier County Utilities for use, provide exterior protection for underground ductile iron pipe and fittings within areas of severe corrosive conditions. This shall be accomplished by the installation of polyethylene encasement through the area of concern. The soil test evaluation to determine the necessity for extra protection in suspect areas shall be those set forth in ANSI Standard A21.5. Additionally, where other existing utilities are known to be cathodically protected, ductile iron pipe crossing said utility shall be protected for a distance of 20 feet to each side. If ductile iron pipe is to be installed parallel to and within 10 feet of cathodically protected pipe, then protection shall be provided for the entire length. Do not install steel pipe in severe corrosion areas.
- PART 2 PRODUCTS
- 2.1 GENERAL
  - A. Protective Lining for Water Mains: Cement mortar lined ductile iron pipe shall conform to ANSI/AWWA C151 and C104, subject to the following supplemental requirements. The pipe shall be of the diameter and class shown, shall be furnished complete with rubber gaskets as indicated in the Contract Documents, and all specials and fittings shall be provided as required under the Contract Documents.
  - B. Protective Lining for Force Mains and Sewers: Where lining is shown, specified or required, for the protection of pipelines carrying sewage from corrosive gases, line the pipe using protective ceramic epoxy coating (see County Approved Product List, Appendix F) in accordance with the manufacturer's written instructions. For ceramic epoxy lining, abrasive blast clean pipe and fittings to a near white surface to SSPC SP-10 and provide 40 mils minimum of dry film thickness of ceramic epoxy lining.
  - C. Handling and Storage: Handle the pipe by using wide slings, padded cradles, or other devices designed and constructed to prevent damage to the pipe and its lining. The use of equipment or handling, which might injure the pipe and its lining, will not be permitted. Stockpiled pipe shall be suitably supported and shall be secured to prevent accidental rolling. Assure that all other pipe handling equipment and methods is acceptable to the ENGINEER.
  - D. Laying lengths: Maximum pipe laying lengths shall be 20 feet.

- E. Finish: The pipe shall have smooth dense interior surfaces and shall be free from fractures, excessive interior surface crazing and roughness, in accordance with ANSI/AWWA C104.
- F. Closures and Correction Pieces: Provide closures and correction pieces as required so that closures may be made due to different headings in the pipe laying operation and so that correction may be made to adjust the pipe laying to conform to pipe stationing shown on the Drawings or line layouts where applicable.
- 2.2 PIPE DESIGN CRITERIA
  - A. General: Ductile Iron pipe shall be designed in accordance with the requirements of ANSI/AWWA C150 as applicable and as modified in this Section.
  - B. Pipe Wall Thickness for Internal Pressure: The pipe shall be designed with a net thickness to withstand the design internal pressure in accordance with the hoop stress formula. In addition to the requirements of the Section, the minimum wall thickness shall be in accordance with the minimum thickness wall depicted in table 50.5 of ANSI/AWWA C150.
  - C. Potable, Raw and Non-Potable Irrigation Water Mains:
    - 1. Ductile Iron Pipe shall be a minimum pressure Class 250 and will be accepted in any diameter for use within the water distribution system.
    - 2. All aboveground potable water main pipe shall be painted Federal Safety Blue. All aboveground raw water main pipe shall be painted white. All aboveground non-potable irrigation, reclaimed or reuse water main pipe shall be painted Pantone Purple 522C. The pipe wall thickness shall not be less than that required by a working pressure of 250 psi in laying condition Type 4 "B" with 5-foot cover in conformance with ANSI Standard A21.50.
  - D. Force Mains and Gravity Sewers:
    - 1. Ductile Iron Pipe shall be a minimum pressure Class150 and will be accepted in any diameter for use within the wastewater collection system.
    - 2. Ductile iron pipe for Gravity Sewer applications in not permitted unless the ENGINEER can demonstrate that C900 PVC pipe, Class 150 or 200, cannot be utilized from a structural standpoint.
    - 3. All aboveground force main pipe shall be painted Safety Green. The pipe wall thickness shall not be less than that required by a working pressure of 150 psi.

# 2.3 MATERIALS

- A. Ductile Iron Pipe: Pipe materials shall conform to the requirements of ANSI/AWWA C151.
- B. Adapters to connect ductile iron pipe or fittings to pipe or fittings of dissimilar materials shall be supplied by the CONTRACTOR in accordance with ASTM specifications and the pipe manufacturer recommendations, and as approved by the ENGINEER.
- C. Water Mains:
  - 1. All water mains shall contain cement for mortar lining conforming to the requirements of ANSI/AWWA C104. Cement for mortar lining shall be Type II or V. A fly ash or pozzolan shall not be used.
  - 2. All Ductile Iron buried water main pipelines shall have blue stripes applied to the pipe wall. Stripe width shall comply with AWWA standards. The stripes shall be applied during installation and shall incorporate blue tape or blue paint. The tape or paint shall be applied in a continuous line that runs parallel to the axis of the pipe and be located along the top of the pipe.
  - 3. All pipe with an internal diameter of 24" or greater, tape or paint shall be applied in continuous lines along each side of the pipe as well as along the top of the pipe.
- D. Force Mains and Gravity Sewer:
  - 1. All Ductile iron pipe used within the wastewater system shall be lined with a ceramic epoxy, (see County Approved Product List, Appendix F). Pipe and fittings shall be lined as specified herein. Each piece of pipe shall bear a marking denoting the class to which it belongs.

#### 2.4 SPECIALS AND FITTINGS

- A. Fittings for Potable, Raw, Non-Potable Irrigation, Reclaimed and Reuse Water Systems:
  - 1. Fittings for ductile iron pipe shall conform to the requirements of ANSI/AWWA C153/A21.53 or ANSI/AWWA C110/A21.10 for diameters 3 inches through 48 inches and shall have a minimum pressure rating of 350 psi for pipe sizes 6 inches through 24 inches and 250 psi for sizes larger than 24 inches. Ductile iron fittings shall be double cement lined, seal coated and outside coated with an asphaltic material in accordance with AWWA C104 as specified.
- B. Fittings for Wastewater System:

 All pipe and fittings in direct contact with wastewater shall be interior coated with a 40 mil thickness of ceramic epoxy coating (see County Approved Product List, Appendix F). Pipe and fittings shall have an outside asphaltic coating as specified in AWWA Standard C151. Each piece of pipe shall bear a marking denoting the class to which it belongs.

# 2.5 DESIGN OF PIPE

- A. General: The pipe furnished shall be ductile iron pipe, lined as specified, with rubber gasketed joints.
- B. The pipe shall be designed, manufactured, tested, inspected, and marked according to applicable requirements previously stated and except as hereinafter modified, shall conform to ANSI/AWWA C150 and ANSI/AWWA C151.
- C. Pipe Dimensions: The pipe shall be of the diameter and class shown. The minimum wall thickness for each pipe size shall be as specified herein or shown on the Drawings.
- D. Fitting Dimensions: The fittings shall be of the diameter shown and class specified.
- E. Joint Design: Ductile Iron pipe and fittings shall be furnished with mechanical joints, push-on joints and flanged joints as follows:
  - 1. For buried pipe applications, unless otherwise indicated, mechanical and push-on joints shall conform to ANSI/AWWA C111/A21.11, with the minimum pressure rating of 350 psi.
  - 2. For above-ground or buried vault applications, unless otherwise indicated, flanged joints shall conform to ANSI/AWWA C115/A21.15, with the minimum pressure rating of 250 psi. All above-ground fittings shall be painted blue.
  - 3. Use manufactured, labeled gasket lubricant for push on joints with trade name and pipe manufacturer name, other lubricants are prohibited.
  - 4. Nuts and bolts for flanged joints shall be 304 stainless, as specified by the COUNTY, and conform to ANSI/AWWA C111.
- F. Restraining Devices: Joint restraining devices (see County Approved Product List, Appendix F) shall be placed at all bends, tees, plugs, reducers, and other fittings to provide lateral support, and shall conform to the Collier County Standard Details. Concrete thrust blocks shall only be utilized if approved by Collier County Utilities.
- G. For bell-and-spigot ends with rubber gaskets, the clearance between the bells and spigots shall be such that when combined with the gasket groove configuration and the gasket itself will provide watertight joints under all operating conditions

when properly installed. Require the pipe manufacturer to submit details complete with significant dimensions and tolerances and also to submit performance data indicating that the proposed joint has performed satisfactorily under similar conditions. In the absence of a history of field performance, the results of a test program shall be submitted.

- H. Gaskets shall be a Buna N, Neoprene, or a Nitryl-based rubber product. Gaskets shall have clean tips unless otherwise specified. Elastomeric gaskets conforming to ASTM F-477 shall also be acceptable.
- I. Shop-applied interior linings and exterior coatings shall be applied evenly to the nominal thickness specified. Exterior coatings: asphalt coating for buried pipe or primed pipe cannot be furnished holiday free.
- 2.6 CEMENT-MORTAR LINING
  - A. Cement-Mortar Lining For Shop Application: Except as otherwise provided herein, interior surfaces of all ductile iron pipe shall be cleaned and lined in the shop with cement-mortar lining applied centrifugally in conformity with ANSI/AWWA C104. Ductile-Iron pipefittings need not have the cement-mortar lining applied centrifugally. The lining machines shall be of a type that has been used successfully for similar work. Every precaution shall be taken to prevent damage to the lining. If lining is damaged or found faulty at delivery site, the damaged or unsatisfactory portions shall be repaired in the filed in accordance with ANSI/AWWA C104.
  - B. The nominal wet lining thickness shall be as follows:

Nominal Factory Nominal Replacement			
Nominal Pipe	Applied Lining	Lining	
Diameter (in.)	Thickness (in.)	Thickness (in.)	
3-12	1/8	1/8	
14-24	3/16	3/16	
30-64	1/4	1/4	

- C. Protection of Pipe Lining/Interior: All shop-applied cement mortar lining shall be given a seal coat of asphaltic material in conformance with ANSI/AWWA C104.
- 2.7 EXTERIOR COATING OF PIPE
  - A. Exterior Coating of Buried Piping: The exterior coating shall be an asphaltic coating approximately 1 mil thick, conforming to ANSI/AWWA C151.
- 2.8 CORROSION PROTECTION
  - A. If specifically approved by Collier County Utilities for use, exterior protection shall be provided for underground ductile iron pipe and fittings within areas of severe

corrosive conditions. This shall be accomplished by the installation of polyethylene encasement through the area of concern. The soil test evaluation to determine the necessity for extra protection in suspect areas shall be those set forth in ANSI Standard A21.5. Additionally, where other existing utilities are known to be cathodically protected, ductile iron pipe crossing said utility shall be protected for a distance of 20 feet to each side. If ductile iron pipe is to be installed parallel to and within 10 feet of cathodically protected pipe, then protection shall be provided for the entire length. Steel pipe shall not be installed in severe corrosion areas.

# PART 3 EXECUTION

# 3.1 INSTALLATION OF PIPE

- A. Handling and Storage: Carefully handle and protect all pipe, fittings, etc., against damage, impact shocks, and free fall and in accordance with ANSI/AWWA C600. Do not place pipe directly on rough rocky ground, but in such instances support the pipe in a manner that will protect the pipe against injury whenever stored at such trench site or elsewhere. Do not install any pipe where the lining or coating show defects that may be harmful as determined by the ENGINEER. Repair such damaged lining or coating, or furnish and install a new undamaged pipe.
- B. Repair or replace all pipe damaged prior to Substantial Completion or during warrantee period.
- C. Inspect each pipe and fitting prior to installation to insure that no damaged portions of pipe are installed.
- D. Before placement of pipe in the trench, thoroughly clean each pipe or fitting of any foreign substance that may have collected therein, and keep the pipe clean at all times thereafter. For this purpose, close the openings of all pipes and fittings in the trench during any interruption to the work.
- E. Pipe Laying: Install the pipe in accordance with ANSI/AWWA C600.
- F. Lay pipe directly on the bedding material. Refer to the Utilities Standards and Procedures Ordinance Section 9.1.2 for laying and backfilling requirements. No blocking will be permitted, and the bedding shall be such that it forms a continuous, solid bearing for the full length of the pipe. Make excavations as needed to facilitate removal of handling devices after the pipe is laid. Form bell holes at the ends of the pipe to prevent point loading at the bells or couplings. Make excavations as needed outside the normal trench section at field joints to permit adequate access to the joints for field connection operations and for application of coating on field joints.
- G. Where necessary to raise or lower the pipe due to unforeseen obstructions or other causes, the ENGINEER may change the alignment and/or the grades. Such

change may be made by the deflection of joints, by the use of bevel adapters, or by the use of additional fittings. However, in no case shall the deflection in the joint exceed 70 percent of the maximum deflection recommended by the pipe manufacturer. No joint shall be misaligned any amount which will be detrimental to the strength and water tightness of the finished joint.

- H. Pipe and Specials Protection: Protect the openings of all pipe and specials with suitable bulkheads to prevent unauthorized access by persons, animals, water, or any undesirable substance. At all times, provide means to prevent the pipe from floating.
- I. Pipe Cleanup: As pipe laying progresses, keep the pipe interior free of all debris. Completely clean the interior of the pipe of all sand, dirt, mortar splatter and any other debris following completion of pipe laying, pointing of joints, and any necessary interior repairs per ANSI/AWWA C600 and C602 prior to testing and disinfecting the completed pipeline. For pipe larger than 12" diameter, utilize a polyurethane foam plug "Poly Pig" to remove all debris from main.

# 3.2 RUBBER GASKETED JOINTS

A. Rubber Gasketed Joints: Immediately before jointing pipe, thoroughly clean the bell end of the pipe, and place a clean rubber gasket in the bell groove. Carefully clean the bell and spigot end of push-on joint pipe, and lubricate with a vegetable-based lubricant or per manufacturer's recommendation. Insert the spigot end of the pipe section into the bell of the previously laid joint and telescope into the proper position. Do not tilt the pipe to insert the spigot into the bell.

# 3.3 INSTALLATION OF PIPE APPURTENANCES

- A. Installation of Valves: Handle all valves in a manner to prevent any injury or damage to any part of the valve. Thoroughly clean and prepare all joints prior to installation. Adjust all stem packing and operate each valve prior to installation to insure proper operation.
- B. Install all valves so that the valve stems are plumb and in the location shown on the Drawings.
- C. Mechanical joints consisting of bell, socket, gland, gasket, bolts, and nuts shall conform to ANSI Standard A21.11. Bolts and nuts shall be high strength, low alloy, Cor-Ten, T-Head Type having hexagonal nuts. Bolts and nuts shall be machined through and nuts shall be tapped at right angles to a smooth bearing surface. Single sealed gasket push-on type joints (see County Approved Product List, Appendix F) shall conform to the requirements of ANSI A21.11.
- D. Mechanical joint retainer glands may be used to restrain mechanical joint pipe and fittings to the plain end of ductile iron pipe and fittings when used in conjunction with thrust blocks of reduced size. The Utilities ENGINEER must approve thrust block size. Maintain joint flexibility.

# 3.4 TESTING AND DISINFECTION

A. Test completed water or force main pipeline in accordance with Section 022501. Disinfect completed water pipeline in accordance with Section 025400.

# END OF SECTION

# SECTION 330518

# LAYING AND JOINTING BURIED PIPELINES

#### PART 1 GENERAL

#### 1.1 SUMMARY

- A. Section Includes: Installation of all underground pipelines. Provide pipeline materials, coatings and linings as specified and pipe of the types, sizes and classes shown or specified.
  - 1. Use proper and suitable tools and appliances for the safe and convenient cutting, handling, and laying of the pipe and fittings.
  - 2. Use suitable fittings where shown and at connections or where grade or alignment changes require offsets greater than those recommended and approved.
  - 3. Lay all underground pipelines not supported on piles or concrete cradle in select fill bedding material.
  - 4. Close off all lines with bulkheads when pipe laying is not in progress.
- B. Related Work Specified in Other Sections Includes:
  - 1. Section 022501 Leakage Tests
  - 2. Section 025400 Disinfection
  - 3. Section 312316 Excavation Earth and Rock
  - 4. Section 312319 Groundwater Control for Open Excavation
  - 5. Section 312323 Backfilling
  - 6. Section 330502 High Density Polyethylene (HDPE) Pipe and Fittings
  - 7. Section 330503 Polyvinyl Chloride (PVC) Pipe and Fittings
  - 8. Section 330504 Ductile Iron Pipe (DIP) and Fittings
- 1.2 REFERENCES
  - A. Codes and standards referred to in this Section are:

- ASTM D 2774 Practice for Underground Installation of Thermoplastic Pressure Piping
  AWWA C600 - Installation of Ductile-Iron Water Mains and Their
  - AWWA C600 Installation of Ductile-Iron Water Mains and Their Appurtenances
- 3. ASTM A 307 Specification for Carbon Steel Bolts and Studs, 60000 psi Tensile
- 4. ASME B16.1 Cast Iron Pipe Flanges and Flanged Fittings, C25, 125, 250, 800
- 5. ASME B16.21 Nonmetallic Flat Gaskets for Pipe Flanges
- 6. AWWA C111/A21.11 Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
- 7. AWWA C115/A21.15 Flanged Ductile-Iron Pipe With Threaded Flanges
- 8. Uni-Bell Handbook of PVC Pipe
- 9. Collier County Utilities Standards and Procedures Ordinance
- 1.3 DELIVERY, STORAGE AND HANDLING
  - A. General: Deliver, store and handle all products and materials as specified in Division 1 and as follows:
  - B. Transportation and Delivery: Take every precaution to prevent injury to the pipe during transportation and delivery to the site.
  - C. Loading and Unloading: Take extreme care in loading and unloading the pipe and fittings.
    - 1. Work slowly with skids or suitable power equipment, and keep pipe under perfect control at all times.
    - 2. Under no condition is the pipe to be dropped, bumped, dragged, pushed, or moved in any way that will cause damage to the pipe or coating.
  - D. Sling: When handling the pipe with a crane, use a suitable sling around the pipe.
    - 1. Under no condition pass the sling through the pipe. Interior of pipe is to be kept free of dirt and foreign matter at all times.
    - 2. Use a nylon canvas type sling or other material designed to prevent damage to the pipe and coating.

- 3. When handling reinforced concrete pipe or uncoated steel or ductile iron pipe, steel cables, chain or like slings are acceptable.
- E. Damaged Piping: If in the process of transportation, handling, or laying, any pipe or fitting is damaged, replace or repair such pipe or pipes.
- F. Blocking and Stakes: Provide suitable blocking and stakes installed to prevent pipe from rolling.
  - 1. Obtain approval for the type of blocking and stakes, and the method of installation.
- G. Storage for Gaskets: Store gaskets for pipe joints in a cool place and protect gaskets from light, sunlight, heat, oil, or grease until installed. Store gaskets in a sealed container (such as a vented drum). When long-term storage with exposure to direct sunlight is unavoidable, PVC pipe should be covered with an opaque material while permitting adequate air circulation above and around the pipe as required to prevent excessive heat accumulation (Uni-Bell PVC Handbook).
  - 1. Do not use any gaskets showing signs of cracking, weathering or other deterioration.
  - 2. Do not use gasket material stored in excess of six months without approval.

#### 1.4 FIELD CONDITIONS

- A. Repair of Sanitary Sewers and Services: Rebed, in compacted select fill material, sanitary sewers which cross over the new pipe or which cross under the new pipe with less than 12 inches clear vertical separation. Compact the bedding to densities required for new pipeline construction and extend bedding below the sewer to undisturbed earth. Reconstruct sewers damaged by pipeline construction.
  - 1. Furnish and install all materials and do all work necessary for the reconstruction or repairs of sanitary sewers and services.
  - 2. Provide pipe for reconstruction of sanitary sewers and services meeting the appropriate specification requirements.
  - 3. Provide pipe of the same size as the existing sewer or when the same size is not available, use the next larger size of pipe. Obtain approval of joints made between new pipe and existing pipe.

#### PART 2 PRODUCTS

A. The materials allowed for buried sewer pipes are PVC, HDPE or Ductile Iron Pipe.

# PART 3 EXECUTION

#### 3.1 PREPARATION

- A. Dry Trench Bottoms: Lay pipe only in dry trenches having a stable bottom.
  - 1. Where groundwater is encountered, make every effort to obtain a dry trench bottom in accordance with Section 312319.
  - 2. Perform trench excavation and backfill in accordance with Sections 312316 and 312323.

#### 3.2 INSTALLATION

- A. General: Install all piping in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 1. Where pipe joint deflections are used, do not exceed 80 percent of the maximum deflection limits shown in AWWA C600. Gravity systems shall contain no joint deflection.
  - 1. Arrange miscellaneous pipelines, which are shown in diagram form on the Plans, clear of other pipelines and equipment.
  - 2. Gravity systems shall not contain vertical dips greater than one and a half inches (1.5").
- B. Code Requirements: Provide pipeline installations complying with AWWA C600 for iron pipe, AWWA Manual M11 for steel pipe, ASTM D 2774 for thermoplastic pressure piping, and as modified or supplemented by the Specifications.
- C. Pipe Laying General:
  - 1. Thoroughly inspect all pipe for damage and cleanliness. If found to be defective, tag, remove and replace pipe with satisfactory pipe or fittings at no additional charge to COUNTY.
  - 2. Generally, lay all pipe with bells pointing ahead.
  - 3. Carefully place all pipe, pipe fittings, valves and hydrants into trench by means of a derrick, ropes or other suitable tools or equipment in such a manner as to prevent damage and check for alignment and grade.
  - 4. Make adjustments to bring pipe to line and grade by scraping away or filling in select fill material under the body of the pipe.
  - 5. Wedging or blocking up the pipe barrel is not permitted.

- 6. Bring the faces of the spigot ends and the bells of pipes into fair contact and firmly and completely shove the pipe home.
- 7. As the work progresses, clean the interior of pipelines of all dirt and superfluous materials of every description.
- 8. Keep all lines absolutely clean during construction.
- 9. Lay pipelines accurately to line and grade.
- 10. During suspension of work for any reason at any time, a suitable stopper shall be placed in the end of the pipe last laid to prevent mud or other material from entering the pipe.
- D. Pipe Laying Trenches:
  - 1. Carefully lay all pipelines in trench excavations piece by piece using suitable tools or equipment on select fill bedding (refer to Utilities Standards and Procedures Ordinance, Section 9.1.2), concrete cradle or other foundations as shown, specified or ordered in writing. Prevent damage to materials, protective coatings and linings.
  - 2. Do not dump or drop pipe or pipe materials into trench.
  - 3. Properly secure the pipe against movement and make the pipe joints in the excavation as required.
  - 4. Carefully grade and compact pipe bedding.
  - 5. Bell Holes:
    - a. Cut out bell holes for each joint as required to permit the joint to be properly made and allow the barrel of the pipe to have full bearing throughout its length.
    - b. Thoroughly tamp bell holes full of select fill material following the making of each joint to provide adequate support to the pipe throughout its entire length.
- E. Other Foundations: Install pipelines laid on other types of foundations as specified for such other foundations or as ordered in writing.
- F. Field Cuts of Pipelines: For shorter than standard pipe lengths, make field cuts in a manner producing a cut square and perpendicular to the pipe axis. Remove any sharp, rough edges which otherwise might injure the gasket.
- G. Procedure for sealing cut ends and repairing field damaged areas of polyethylene lined pipe and fittings is as follows:

- 1. Remove burrs caused by field cutting of ends or handling damage and smooth out edge of polyethylene lining if made rough by field cutting or handling damage.
- 2. Remove oil or lubricant used during field cutting operations.
- 3. Areas of loose lining associated with field cutting operation must be removed and exposed metal cleaned by sanding or scraping. For larger areas, remove loose lining and dirt, then roughen bare pipe surface by scratching or gouging with a small chisel to provide an anchor pattern for the epoxy. It is recommended that the polyethylene lining be stripped back by chiseling, cutting, or scraping about 1 inch to 2 inches into well adhered lined area before patching. This ensures that all areas of undercutting have been removed. Be sure to roughen an overlap of 1 inch to 2 inches of polyethylene lining in area to be epoxy coated. This roughening should be done with a rough grade emery paper (40 grit), rasp, or small chisel. Avoid honing, buffing, or wire brushing since these tend to make surface to be repaired too smooth for good adhesion.
- 4. With area to be sealed or repaired clean and suitably roughened, apply a thick coat of a two-part coal tar epoxy (see County Approved Product List, Appendix F). The heavy coat of epoxy must be worked into the scratched surface by brushing. Mixing and application procedure for the epoxy must follow the epoxy manufacturer's instructions.
- 5. It is important that the entire freshly cut, exposed metal surface of the cut pipe be coated. To ensure proper sealing, overlap at least 1 inch of the roughened polyethylene lining with this two-part epoxy system.
- H. Ductile Iron Pipe Mechanical Joints:
  - 1. Assembly: In making up mechanical joints, center the spigot in the bell.
    - a. With a wire brush just prior to assembly of the joint thoroughly brush 8 inches outside of spigot and inside of bell with which the rubber gasket comes in contact. Remove all oil, grit, tar (other than standard coating) and other foreign matter from joint.
    - b. Brush lubricant over the gasket just prior to installation. (Note: There is only one rubber gasket size for each diameter of pipe.)
    - c. Press the gasket into place within the bell and move the gland into position, bolts inserted, and the nuts tightened finger tight.
    - d. Tighten the nuts with a torque wrench so that the gland is brought up toward the pipe evenly. Torque wrenches shall be set as specified in AWWA C111. Spanner type wrenches not longer than specified in

AWWA C111 may be used with the permission of County Manager or designee.

- e. Tighten all nuts 180 degrees apart alternately in order to produce equal pressure on all parts of the gland.
- 2. Torques: Apply the following range of bolt torques:

Size <u>Inches</u>	Range of Torque - ft. lbs
5/8	40 - 60
3/4	60 - 90
1	70 - 100
1-1/4	90 - 120

- 3. Remaking of Joints: If effective sealing is not obtained at the maximum torque listed above, disassemble and reassemble the joint after thorough cleaning.
- I. Ductile Iron Pipe Rubber Gasket Joints:
  - 1. Assembly: In making up the rubber gasket joint, brush the gasket seat in the socket thoroughly with a wire brush and wipe the gasket with a cloth.
    - a. Place the gasket in the socket with the large round end entering first so that the groove fits over the bead in the seat.
    - b. Apply a thin film of lubricant (AWWA C600) to the inside surface of the gasket that will come in contact with the entering pipe.
    - c. Brush the plain end of the pipe to be entered thoroughly with a wire brush and place it in alignment with the bell of the pipe to which it is to be joined.
    - d. Exert 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 to make the joint.
  - 2. Positioning: Before proceeding with backfilling, feel completely around the joint using a feeler gauge to confirm that the gasket is in its proper position.
    - a. If the gasket can be felt out of position, withdraw the pipe and examine the gasket for cuts or breaks.
    - b. If the gasket has been damaged, replace it with a new one before reinstalling the pipe.

- 3. Optional Mechanical Joints: Use mechanical joint fittings that meet the requirements of Section 330504 with the rubber gasket joint pipe when specified or when rubber gasket fittings are not available.
- J. Temporary Bulkheads: Provide temporary bulkheads at the ends of sections where adjoining pipelines have not been completed, and in connections built into pipelines where adjoining pipelines or structures have not been completed and are not ready to be connected.
  - 1. Remove bulkheads encountered in connecting sewers or structures included in this Contract, or in pipelines or structures previously built, when they are no longer needed or when ordered.
- K. Temporary Blow-Off Assembly: Dead-end water lines shall be temporarily ended with a blow-off as shown in Collier County Standard Details. After full bore flush replace with a fire hydrant meeting the requirements of Section 331619.
- L. Sleeve Type Couplings: For sleeve type couplings, equally tighten diametrically opposite bolts on the connection so that the gaskets will be brought up evenly all around the pipe.
  - 1. Torque Wrenches: Do the final tightening with torque wrenches set for the torque recommended by the coupling manufacturer.
- M. Concrete Encasement: Concrete encasement shall be constructed in accordance with Collier County Standard Details when:
  - 1. A potable water main crosses at a depth that provides less than 18 inches clear distance from sewer lines in which case a Deviation Form request should be completed. Encase the sewer main unless specifically approved by Collier County Utilities. Encasement shall extend a minimum 10 feet on each side of the point of crossing. Pressure test both pipelines to 150 psi after the concrete has properly cured.
  - 2. A water main running parallel to a sewer line provides less than 10 feet separation from sewer lines, in which case a Deviation Form Request needs to be completed. Encase the sewer main unless specifically approved by Collier County Utilities.
  - 3. The ENGINEER has ordered the line encased. <u>NO POTABLE WATER</u> <u>MAIN SHALL BE ENCASED IN CONCRETE UNLESS SPECIFICALLY</u> <u>AUTHORIZED BY THE COUNTY MANAGER OR DESIGNEE</u>.

The points of beginning and ending of pipe encasement shall be not more than 6 inches from a pipe joint to protect the pipe from cracking due to uneven settlement of its foundation or the effects of superimposed live loads.

- N. Valve Box Setting: Install valve boxes vertical and concentric with the valve stem.
  - 1. Adjust valve-box to final grade at the time designated by the County Manager or designee.
  - 2. Build a collar, as shown in the standard details, 18 inches by 18 inches by 6 inches or 24 inch diameter round by 6 inches flush to grade of top of box. Similar collar shall be poured flush with grade and top of unpaved areas.
  - 3. Satisfactorily reset any valve box that is moved from its original position, preventing the operation of the valve.
  - 4. Replace any valve box that has been damaged.
- O. Identification:
  - Metallized Warning Tape: For DIP and PVC pipe (other than gravity sewer pipe and laterals) to be installed, 3-inch detectable marking tape, of appropriate color and appropriate warning statement, shall be placed along the entire pipe length. In all cases, marking tape shall be installed two feet (2') below grade or one-half the pipe's bury, whichever is less, during backfill operations (refer to Utilities Standards Manual Section 1 – 1.1 and 2.2.1). All PVC pipe, PVC fittings, and identification tape shall be color-coded per Collier County Standards. HDPE pipe installed by horizontal directional drilling will not be required to be marked with metalized warning tape.
  - 2. Electronic Markers (see County Approved Product List, Appendix F): Install electronic markers twenty-four inches (24") below final grade, above pipe, at all bends or changes in alignment and every two hundred and fifty feet (250') along the pipe between bends.
- P. Separation From Other Pipe Systems:
  - Parallel Water and Sewer or Non-Potable Lines: Sanitary sewer lines, storm sewers or force mains shall be separated from water mains by a minimum clear vertical distance of 18 inches and a horizontal distance of 10 feet. Non-potable, reclaimed or reuse water mains shall be separated from water mains, gravity sewers or force mains by a minimum clear vertical distance of 18 inches and a horizontal distance of 5 feet center to center or 3 feet outside to outside. When this standard cannot be maintained, the sewer line shall be concrete encased for a distance of 10 feet each way from the water line and any other conduit, with a minimum vertical clearance of 12 inches being provided at all times. See Section 1 - Design Criteria, Subsection 1.2.3.
  - 2. Crossing Water and Sewer or Non-Potable Lines: Water mains crossing over a sewer or non-potable water line shall be (bottom of water main to top of sewer) separated by at least 18 inches unless local conditions or barriers

prevent an 18 inch vertical separation. All crossings with vertical clearance less than 18 inches shall be made using sewer pipe thickness Class 200 AWWA C900 PVC pipe, and water pipe of Class 51 Ductile iron pipe, for a distance of 10 feet on each side of the crossing. The gravity sewer pipe in these locations shall be backfilled with USCS Class I bedding stone to a height of 6 inches above the crown of the pipe. When water mains cross under a sewer, both mains shall be constructed of C900 Class 200 PVC pipe with joints equivalent to water main standards for a distance of 10 feet on each side of the point of crossing with no intermediate joints. Additionally, a section of water main pipe shall be centered at the point of crossing. See Section 1 – Design Criteria, Subsection 1.3.

- Q. Aerial Crossings:
  - Pipes spanning elevated pier crossings shall be flanged ductile iron Pressure Class 350 pipe conforming to AWWA C115, C150 & C151. Pipe spanning on piers spaced further apart than normal pipe length of 18 or 20 ft. shall be multiple length pipe with interior flanged joints with a rubber gasket pipe (see County Approved Product List, Appendix F). The pipe wall thickness and flanged joints shall be designed to safely span the elevated piers under working pressure without exceeding the allowable stresses and conform to AWWA C150. Limit pipe deflection at center of span with pipe full of water to 1/720 of span length. Provide expansion joints for between above ground and below ground wastewater lines.
  - Flanges shall conform to AWWA C150 and C115. All bolts and nuts used in aerial crossings shall be 304 stainless steel. Gaskets shall be full faced or recessed "O-Ring" type to prevent leaks in pipe under stress in the aerial crossing.
  - Outside surface of all pipe, flanges or spool pieces shall be shop coated with zinc primer, High Build Epoxy protective coat and a finish coat of polyurethane high gloss. Color shall be Federal Safety Blue for potable water mains and Pantone Purple 522 C for non-potable irrigation water mains.
  - 4. Install operating valves or other flow regulating devices on each shoreline or at a safe distance from each shoreline to prevent discharge in the event the line is damaged.
  - 5. Install supports for all joints in pipes utilized for aerial crossings and to prevent overturning and settlement. Expansion jointing is specified between above ground and below ground sewers and force mains.

#### 3.3 FIELD QUALITY CONTROL

A. Testing: Test pipelines in accordance with Section 022501.
- 1. Test valves in place, as far as practicable, and correct any defects in valves or connections.
- 2. Gravity Sewer Lines: Test in accordance with Section 022501
- B. Inspection: Clean, inspect, and examine each piece of pipe and each fitting and special for defects before it is installed.
  - 1. Cut away any lumps or projections on the face of the spigot end or the shoulder.
  - 2. Do not use any cracked, broken, or defective pieces in the work.
  - 3. If any defective piece should be discovered after having been installed, remove and replace this piece with a sound piece in a satisfactory manner at no increase in Contract Amount.

## 3.4 CLEANING

- A. General: Thoroughly clean all pipe before it is laid and keep it clean until it is accepted in the completed work.
- B. Removal of Materials: Exercise special care to avoid leaving bits of wood, dirt, and other foreign particles in the pipe. If any particles are discovered before the final acceptance of the work, remove and clean the pipe.

## 3.5 DISINFECTION

A. General: Disinfect all pipelines that are to carry potable water in accordance with Section 025400.

END OF SECTION

## NO TEXT FOR THIS PAGE

## **SECTION 330520**

## PIPE REMOVAL AND ABANDONMENT

### PART 1 GENERAL

### 1.1 SUMMARY

- A. Section Includes: Removal and abandonment of piping and appurtenances, wholly or in part, as required to complete Work as shown on the Drawings and specified in this Section.
- B. Related Work Specified in other Sections Includes:
  - 1. Section 020500 Connection to Existing Systems
  - 2. Section 033100 Concrete, Masonry Mortar and Grout
  - 3. Section 312316 Excavation Earth and Rock
  - 4. Section 312323 Backfilling

## 1.2 SUBMITTALS

- A. General: Provide all submittals, including the following, as specified in Division 1.
- B. Submit the following:
  - 1. Proposed methods for pipe removal and abandonment;
  - 2. Equipment proposed to be used to do pipe removal and abandonment work;
  - 3. Resume of pipe grouting subcontractor;
  - 4. Pipe removal and abandonment schedule/sequence.
- C. If a detour is required, submit a traffic control plan for approval to County Manager or designee and/or the Florida Department of Transportation as described in Section 015526.

## 1.3 SITE CONDITIONS

- A. General
  - 1. Prior to any work, a proper and approved maintenance of traffic plan (MOT) shall be submitted to the engineer and the County.
  - 2. Execute pipe removal and abandonment so that there is no injury to persons or damage to adjacent buildings, structures, equipment, materials, piping, wiring, pavement, fences, trees, guardrails, and other adjacent improvements. Execute demolition and abandonment so that access to facilities that are in operation and to residences and businesses is free and safe.
  - 3. Execute pipe removal and abandonment so that interference to vehicular traffic and personnel traffic does not exceed scheduled interference. Do not place rubble,

excavation, piping, or other materials removed on roadways, drives, or sidewalks that are to remain in service.

## PART 2 - PRODUCTS

### 2.1 TEMPORARY MATERIALS

- A. Provide temporary fencing, barricades, barriers, piping, valves, pumps, power and controls, and water necessary to meet the requirements of this Section.
- B. Temporary fencing, barricades, barriers, and enclosures shall be suitable to the purpose intended.

#### 2.2 REPAIR AND REPLACEMENT MATERIALS

For repair or replacement of existing facilities or improvements to remain, use materials identical to, or equal to, materials used in existing work when new.

### PART 3 – EXECUTION

#### 3.1 GENERAL

- A. Conduct pipe removal and abandonment as shown and specified in the Contract Documents.
- B. Conduct pipe removal and abandonment so that existing equipment, piping, wiring, structures, and other improvements to remain are not damaged. Repair or replace equipment, piping, wiring, structures, and other improvements damaged at no additional cost to the County.
- C. Do not remove equipment, piping, wiring, structures, or other improvements not shown or specified to be removed. If equipment, piping, wiring, structures, or other improvements not shown or specified to be removed is removed, replace equipment, piping, wiring, structures, or other improvements at no additional cost to the County.

#### 3.2 DISCONNECTIONS

- A. Prior to starting pipe removal or abandonment, check underground and exposed existing utilities, piping, and equipment within the limits of pipe removal or abandonment. Prior to starting, check underground and exposed existing utilities, piping connected to and associated with existing pipe to be removed or abandoned. Verify the following:
  - 1. Piping is inactive (abandoned);
  - 2. Other utilities which may be in conflict have been permanently or temporarily disconnected, if required:
- B. Do not proceed with salvage or demolition if piping is active or utilities have not been disconnected.

### 3.3 ABANDONMENT

- A. The Contractor shall, as described on the Drawings and as may be directed by the County, abandon in place the following existing utility improvements:
  - 1. All water mains, reuse water mains and raw water mains that are designated to be abandoned shall be filled with grout. Refer to Section 033100 Concrete, Masonry Mortar and Grout.
  - 2. All sewer lines, force mains, laterals and services that are designated to be abandoned shall be flushed clean and filled with grout. Prior to grout fill, sewer lines, force mains, laterals and services to be abandoned shall be flushed clean to remove wastewater and solids. Contractor is responsible for securing and providing flushing water, collection of flush water/wastewater, and disposal. The cleaning of these piping systems shall comply with all local and DEP requirements.
  - Sewer manholes designated to be abandoned shall have the top two feet removed. The remainder of each manhole shall be abandoned and filled with grout or flowable fill. The excavation or pit shall be backfilled with select fill and compacted in accordance with Section 312323 – Backfilling and the trenching details on the Drawings.
- B. Appurtenances: All water hydrants, ARV valves and other appurtenances on abandoned lines shall be removed to the main and the fitting at the main shall be capped or plugged. All valves shall have the valve box, pad and operator removed, with the valve left in the open position unless specifically noted otherwise.
- C. Preparation:
  - 1. The County shall be notified at least 72 hours in advance of grouting operations.
  - 2. Bulkheads shall be spaced at intervals of not more than 1,000 feet. If the line to be abandoned is longer, bulkheads shall be inserted in the pipe to maintain the required maximum spacing between bulkheads.
  - 3. Temporary vents shall be installed in the line to be filled at a maximum spacing of 150 ft. The vents shall be capable of being capped to allow further grouting operations.
- D. Equipment:
  - The materials shall be mixed or delivered in equipment of sufficient size and capacity to provide the desired amount of grout material for each stage in a single operation. The equipment shall be capable of mixing the grout at densities required for the approved procedure and shall also be capable of changing density as dictated by field conditions any time during the grouting operation.
  - 2. Mixers and Pumps The grout shall be delivered to the injection point at a steady pressure with a non-pulsating centrifugal or triplex pump. Means shall be provided to increase or decrease the water-cement ratio. The system shall mix the grout to a homogeneous consistency. Means of accurately measuring grout component quantities, pumping pressures, and volumes pumped shall be provided.

- 3. Pressure Gauges CONTRACTOR shall provide one pressure gauge at the point of injection and one pressure gauge at the grout pump. Grouting shall not proceed without appropriate calibrated gauges in place and in working order. Pressure gauges shall be equipped with diaphragm seals, have a working range between 1.5 to 2.0 times the design grout pressure, and have an accuracy within 0.5 percent of full range. Pressure gauges shall be instrument oil filled and attached to a saddle-type diaphragm seal to prevent clogging with grout.
- E. Grouting:

Once grouting operations begin, grouting shall proceed uninterrupted from bulkhead to bulkhead. Grout placement shall not be terminated until both of the following conditions have been met, unless otherwise approved by the County: a) The estimated volume of grout to fill the line has been injected; and, b) grout has been expelled from the furthest vent or bulkhead. Bulkheads and temporary vents shall not be removed until the grout has set.

- F. Testing and Sampling:
  - 1. Take four test specimens for each 50 cubic yards of grout or for each four hours of placing.
  - 2. Test in accordance with ASTM C109 except:
    - a. The specimens shall be 3 inch by 6 inch cylinders covered after casting to prevent damage and loss of moisture. Moist cure specimens for a period up to 7 days prior to a 28-day compressive strength test.
    - b. Do not oven dry specimens that are load tested. Specimens may be tested at any age to monitor compressive strength. The material may require special handling and testing techniques.
- G. The CONTRACTOR may remove the pipe in accordance with the Paragraph 3.04 in lieu of abandonment if acceptable to the County. Such removal, however, will be paid at the same price for pipe abandonment.
- H. All work under this Section shall comply with City, County, State and Federal regulations.
- 3.4 REMOVAL AND DISPOSAL
  - A. The Contractor shall, as described on the Drawings and as may be directed by the County, remove the following existing utility improvements:
    - 1. All water mains, reuse water mains and raw water mains that are designated to be removed.
    - 2. All sewer lines, sewer manholes, force mains, laterals and services that are designated to be removed shall be flushed clean with water prior to removal. Contractor is responsible for securing and providing flushing water, collection of flush water/wastewater, and disposal. The cleaning of these piping systems shall comply with all local and DEP requirements.

## 3.5 SALVAGE OF EQUIPMENT, PIPING, AND MATERIALS

- A. Remove items identified on the drawings or specified to remain the property of the County. Do not damage equipment, piping, and materials to be salvaged.
- B. Following removal or equipment, piping, and materials to be salvaged, place equipment, piping, and materials in a location within the County limits as designated by the County.

### 3.6 REPAIRS

Repair structural elements, equipment, piping, conduit, and other improvements to remain that are damaged during demolition. Use workers specifically qualified in trade, or trades, involved to repair damaged work.

### 3.7 DISPOSAL

- A. Remove and dispose of all equipment, piping, and materials from the jobsite not specifically designated to be retained by the County.
- B. Contractor shall not accumulate or store debris from demolition on the project site.
- C. The disposal of the piping, manholes and appurtenances shall be in accordance with County, State and Federal laws.

### 3.8 BACKFILLING

- A. Backfill excavations, trenches, and pits resulting from abandonment and removal according to Section 312323 Backfilling.
- B. Backfill of the pipe trenches shall be according to the County details for pipe trench backfill. Pipe trenches for removed pipes that were within 3 horizontal feet of the edge of pavement shall be backfilled according to the detail for the type of roadway.

#### 3.9 CLEANUP AND CLOSURE

- A. Following pipe abandonment or removal, clean-up areas where other work is to be done as specified in this Section, or Sections applicable to work to be done.
- B. Following pipe abandonment or removal, clean-up areas where no other work is to be done under this Contract. Remove debris and rubbish, temporary facilities, and equipment. Level surface irregularities to eliminate depressions. Leave work in a neat and presentable condition.
- C. In locations where a pipe to be abandoned or removed connects to a pipe that remains in service, the Contractor shall install a suitable cap or plug on the end of the active pipe.

## END OF SECTION

NO TEXT FOR THIS PAGE

## **SECTION 331200**

## WATER VALVES AND APPURTENANCES

## PART 1 GENERAL

### 1.1 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals required and install complete and ready for operation all valves and appurtenances as shown on the Drawings and as specified herein.

## 1.2 REFERENCES

- A. Codes, specifications, and standards referred to by number or title form a part of this Section to the extent required by the references to codes, specifications, and standards. Latest revisions, as of the date of bid opening, apply, unless otherwise noted on the Drawings or specified in this Section.
- B. Standards

Designation	Title
ANSI/AWWA C111/A21.11	Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings
ANSI/AWWA C500	Gate Valves
ANSI/AWWA C509	Resilient-Seated Gate Valves 3 through 12 NPS, for Water and Sewage Systems
ANSI/AWWA C512	Air Release, Air/Vacuum, and Combination Air Valves for Waterworks Service
ANSI/B16.1	Cast Iron Pipe Flanges and Flanged Fittings, Class 125
ANSI/B16.3	Malleable Iron Threaded Fittings, Class 150 and 300
ANSI/B16.5	Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and Other Special Alloys
ASTM A276	Specification for Stainless and Heat-Resisting Steel Bars and Shapes
ASTM A231	Specification for Steel Casting, Austenitic, for High-Temperature Service

ASTM A743 Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, and Nickel-Base Corrosion-Resistant for General Application MSS SP-60 Connecting Flange Joint Between Tapping Sleeves and

### 1.3 DEFINITIONS

A. References to valve sizes on the Drawings and in the Specifications are intended to be nominal size, and shall be interpreted as nominal size.

**Tapping Valves** 

- 1.4 SUBMITTALS
  - A. General: as specified in:
    - 1. General Conditions;
    - 2. Supplementary General Conditions;
- 1.5 QUALITY ASSURANCE
  - A. Testing: Test valves as specified in this Section.
- PART 2 PRODUCTS
- 2.1 GENERAL:
  - A. All valves and appurtenances shall be of the size shown on the Drawings and if possible all equipment of the same type shall be from one manufacturer.
  - B. All valves and appurtenances shall have the name of the maker and the working pressure for which they are designed cast in raised letters on the body.
  - C. All stainless steel components and hardware shall be a minimum of Type 304, unless otherwise specified.
- 2.2 MANUFACTURERS (SEE COUNTY APPROVED PRODUCT LIST, APPENDIX F).
- 2.3 DESIGN
  - A. Resilient, Wedge or Gate Valves and Boxes
    - 1. Valves for pipe less than 2 inches in diameter shall conform to the requirements of AWWA C509 (latest revisions) and shall be cast iron, single wedge, non-rising stem, screwed bonnet, 125 pounds S.P., 200 pounds W.O.G with stuffing box repackable under pressure and all parts renewable.

Ends shall be as shown or indicated on the drawings. For approved air release line valves, bacterial sampling station line valves, curb stops, corporation stops, and ball valves see County Approved Product List, Appendix F.

2. Resilient, wedge or gate valves 2 inches in diameter and larger shall be ductile iron body, non-rising stem, bronze mounted gate valves, mechanical joint conforming to requirements of the AWWA C515 and shall be provided with a 2 inch square operating nut with the word "open" and an arrow cast in the metal to indicate direction. Valves shall be vertical resilient, wedge, or gate type and shall turn to the left (counter clockwise) to open. The wedge or gate shall be ductile iron per ASTM A536, minimum 65,000-psi strength and, completely encapsulated with urethane rubber, permanently bonded to the wedge or gate to meet ASTM test for rubber metal bond, ASTM D429. The valve stems for non-rising stem assemblies shall be cast bronze with integral collars in full compliance with AWWA. OS & Y stems shall be on bronze bar stock. The NRS stem stuffing box shall be the O-ring seal type with two rings located above thrust collar; the two rings shall be replaceable with valve fully open and subjected to full rated working pressure. The minimum safe working pressure shall be 200 psi. All valves thirty inches (30") or larger shall have a concrete slab placed under the valve to help distribute the total weight of the valve and reduce line sagging. The concrete slab shall have 6"x6" 10/10 welded wire mesh, have lifting eyes, constructed using 3,000 psi concrete, be six inches (6") thick, and sized according to the following table:

Valve Size	Length	Width	
<u>30"</u>	42"	30"	
<u>36"</u>	48"	36"	
<u>42"</u>	54"	42"	
<u>48" – 54"</u>	60"	48"	
<u>60" – 66"</u>	78"	60"	

- 3. There shall be two low torque thrust bearings located above and below the stem collar. The stem nut shall be independent of wedge and shall be made of solid bronze. There shall be a smooth unobstructed waterway free of all pockets, cavities and depressions in the seat area. The body and bonnet shall be coated with fusion-bonded epoxy both interior and exterior. Each valve shall have the manufacturers name, pressure rating and year manufactured cast on body. The valve shall be designed and tested to be opened and closed under a differential pressure of at least twice the working pressure.
- B. Valves for Buried Service
  - 1. Valves for buried service shall meet all the requirements as specified herein but shall have mechanical joint ends and stainless steel cover bolts.

- 2. All buried valves shall have cast-iron two-piece valve boxes (see County Approved Product List, Appendix F). Valve boxes shall be provided with suitable heavy bonnets to extend to such elevation at the finished grade surface as directed by the ENGINEER. The barrel shall be two-piece, screw type. The upper section shall have a flange at the bottom having sufficient bearing area to prevent settling, shall be designed so as to prevent the transmission of surface loads directly to the valve or piping, and shall be complete with cast iron covers. Covers shall have "WATER" cast into the top. The covers shall be so constructed as to prevent tipping or rattling. All valve boxes located in paved roadways or sidewalks shall have locking covers.
- 3. Where valves are located out of pavement, the boxes shall be adjusted to finished grade with a concrete collar as shown in the Details.
- 4. Valve boxes shall be of the heavy duty, traffic bearing cast iron, adjustable screw type with a drop cover. The valve box assembly shall consist of a bottom section, top section and cover which is cast from gray iron, formulated to ASTM specification A-48 latest revision, minimum tensile of 21,000 psi and shall be free from blowholes, shrinkage or other imperfections not true to pattern. The shaft size shall be 5 1/4" and the adjustable length shall be from 18" to 36". The wall thickness shall be 1/4". The weight of the assembly shall be 61 pounds <u>+</u> 2 pounds, with the cover weight being a minimum of 13 pounds.
- 5. The name of the manufacturer and foundry of origin shall be cast into each of the components of the assembly in legible form. The assembly shall be suitable for highway traffic wheel loads of 16,000 pounds and shall withstand a proof load test of 25,000 pounds without failure or permanent deflection.
- C. Check Valves
  - 1. All check valve bodies shall be cast iron per ASTM A126 Class B, having integral (not wafer) flanges.
  - 2. The seat shall be centrifugally cast bronze with an O-ring seal and be locked in place with stainless steel lock screws and be field replaceable, without the use of special tools.
  - 3. Swing check valves shall have a shaft of single and continuous stainless steel, extending both sides of the body with a lever and weight. The air cushion cylinder, when specifically required, shall be constructed of corrosion resistant material and the piston shall be totally enclosed within the cylinder and not open at one end. The air cushion cylinder assembly shall be externally attached to either or both sides of the valve body and shall permit adjustability to cushion the closure of the valve. Cushioning shall be by air trapped in the cushion cylinder, which shall be fitted with a one-way adjustable control check valve to cushion disc contact to the seat at

the shut-off point. The bottom cylinder head shall be swivel mounted and not rigid to follow the change of force angles as the lever raises or lowers to open or close the check valve. Valve shall prevent backflow on normal pump shut off or power failure, at zero velocity and be watertight. The disc shall be cast iron utilizing a double clevice hinge connected to a ductile iron disc arm. The disc arm assembly shall be suspended from a stainless steel shaft, which passes through a seal retainer on both sides of the valve body.

- 4. Rubber flapper swing valves shall have a heavily constructed cast iron body and cover. The body shall be long pattern design (not wafer) with integrally cast-on end flanges. The flapper shall be Buna-N having an O-ring seating edge and be internally reinforced with steel. Flapper shall be captured between the body and the body cover in a manner to permit the flapper to flex from closed to full open position. Flapper shall be easily removed without the need to remove the valve from line. The check valves shall have full pipe size flow area. Seating surface to be on a 45° angle requiring the flapper to travel only 35° from closed to full open position for minimum head loss. Valve has non-slam closure characteristics. Flapper shall create an elastic spring effect to assist the flapper to close against a slight head to prevent or minimize slamming. Valve shall be designed for 175 psi working pressure for water. The valve shall be suitable for buried service.
- 5. Valve exterior to be painted with Red Oxide Phenolic Primer Paint as accepted by the FDA for use in contact with Potable Water. Materials shall be certified to the following ASTM specifications:
  - a. Body, cover & disc Cast Iron ASTM A126, Class B
  - b. Disc Arm Ductile Iron ASTM A536
  - c. Seat Aluminum Bronze or Stainless Steel ASTM B148, ASTM A276
  - d. Disc Seat Buna-N or metal
  - e. Cushion cylinder Corrosion-resistant Commercial material
- D. Backflow Prevention Devices
  - 1. Backflow prevention devices shall be reduced pressure principle assemblies and shall be USC approved, and shall meet all requirements of the Collier County Cross-Connection Control/Backflow Prevention Ordinance, as then amended. Refer to Section 3, Utility Detail Drawings.
- E. Combination Air Release Valves for Potable Water and Non-Potable Irrigation Systems
  - 1. Air release valves shall exhaust large quantities of air during the filling of a pipeline or vessel. The valve shall be capable of venting air up to sonic

velocity without blowing shut; closing only after all the air has been vented. The valve shall continue to release small quantities of air under pressure as often as needed to keep the system free of accumulated air. The valve shall automatically open to allow air to re-enter during draining or whenever a negative pressure occurs.

- 2. Combination air valves shall be of the size shown on the plans and conform to the requirements of AWWA C512 and be of the "Kinetic" design capable of exhausting air at up to sonic velocity without blowing shut.
- 3. Body and cover shall be ASTM A126 Class B cast iron with stainless steel floats and replaceable seats of Buna-N or other suitable material. Internal linkage mechanism shall be 18-8 stainless steel. Plastic or bronze components are not acceptable. Air release orifice shall be suitable for 300 PSI maximum working pressure. Screens shall be installed on the opening of all air release valves.
- 4. Valves 3-inch size and smaller shall have a threaded inlet connection, and larger valves shall have a flanged inlet faced and drilled per ANSI B16.1 Class 250.
- 5. Valves shall have a threaded outlet on valves to 4-inch size and a protective cowl on larger sizes.
- 6. 1 inch NPT inlet and outlet shall be provided, unless otherwise specified on the drawings.
- 7. Connections from corporation stops to air release valves shall be brass for rigidity.
- F. Tapping Valves and Sleeves
  - All tapping sleeve and valve assemblies shall meet the requirements of AWWA Standard C500, latest revision. Cast iron tapping sleeves or stainless steel wrap-around sleeves, and cast iron valves shall be used to make live taps into the existing water mains where shown on the drawings. Flanges must conform to AWWA C207 Class D ANSI 150# drilling. Mechanical Joint (MJ) tapping sleeves are also acceptable. All bolts and nuts shall be stainless steel.
  - 2. CONTRACTOR shall verify type of existing main prior to ordering. The tapping valve shall have an inlet flange to match the sleeve and a mechanical joint outlet for connection to water main pipe. Tapping valve shall meet the requirements for gate valves specified herein. The sleeve shall have provisions for a tap and shall be pressure tested at 150 psi for a minimum of 30 minutes prior to tapping.
- G. Service Connection Materials

- 1. Service Saddles (see County Approved Product List, Appendix F)
  - a. Service saddles or fittings shall be used with taps to all types of pipe. Gasket shall be cemented in place and confined in a retaining groove. Saddles shall be cast iron saddles with double brass straps.
  - b. Tapping sleeves and valves shall be used for all taps.
- 2. Water Meters
  - a. Potable Water Meters: Potable water meters provided for service connections to the COUNTY water distribution system shall be designed to accept an encoder compatible with the COUNTY Automatic Meter Reading (AMR) system. The COUNTY will install the meter and the AMR encoder unit on 2" and smaller meters. AMRs 3" and larger shall be turned over to the technician doing the full bore flush. All potable water meters larger than 2" shall be installed above ground. These meters shall be equipped with a backflow preventer and installed by the CONTRACTOR at his expense, including the AMR encoder unit. The type of backflow device utilized for potable lines shall be on the Water Department approved list of backflow preventers, Appendix G. All potable water meters 3" or greater shall be purchased by the owner and installed by the CONTRACTOR. The master meter assemblies shall be built in accordance with the design details in Section 3 – Utilities Detail Drawings. The location of all meters shall be clearly shown on the construction plans.
  - b. Non-Potable Irrigation Water Meters: Non-potable water meters provided for service connections to the COUNTY non-potable reclaimed distribution system shall be designed to accept an encoder compatible with the COUNTY Automatic Meter Reading (AMR) system. The COUNTY will install the meter and the AMR encoder unit on 2" and smaller meters. All non-potable water meters 3" or greater shall be purchased by the owner and installed by the CONTRACTOR. The master meter assemblies shall be built in accordance with the design details in Section 3 Utilities Detail Drawings. The location of all meters shall be clearly shown on the construction plans.
- 3. Corporation Stops for Service Connections
  - a. Corporation stops (see County Approved Product List, Appendix F) shall meet the requirements of AWWA C800; ends AWWA thread x compression, CTS.
- 4. Water Service Tubing

- a. Water service connection tubing shall be blue polyethylene municipal service tubing as shown on Utility Detail Drawing W-12.
- b. Polyethylene tubing shall meet the requirements of AWWA Standard C901. Polyethylene tubing shall be 3406 polyethylene.
- 5. Polyethylene Service Tube Stiffeners
  - a. A solid ring, stainless steel insert shall be installed with each and every compression connection made with polyethylene tubing.

## PART 3 EXECUTION

- 3.1 INSTALLATION
  - A. Install all valves and appurtenances in accordance with manufacturer's instructions and in the locations shown, true to alignment and rigidly supported. Repair any damage to the above items to the satisfaction of the ENGINEER before they are installed.
  - B. After installation, test all valves and appurtenances for at least one hour at the working pressure corresponding to the class of pipe, unless a different test pressure is specified. If any joint proves to be defective, repair it to the satisfaction of the ENGINEER.
  - C. Install all floor boxes, brackets, extension rods, guides, the various types of operators and appurtenances as shown on the Drawings that are in masonry floors or walls, and install concrete inserts for hangers and supports as soon as forms are erected and before concrete is poured. Before setting these items, check all plans and figures, which have a direct bearing on their location and assure the proper location of these valves and appurtenances during the construction of the structures.
  - D. Flanged joints shall be made with stainless steel bolts.
  - E. Buried mechanical joints shall be made with COR-TEN bolts.
  - F. Prior to assembly of split couplings, thoroughly clean the grooves as well as other parts. The ends of the pipes and outside of the gaskets shall be moderately coated with petroleum jelly, cup grease, soft soap or graphite paste, and the gasket shall be slipped over one pipe end. After the other pipe has been brought to the correct position, center the gasket properly over the pipe ends with the lips against the pipes. The housing sections then shall be placed. After the bolts have been inserted, tighten the nuts until the housing sections are firmly in contact, metal-to-metal, without excessive bolt tension.
  - G. Prior to the installation of sleeve-type couplings, thoroughly clean the pipe ends for a distance of 8". Soapy water may be used as a gasket lubricant. A follower

and gasket, in that order, shall be slipped over each pipe to a distance of about 6" from the end, and the middle ring shall be placed on the already laid pipe end until it is properly centered over the joint. Insert the other pipe end into the middle ring and bring to proper position in relation to the pipe already laid. The gaskets and followers shall then be pressed evenly and firmly into the middle ring flaires. After the bolts have been inserted and all nuts have been made up finger-tight, uniformly tighten diametrically opposite nuts progressively all around the joint, preferably by use of a torque wrench of the appropriate size and torque for the bolts.

- H. Carefully inspect each valve, open it wide and then tightly close it and test the various nuts and bolts for tightness. Special care shall be taken to prevent any foreign matter from becoming lodged in the valve seat. Gate valves, unless shown otherwise, shall be set with their stems vertically above the centerline of the pipe. Remove and replace any valve that does not operate correctly.
- I. Carefully center valve boxes over the operating nuts of the valves so as to permit a valve wrench or key to be fitted easily to the operating nut. Valve boxes shall be set to conform to the level of the finished surface and held in position by a ring of concrete placed under the support flange as shown in Section 3, Utility Detail Drawings. The valve box shall not transmit surface loads to the pipe or valve. Exercise care to prevent earth and other material from entering the valve box. Any valve box which is out of alignment or whose top does not conform to the finished ground surface shall be dug and reset. Before final acceptance of the work, adjust all valve boxes to finish grade. Valve extension stems or risers shall not be used.

## 3.2 AIR RELEASE VALVE INSTALLATION

- A. Prior to pressure testing a pipeline, all air release valve assemblies on that pipeline shall be installed.
- 3.3 SHOP PAINTING
  - A. Ferrous surfaces of valves and appurtenances shall receive a coating of epoxy in accordance with AWWA Standard C550 and meets or exceeds all test requirements including the Food and Drug Administration Document Title 21 of the Federal Regulations on Food Additives, Section 175.000 entitled "Resinous and Polymeric Coating"; Impact Test Requirement in accordance with the ASTM D2794.

## END OF SECTION

## NO TEXT FOR THIS PAGE

Specifications for Rehabilitation of Two Collier County Production Wells: RO-117N, & RO-119N



PREPARED FOR:



AND



SEPTEMBER 2023 (REVISED APRIL 2024)



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SEPTEMBER 2023 (REVISED APRIL 2024)

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# 1.0 PURPOSE AND SCOPE

The purpose of this document is to provide the technical specifications for testing and rehabilitation treatment of two Collier County Water and Sewer District (CCWSD) public supply wells, RO-117N and RO-119N. The selected wells were previously constructed but were never equipped with the necessary pumping and discharge piping facilities to be operated. Prior to bringing these wells into an operational status, it is necessary to conduct the specified testing and treatment to verify the water quality and maximize the well capacity by acidification treatment using hydrochloric acid (HCI).

The CONTRACTOR will be required to obtain coverage under the Florida Department of Environmental Protection (FDEP) Generic Permit for the Discharge of Groundwater from Dewatering Operations prior to discharging produced ground water from the production wells.

The CONTRACTOR will coordinate with CCWSD operational staff to determine the sequence for well rehabilitation based on the County's operational schedule and system demands. Refer to **Figure 1** for a map showing the locations of the wells to be treated. Refer to **Figure 2** and **Table 1** for construction details of the selected wells.

The products and equipment required for the testing and rehabilitation are listed in Section 2. The technical specifications for well treatments are provided in Section 3.

Well ID	Well Diameter (inches)	Casing Depth (ft. bls)	Total Depth (ft. bls)	Casing Material	Completion Date
RO-117N	16	444	477	FRP	June 2005
RO-119N	16	405	502	FRP	January 2006

#### Table 1. Construction Details for Selected Wells.

# 2.0 GENERAL REQUIREMENTS

- 2.1 CONTRACTOR'S LICENSURE REQUIREMENTS: The CONTRACTOR for this project will provide documentation showing that their firm is licensed with the State of Florida as a Water Well Contractor under Chapter 62-532, F.A.C. to engage in the business of construction, modification, repair, or abandonment of a well.
- **2.2 CONSTRUCTION SCHEDULE**: The CONTRACTOR will submit a detailed schedule prior to the commencement of any sitework. The schedule will include a proposed mobilization, completion, and demobilization date. The CONTRACTOR will schedule all work or tests during daylight hours (7:00 a.m. to 6:00 p.m.) unless prior approval from the ENGINEER and OWNER has been obtained; except for HCI injection which will be allowed during all hours.
- 2.3 WATER SUPPLY: The CONTRACTOR will provide the OWNER and ENGINEER with a description of his water supply needs at a required pre-construction meeting. The CONTRACTOR will coordinate with the OWNER for access to raw water from the transmission main adjacent to each well site. The CONTRACTOR is responsible for metering the volume of water supplied by the OWNER to the OWNER's satisfaction. The cost of water for this project will be included in the lump sum price for mobilization and site preparation. The CONTRACTOR will obtain any temporary hydrant meters and/or backflow prevention devices that may be required by the OWNER and will pay any deposits and rental as required by the OWNER.
- **2.4 ELECTRICITY**: All electric current required by the CONTRACTOR will be furnished at his own expense. All temporary lines will be furnished, installed, connected, and maintained by the CONTRACTOR in a workmanlike manner satisfactory to the OWNER and ENGINEER and will be removed by the CONTRACTOR in like manner at his expense at the completion of the work. All temporary electrical fixtures, lines, and related equipment and installation will be in accordance with applicable city, county, and state regulations.
- **2.5 EQUIPMENT REQUIREMENTS**: Equipment utilized for this project will be in firstclass working order. The CONTRACTOR will use his own equipment, having the minimum capabilities necessary to do the described work. No delays or work stoppages will be tolerated because of equipment failure. Nor will equipment failure be considered a valid reason for extending the length of the contract. The CONTRACTOR will be held responsible, and payment may be withheld for damages to the wells due to any cause of negligence, faulty operation, or equipment failure.
- **2.6 REMEDIAL WORK**: If remedial work proves to be necessary to make the well acceptable to the OWNER to comply with the regulations and/or Specifications because of accident, loss of tools, defective material, or for any other cause, the CONTRACTOR will propose a method of correcting the problem, in writing. Suggested methods will be reviewed and approved by the ENGINEER before work proceeds. Such work will be performed at no additional cost to the OWNER, and it will not extend the length of the contract. The CONTRACTOR is notified that all specifications will be met as designated by the ENGINEER.
- **2.7 DAILY LOG:** The CONTRACTOR will maintain a detailed daily log of the testing and remediation operations. The logs will be on printed forms and will give a brief description of all field activities and pertinent data as may be required by the

ENGINEER. One copy of each daily log will be submitted to the ENGINEER daily.

- **2.8 SITE PREPARATION**: No clearing is expected to be needed for the sites. The CONTRACTOR will take precautions to avoid damage to the OWNER's property. Any damage to public or private property will be repaired or paid for by the CONTRACTOR at no expense to the OWNER. The CONTRACTOR will install "No Trespassing" signage to keep onlookers out of the work area. The OWNER is not responsible for damage of theft to the CONTRACTOR's equipment.
- 2.9 MAINTENANCE OF TRAFFIC: As applicable, and as directed by the ENGINEER, the CONTRACTOR will file a traffic control plan and obtain approval within the appropriate local, county, or state traffic departments. When work occurs within Department of Transportation rights-of-way or easements, the CONTRACTOR will submit to the ENGINEER, a Maintenance of Traffic Plan that shows the measures for traffic management during the well installation. This Plan will include appropriate signage, barricades and/or temporary striping in accordance with the Florida Department of Transportation, Roadway, and Traffic Design Standards, (Topic #625-010-003-6) and/or the Manual on Uniform Traffic Control Devices (MUTCD), Part VI, Standards and Guides for Traffic Controls for Street and Highway Construction, Maintenance, Utility, and Incident Management Operations.
- **2.10 SAFETY**: The CONTRACTOR is expected to perform the proposed work in a safe manner. If the CONTRACTOR has safety concerns regarding the proposed work, alternative methods may be proposed by the CONTRACTOR in writing prior to commencement of work. Alternative methods must be approved by the ENGINEER before execution. The CONTRACTOR will use every precaution necessary to ensure a safe work area and will comply with all U.S. Occupational Safety and Health Administration (OSHA) and U.S. Environmental Protection Agency (USEPA) regulations regarding the types of work described in this Specifications.
- **2.11 CONTRACTOR SUBMITTALS:** At least 10 days prior to the commencement of work, the CONTRACTOR will provide the ENGINEER the following:
  - 1. Detailed work schedule
  - 2. FDEP Generic Permit for Discharge of Groundwater
  - 3. Name and address of any subcontractors used for the job
  - 4. Detailed drawing of the acidification wellhead
  - 5. Health and Safety Plan
  - 6. SDS sheets for HCl, and additives
  - 7. Manufacturer's specifications and pump curve for temporary submersible test pump
  - 8. Disinfection and well suppression procedure including chemical SDS sheets for disinfectant.
  - 9. Details of any proposed containment and sedimentation and erosion controls to be used.
- **2.12 GUARANTEE**: The CONTRACTOR guarantees that the work and services performed under the contract and that all workmanship, materials, equipment furnished, used, or installed in the work will be free from defect and flaws, and will be performed and furnished in strict accordance with the contract documents; that the strength of all parts of all manufactured equipment will be adequate and as specified; and that the performance test requirements of the contract documents will be fulfilled. The CONTRACTOR will repair, correct, or replace all damage to the work resulting from failures covered by the guarantee.

- **2.13 STANDBY TIME**: The OWNER may ask the CONTRACTOR to stop operations so that extra work not included in these Specifications, such as testing or additional data collection, can be performed. The OWNER and ENGINEER will schedule the request, so it causes a minimum of delay. All standby time for which extra payment will be made will be approved by the ENGINEER in writing in advance. The CONTRACTOR will be reimbursed at hourly rates agreed upon with the OWNER in the Task Order.
- **2.14 REGULATORY REQUIREMENTS**: The CONTRACTOR will comply with all requirements and conditions of all permits related to the work of this contract and will comply with the provisions of any permits issued. The CONTRACTOR will be responsible for obtaining any necessary licenses and permits, and for complying with any applicable federal, state, and municipal laws, codes, and regulations, in connection with the execution of the Work. The CONTRACTOR will take proper safety and health precautions to protect the Work, the workers, the public and the property of others. The CONTRACTOR will be required to obtain coverage under the Florida Department of Environmental Protection (FDEP) Generic Permit for the Discharge of Groundwater from Dewatering Operations prior to discharging water from production wells.
- **2.15 REFERENCE STANDARDS**: All design, material and work will be in strict accordance with all applicable governmental, regulatory, and testing organizations including, but not limited to the following:

ANSI – American National Standards Institute ASTM – American Society of Testing and Materials AWWA – American Water Works Association DOH – Department of Health FDEP – Florida Department of Environmental Protection FDOT – Florida Department of Transportation NSF – National Sanitation Foundation OSHA – Occupational Safety and Health Administration Florida Building Code 2001 and Companion Codes as amended.

**2.16 MEASUREMENT AND PAY**: Measurement of an item of work will be by the unit indicated in the Task Order. Measurement will include all necessary and incidental related work not specified to be included in any other item of work listed in the quote schedule. Unless otherwise stated in individual sections of the Specifications or in the Quote Schedule, no separate payment will be made for any item of Work, materials, parts, equipment, supplies, or related items required to perform and complete the Work. The costs for all such items required will be included in the contract price quote for each item of which it is a part.

Payment will be made at the contract price per unit indicated in the Task Order with total price of the contract being equal to the Total Quote, as specified and as modified, by extending unit prices.

2.17 PROTECTION OF PROPERTY: The CONTRACTOR will take special precautions to reduce to a minimum the nuisances and damage to property which could result from working near a residential area and adjacent to a road. Any damage to public or private property will be immediately repaired or paid for by the CONTRACTOR at no expense to the OWNER. Equipment, tools, and materials will be stored at a location where they will produce a minimum of nuisance. The appropriate warning signs will be posted on

the streets and the local authorities will be informed of the location of the construction site.

- **2.18 NOISE CONTROL:** Noise produced by field operations will be kept to a minimum. The CONTRACTOR will equip all machinery and equipment used for construction with noise devices such as mufflers, muffling sleeves, and spark arrestors or other suitable noise suppressors. Electric power will be used in lieu of internal combustion engine power whenever possible. Air compressors will be of a quiet type such as a "whisperized" compressor. The CONTRACTOR will comply with all applicable federal, state, and Collier County noise pollution control regulations. Noisy equipment will be kept as far as possible from noise sensitive site boundaries. Equipment will be properly maintained to reduce noise from excessive vibration, faulty mufflers, or other sources. No equipment will be left idling unnecessarily.
- **2.19 SITE RESTORATION AND DEMOBILIZATION**: Upon completion of the work, the CONTRACTOR will disassemble all temporary piping and equipment modifications from the site and demobilize. The CONTRACTOR will remove all equipment which is not part of the well and leave the site in a condition acceptable to the OWNER. The CONTRACTOR will broom clean exterior paved surfaces and rake clean other adjacent surfaces of the grounds. The CONTRACTOR will return the Site to its original condition as defined by the ENGINEER.
- **2.20 SITE PHOTOS/VIDEO**: The CONTRACTOR is required to take a digital photographs or video of pre- and post- construction site conditions of the well sites and surrounding areas to allow for clear comparisons of site conditions before and after the work is conducted.

FIGURES



FIGURE 1. MAP SHOWING LOCATIONS OF WELLS TO BE TREATED





# **3.0 TECHNICAL SPECIFICATIONS FOR WELL ACIDIFICATION**

## 3.1 GENERAL

**3.1.1 SCOPE OF WORK**: The scope of work includes the following: video survey, capacity testing, rehabilitation, development, sampling, and disinfection of two wells in Collier County's North Reverse Osmosis (NRO) wellfield. Wells RO-117N and RO-119N will be initially inspected with a downhole video survey and capacity tested via step-drawdown method using a temporary test pump. Each well will then be treated with a volume of 6,000 gallons of 32% HCI mixed in-line at 4 gpm with 150,000 gallons of raw water and injection of the mixture at a rate of 100 gpm over a period of 25 hours. Following the acidification, the wells will be developed by airlifting for a period of 16 hours and by high-rate pump development for a period of 16 hours. Following development, a post-treatment step-drawdown test will be conducted, and water samples will be collected from each well and analyzed by a certified laboratory for primary and secondary drinking water standards. After completion of treatment and testing, each well will be disinfected.

The CONTRACTOR will be responsible for providing all equipment needed for well development including an air compressor, temporary submersible pump, motor, generator, discharge piping, totalizer, and flow control. The temporary test pump will have a capacity of up to 700 gallons per minute. The CONTRACTOR will be required to obtain coverage under the Florida Department of Environmental Protection (FDEP) Generic Permit for the Discharge of Groundwater from Dewatering Operations prior to discharging water from the production wells.

**3.1.2 WORK SEQUENCE:** The specified work sequence is provided in **Table 2**.

Step No.	Task Description
1	Obtain necessary permits. Mobilize equipment and materials to the site.
2	Perform pre-treatment downhole video camera survey
3	Install temporary test pump and perform pre-treatment step-drawdown test
4	Install required temporary wellhead, isolation packer, and tubing, and treat each well using 6000 gallons of HCl as specified
5	Conduct airlift surge development for 16 hours
6	Install temporary test pump and perform post-treatment high-rate pump development for 16 hours. Perform sand content, turbidity, and silt density index testing during pump development.
7	Conduct post-treatment step-drawdown test
8	Collect water samples and provide analysis results for primary and secondary drinking water standards.
9	Disinfect the well as specified
10	Clean and restore site and demobilize

 Table 2. Work Sequence Summary

## 3.2 PRODUCTS AND EQUIPMENT

The CONTRACTOR will provide all the products and equipment required to accomplish the work and all work will be supervised by the ENGINEER. Additional materials may be added to the list below. It is the CONTRACTOR's responsibility to ensure that adequate materials are provided for the successful completion of the work. The following products and equipment will be needed for the project.

- **3.2.1 SALT:** The CONTRACTOR will use only food grade granular sodium chloride which is NSF approved for use with drinking water systems for any necessary flow suppression during the project. The CONTRACTOR will provide the manufacturer's specifications for the salt to the ENGINEER prior to mobilization of the salt to the project site.
- **3.2.2 HYDROCHLORIC ACID:** The acid used for well treatment will be 32% inhibited Hydrochloric Acid (HCI) from a source and carrier approved by the ENGINEER. Certification from the acid supplier will be required to verify materials and acid quantities on the same working day as the acid delivery to the site.
- **3.2.3 HYDROCHLORIC ACID ADDITIVES:** A chelating agent, such as citric acid or Ban-T, will be added to the hydrochloric acid prior to injection into the well. The purpose of the chelating agent is to keep dissolved metal ions such as iron and calcium in solution during the acid treatment process. A mix concentration of 10 pounds dry weight or 1 gallon of liquid per 1,000 gallons of 32% acid will be achieved. Manufacturer's safety data sheets will be submitted to the ENGINEER for approval prior to acid delivery.
- **3.2.4 SODA ASH:** Sodium Carbonate in the form of dry powder will be used, if necessary, as per the manufacturer's instructions to raise the pH of discharged groundwater after acidification using HCI. The pH of water discharged will be no less than 6 pH units. Water will be neutralized in the specified water storage tank using soda ash to a pH of 6 or higher before it is discharged from the tank to ground.
- **3.2.5 TEMPORARY TEST PUMP:** For capacity testing and pump development, CONTRACTOR will provide and utilize a temporary submersible test pump capable of pumping 700 gpm at 100 feet of drawdown. The test pump will be installed on 6-inch diameter riser pipe and set at a depth of 120 feet below top of casing. The contractor will provide a temporary power generator for operation of the test pump.
- **3.2.6 TEMPORARY FLOWMETERS**: The CONTRACTOR will provide and install temporary flowmeters that are capable of instantaneous reading of flow and total gallons pumped. The meters will be new or have a calibration certificate within 60 days prior to the testing. The CONTRACTOR will submit a dated calibration certificate for the proposed flowmeters upon request of the ENGINEER.
- **3.2.7 TEMPORARY PRESSURE GAUGES**: The CONTRACTOR will provide and install temporary pressure gauges that are capable measuring and displaying pressures from 0 to 200 pounds per square inch (psi). A minimum of one pressure gauge on the wellhead and one gauge on the injection line are required.
- **3.2.8 INFLATABLE PACKER:** The inflatable packer to be used will be of sufficient size to fit within the existing 16-inch diameter well casing and will be installed and inflated

with the centerline of the packer at a depth of approximately 40 feet below top of casing (btoc). The packer will be installed on 4-inch diameter tubing and will be inflated to isolate the casing and wellhead above the packer from pressure generated by the acid reaction in the well below the packer.

- **3.2.9 TEMPORARY AIR COMPRESSOR:** For airlift development, the CONTRACTOR will provide and utilize an air compressor which will be capable of discharging air at a rate of 375 cubic feet per minute (cfm) at a pressure of 125 pounds per square inch (psi). Air compressors will be of a quiet type such as a "whisperized" compressor.
- **3.2.10 WATER QUALITY MONITORING METER:** The water quality monitoring instrument will be capable of measuring pH and temperature. The CONTRACTOR will provide a manufacturer's specification for the instrument upon request to the ENGINEER.
- **3.2.11 WATER LEVEL MONITORING METER:** The water level measuring instrument will include an electronic sensor connected via a cable to a reel which will have both audible and visible indicators that the conductor probe is in contact with water. The instrument will have a minimum of 200 feet of cable which will be permanently marked with depth to water measurements in engineering scale increments of no greater than 0.01 feet.
- **3.2.12 WATER STORAGE TANK:** The CONTRACTOR will provide one or more water storage tanks with a minimum capacity of 10,000 gallons to capture spent acid and its byproducts for neutralization and solids settling prior to disposal.
- **3.2.13 ROSSUM SAND TESTER:** The CONTRACTOR will provide, install, and operate a Rossum Sand Tester or approved equal during the final 6 hours of pump development of each well.
- **3.2.14 TURBIDITY METER:** The CONTRACTOR will provide and operate a turbidity meter during pump development and during step drawdown testing. The meter will be capable of reading turbidity in nephelometric turbidity units (NTUs) in a range between 0 and 100 NTUs. The meter equipment will include factory calibration standards including 0 and 100 NTU samples which will be within the manufacture's expiration dates.
- **3.2.15 SILT DENSITY INDEX (SDI) TESTER:** The CONTRACTOR will provide, install, and operate a Silt Density Index Tester as manufactured by Millipore or equal during final 6 hours of pump development. The CONTRACTOR will supply the manufacturer's brand, or equal, of filter membranes with a mean pore size filter of 0.45 microns. The CONTRACTOR will submit the manufacturer's specifications to the ENGINEER for approval prior to installation of the SDI testing equipment.
- **3.2.16 DISINFECTANT:** The CONTACTOR will provide and install a disinfectant solution containing either calcium hypochlorite (HTH) or sodium hypochlorite as per specification section **3.3.13 DISINFECTION**. The disinfectant will be NSF approved and will be transported to the project site in the original manufacturer's containers.
- **3.2.17 FLANGE GASKETS, NUTS, AND BOLTS:** The CONTRACTOR will provide and install new flange gaskets for each flange that is disconnected during the

performance of the work. The CONTRACTOR will store the OWNER's nuts and bolts onsite and will replace any lost or damaged pre-existing nuts and bolts with equivalent 316 stainless steel nuts and bolts.

## 3.3 EXECUTION

The CONTRACTOR will perform the work in accordance with all applicable worker health and safety procedures. The following methods and procedures are specified to be performed by the CONTRACTOR.

- **3.3.1 PRE-TREATMENT DOWN-HOLE VIDEO SURVEY:** The CONTRACTOR will complete a video survey using a down-hole camera with side looking capability. To achieve good water clarity for the video survey, the CONTRACTOR is required pump or flow the well at a minimum flow rate of 100 gpm for at least 1 hour prior to the camera survey and to maintain the flow during the survey. The record of the video survey will include header information as follows: OWNER name, well ID, and date of survey. The video survey will display depth on the video output and will be recorded on a digital format such as DVD or memory storage device with copies distributed to the OWNER and ENGINEER at the completion of the survey.
- **3.3.2 PRE-TREATMENT STEP DRAWDOWN TESTING:** The CONTRACTOR will install a temporary test pump and discharge piping assembly to conduct a pre-treatment 3-rate step drawdown test. The test will be performed at 50%, 75% and 100% of the estimated maximum capacity of the well and pump. The duration of each step will be 60 minutes. CONTRACTOR will provide and install any fittings necessary to measure the static and pumping water level in the well. The CONTRACTOR will supply and install an inline flowmeter capable of measuring instantaneous flow and providing totalized readings on the discharge line at flow rates up to 1000 gpm. All equipment installed in the well will be disinfected with a chlorine solution prior to installation. Prior to the test, the well may need to be pumped at the maximum capacity for 5 minutes and allowed to fully recover to determine the maximum flow rate of the well. The CONTRACTOR's staff will be present onsite throughout the test to ensure continuous operation of the pump and assist the ENGINEER in taking flow readings from the existing metering system and water level readings using an electronic water level measuring meter (to be provided by the CONTRACTOR).

## 3.3.3 WELLHEAD PREPARATION:

A schematic showing the typical details of the wellhead, packer, and injection tubing configuration is included as **Figure 3**.

<u>Inflatable Packer</u> The inflatable packer to be used will be of sufficient size to fit within the existing 16-inch diameter casing and be installed and inflated with the centerline of the packer at a depth of approximately 40 feet below top of casing (btoc). The packer is to be installed on 4-inch diameter tubing and will be inflated to isolate the casing and wellhead above the packer from pressure generated by the acid reaction in the well below the packer.

<u>Feed Water:</u> After isolating the raw water piping from the distribution system, install all necessary temporary fittings including flanges, valves, meters, etc. to facilitate the specified flow rate of 100 gpm of raw water from the raw water main to the

wellhead. The temporary piping must include an approved backflow prevention device.

<u>Injection Tubing</u>: The injection tubing for HCl injection include a minimum length of 450 feet of 2-inch diameter steel tubing and will also include one or more sections of perforated 2-inch diameter PVC, with a total length of up to 100 feet, for dispersion of the acid solution over section(s) of the open hole of the well to be determined by the ENGINEER based on the video survey.

<u>Pressure Gauge:</u> A pressure gauge capable of reading from 0 to 100 psig will be attached to the wellhead and injection tubing to monitor wellhead pressure during injection operations.

<u>Wellhead Sealing:</u> Any ports or vents in the wellhead will be sealed by threaded plugs if possible. Any leaks in the wellhead will be sealed using silicon sealant to prevent the escape of any gas or fluid from the wellhead. Excessive pressure is not expected for this process.

- **3.3.4 HYDROCHLORIC ACID INJECTION:** The CONTRACTOR will install temporary piping necessary for blending 32% HCl into the injection feed line in the following specified quantities and rates:
  - Each well will be treated with a volume of 6000 gallons of 32% HCl mixed in-line at 4 gpm with 150,000 gallons of raw water and injected at a rate of 100 gpm over a period of 25 hours.
  - The prescribed citric acid additive (Section 3.2.3) will be mixed with the concentrated HCl prior to injection. A mix concentration of 10 pounds dry weight or 1 gallon of liquid per 1,000 gallons of 32% acid will be achieved.
  - Wellhead pressure will be monitored during the injection process and flow will be adjusted to maintain injection pressure of less than 75 psi.

After completion of the acid injection process, the well will remain sealed in for a period of not less than 12 hours and no greater than 24 hours before initiating purging.

**3.3.5 DISCHARGE WATER MANAGMENT**: The CONTRACTOR will be responsible for containment of all fluids within the existing stormwater swales and ensuring that produced groundwater does not cause erosion or sedimentation or adversely impact any protected or environmentally sensitive areas. The pH of the spent acid is not expected to be less than 6 standard units; however, if it is less than 6 units, the recovered water will be neutralized using soda ash to a pH of 6 or higher before it can be discharged to the ground. The discharged water from the 2 HCl treated wells willwill be routed from each well into a minimum 10,000-gallon storage tank for neutralization and setting prior to discharge to ground. Development water is prohibited from direct discharge to any surface water bodies unless previously approved by the OWNER and follows regulatory guidelines. It is suggested that the CONTRACTOR route discharge from the settling tank to a location where the water can be contained on the surface where there is adequate capacity for the water to percolate into the ground. The CONTRACTOR will be responsible for installation of

appropriate erosion and sedimentation control measures such as silt fencing, hay bales, ditch blocks, temporary sediment traps, and/or containment berms. All erosion and sedimentation control measures employed will be installed to the standards set forth by the Florida Stormwater Erosion and Sedimentation Control Inspector's Manual and must be approved by the Engineer.

- **3.3.6 AIRLIFT DEVELOPMENT**: The CONTRACTOR will install a rigid airline with a minimum diameter of 2 inches and develop each well with compressed air released at a depth of 200 feet below pad level. The air compressor used will have a minimum capacity of 375 cubic feet per minute (cfm) at a pressure of 100 pounds per square inch (psi). The temporary well header used for airlifting will not reduce the diameter of the airlift discharge to less than 12-inches so that the airlift discharge remains minimally restricted. The distance from the wellhead to the point of discharge into the water storage tank or to ground will be no greater than 20 feet and there will be an air gap between the top of the storage tank and the discharge line. Perform airlift development with alternating periods of airlifting followed by recovery for a minimum of 16 hours. Each well will be developed until the water is sediment free for a period of one (1) hour.
- **3.3.7 HIGH-RATE PUMP DEVELOPMENT**: The CONTRACTOR will provide and install a temporary test pump and all ancillary equipment including motor, drop pipe, couplings, electric cable, power supply etc. and will perform high-rate pumping development for a minimum of 16 hours The temporary test pump will be set on 8inch diameter drop pipe to the same or greater depth as the existing permanent pump installation. The CONTRACTOR will supply a temporary generator and electric controls to power and control the test pump. The CONTRACTOR will alternate between pumping the well at near the maximum safe discharge rate allowed by the pump manufacture and then allow the well to recover before resuming pumping. The CONTRACTOR will supply the necessary testing equipment and will perform sand content, turbidity, and silt density index testing during the final 6 hours of pump development on wells RO-10N and RO-19N.
- **3.3.8 SAND CONTENT TESTING:** The CONTRACTOR will supply and install a temporary Rossum Sand Tester on the discharge piping of the well. The sand tester will be installed at the vertical centerline of the discharge pipe at a location of turbulent flow immediately (within 1 foot) downstream of a 90-degree elbow or other flow restriction. The mounting location and configuration of the sand tester will be approved by the ENGINEER prior to installation. There will be adequate backpressure on the sand content tester to achieve a minimum of ½ gallon per minute flow through the device and there will be a control valve between the tester and the discharge piping. Sand content tests will be conducted on an hourly frequency during the final 6 hours of pumping development on all wells treated.
- **3.3.9 TURBIDITY TESTING:** The CONTRACTOR will provide a calibrated turbidity meter as specified and will collect grab samples for turbidity at ½ hour intervals during the final 6 hours of pump development. The CONTRACTOR will record the turbidity readings for the final 6 hours of high-rate pump development of all wells treated.
- **3.3.10 SILT DENSITY INDEX TESTING:** During pumping development, the CONTRACTOR will install a silt density index tester on the pump discharge piping at an accessible location and according to manufacturer's guidelines. The silt density index tester will be installed at a location with sufficient back pressure
(approximately 30 psi) for the correct operation of the SDI tester. The SDI testing will be as directed by the ENGINEER. SDI testing will be initiated once turbidity levels are below 5 NTUs.

- 3.3.11 POST-TREATMENT STEP-DRAWDOWN TESTING: After completion of acidification and development, the CONTRACTOR will use a temporary test pump and temporary discharge piping to conduct a pre-treatment 3-rate step drawdown test. The test will be performed at 50%, 75% and 100% of the estimated maximum capacity of the well and pump. The duration of each step will be 60 minutes. The CONTRACTOR will measure the static and pumping water level in the well. The CONTRACTOR will supply and install a temporary inline flowmeter capable of measuring instantaneous flow and providing totalized readings on the discharge line at the specified rates. All instruments and equipment introduced into the well to measure water level will be disinfected with a chlorine solution prior to each use. Prior to the test, the well may need to be pumped at the maximum capacity for 5 minutes and allowed to fully recover to determine the maximum flow rate of the well. The CONTRACTOR's staff will be present onsite throughout the test to ensure continuous operation of the pump and assist the ENGINEER in taking flow readings from the existing metering system and water level readings using an electronic water level measuring meter (to be provided by the CONTRACTOR).
- **3.3.12 WATER QUALITY SAMPLING** At the end of the step-drawdown test, the CONTRACTOR will contract with a laboratory approved by the Florida Department of Health to collect and analyze the required Primary and Secondary drinking water standard samples according to FDEP SOP FS 2200 Groundwater Sampling. The CONTRACTOR will ensure that the laboratory representative performs the required stabilization parameter measurements prior to sampling. The well shall be sampled and analyzed for Primary and Secondary drinking water standards listed in F.A.C 62-550, including the parameters listed in **Table 3.** Additional analyses are required for the following parameters: Alkalinity, Calcium, Manganese, Potassium, Ammonium, Strontium, Carbonate, Bicarbonate, Hydrogen Sulfide, Total Sulfide, and Turbidity.

Primary and Secondary Drinking Water Standards						
Maximum Contaminant Levels for Inorganic Compounds						
Federal Contaminant ID	Contaminant	MCL (mg/L)				
Number						
1074	Antimony	0.006				
1005	Arsenic	0.010				
1010	Barium	2				
1075	Beryllium	0.004				
1015	Cadmium	0.005				
1020	Chromium	0.1				
1024	Cyanide (as free Cyanide)	0.2				
1025	Fluoride	4.0				
1030	Lead	0.015				
1035	Mercury	0.002				
1036	Nickel	0.1				
1040	Nitrate	10 (as N)				
1041	Nitrite	1 (as N)				
	Total Nitrate and Nitrite	10 (as N)				

## Table 3. Analyses Required for Primary and Secondary Drinking Water Standards

1045	Selenium	0.05				
1052	Sodium	160				
1085	Thallium	0.002				
Maximum Contaminant Levels for Volatile Organic Contaminants						
Federal Contaminant ID	Contaminant (CAS NUMBER) MCL (mg/L)					
Number						
2977	1,1-Dichloroethylene (75-35-4)	0.007				
2981	1,1,1-Trichloroethane (71-55-6)	0.2				
2985	1,1,2-Tricholoroethane (79-00-5)	0.005				
2980	1,2-Dichloroethane (107-06-2)	0.003				
2983	1,2-Dichloropropane (78-87-5)	0.005				
2378	1,2,4-Tricholorobenzene (120-82-1)	0.07				
2990	Benzene (71-43-2)	0.001				
2982	Carbon tetrachloride (56-23-5)	0.003				
2380	cis-1,2-Dichloroethylene (156-59-2)	0.07				
2964	Dichloromethane (75-09-2)	0.005				
2992	Ethylbenzene (100-41-4)	0.7				
2989	Monochlorobenzene (108-90-7)	0.1				
2968	o-Dichlorobenzene (95-50-1)	0.6				
2969	para-Dichlorobenzene (106-46-7)	0.075				
2996	Styrene (100-42-5)	0.1				
2987	Tetrachloroethylene (127-18-4)	0.003				
2991	Toluene (108-88-3)	1				
2979	trans-1,2-Dichloroethylene (156-60-5)	0.1				
2984	Trichloroethylene (79-01-6)	0.003				
2976	Vinyl chloride (75-01-4)	0.001				
2955	Xylenes (total) (1330-20-7)	10				
	Maximum Contaminant Levels for Synthetic Organic Contaminants					
Maximum Conta	minant Levels for Synthetic Organic Cont	aminants				
Maximum Conta Federal Contaminant ID	minant Levels for Synthetic Organic Cont Contaminant (CAS NUMBER)	aminants MCL (mg/L)				
Maximum Conta Federal Contaminant ID Number	minant Levels for Synthetic Organic Cont Contaminant (CAS NUMBER)	aminants MCL (mg/L)				
Maximum Conta Federal Contaminant ID Number 2063	Minant Levels for Synthetic Organic Cont         Contaminant (CAS NUMBER)         2,3,7,8-TCDD (Dioxin) (1746-01-6)	aminants MCL (mg/L) 3 X 10 <sup>-8</sup>				
Maximum Conta Federal Contaminant ID Number 2063 2105	minant Levels for Synthetic Organic Cont Contaminant (CAS NUMBER) 2,3,7,8-TCDD (Dioxin) (1746-01-6) 2,4-D (94-75-7)	aminants MCL (mg/L) 3 X 10 <sup>-8</sup> 0.07				
Maximum ContaFederal Contaminant IDNumber206321052110	minant Levels for Synthetic Organic Cont Contaminant (CAS NUMBER) 2,3,7,8-TCDD (Dioxin) (1746-01-6) 2,4-D (94-75-7) 2,4,5-TP (Silvex) (93-72-1)	aminants MCL (mg/L) 3 X 10 <sup>-8</sup> 0.07 0.05				
Maximum ContaFederal Contaminant IDNumber2063210521102051	minant Levels for Synthetic Organic Cont Contaminant (CAS NUMBER) 2,3,7,8-TCDD (Dioxin) (1746-01-6) 2,4-D (94-75-7) 2,4,5-TP (Silvex) (93-72-1) Alachlor (15972-60-8)	Aminants           MCL (mg/L)           3 X 10 <sup>-8</sup> 0.07           0.05           0.002				
Maximum ContaFederal Contaminant IDNumber206321052105211020512050	Aminant Levels for Synthetic Organic Cont           Contaminant (CAS NUMBER)           2,3,7,8-TCDD (Dioxin) (1746-01-6)           2,4-D (94-75-7)           2,4,5-TP (Silvex) (93-72-1)           Alachlor (15972-60-8)           Atrazine (1912-24-9)	Aminants           MCL (mg/L)           3 X 10 <sup>-8</sup> 0.07           0.05           0.002           0.003				
Maximum ContaFederal Contaminant IDNumber2063210521052110205120502306	Alachlor (15972-60-8)           Alrazine (1912-24-9)           Benzo(a)pyrene (50-32-8)	aminants MCL (mg/L) 3 X 10 <sup>-8</sup> 0.07 0.05 0.002 0.003 0.0002				
Maximum Conta           Federal Contaminant ID           Number           2063           2105           2110           2051           2050           2306           2046	minant Levels for Synthetic Organic Cont Contaminant (CAS NUMBER) 2,3,7,8-TCDD (Dioxin) (1746-01-6) 2,4-D (94-75-7) 2,4,5-TP (Silvex) (93-72-1) Alachlor (15972-60-8) Atrazine (1912-24-9) Benzo(a)pyrene (50-32-8) Carbofuran (1563-66-2)	aminants MCL (mg/L) 3 X 10 <sup>-8</sup> 0.07 0.05 0.002 0.003 0.0002 0.004				
Maximum Conta           Federal Contaminant ID           Number           2063           2105           2110           2051           2050           2306           2046           2959	Alachlor         Contaminant (CAS NUMBER)           2,3,7,8-TCDD (Dioxin) (1746-01-6)         2,4-D (94-75-7)           2,4,5-TP (Silvex) (93-72-1)         Alachlor (15972-60-8)           Atrazine (1912-24-9)         Benzo(a)pyrene (50-32-8)           Carbofuran (1563-66-2)         Chlordane (57-74-9)	Aminants           MCL (mg/L)           3 X 10 <sup>-8</sup> 0.07           0.05           0.002           0.003           0.0002           0.04           0.002				
Maximum Conta           Federal Contaminant ID           Number           2063           2105           2105           2051           2050           2306           2046           2959           2031	Alachlor         Contaminant (CAS NUMBER)           2,3,7,8-TCDD (Dioxin) (1746-01-6)         2,4-D (94-75-7)           2,4,5-TP (Silvex) (93-72-1)         Alachlor (15972-60-8)           Atrazine (1912-24-9)         Benzo(a)pyrene (50-32-8)           Carbofuran (1563-66-2)         Chlordane (57-74-9)           Dalapon (75-99-0)         Dalapon (75-99-0)	aminants MCL (mg/L) 3 X 10 <sup>-8</sup> 0.07 0.05 0.002 0.003 0.0002 0.04 0.002 0.02 0.2				
Maximum Conta           Federal Contaminant ID           Number           2063           2105           2110           2051           2050           2306           2046           2959           2031           2035	Minant Levels for Synthetic Organic Cont           Contaminant (CAS NUMBER)           2,3,7,8-TCDD (Dioxin) (1746-01-6)           2,4-D (94-75-7)           2,4,5-TP (Silvex) (93-72-1)           Alachlor (15972-60-8)           Atrazine (1912-24-9)           Benzo(a)pyrene (50-32-8)           Carbofuran (1563-66-2)           Chlordane (57-74-9)           Dalapon (75-99-0)           Di(2-ethylhexyl)adipate (103-23-1)	aminants MCL (mg/L) 3 X 10 <sup>-8</sup> 0.07 0.05 0.002 0.003 0.0002 0.004 0.002 0.04 0.002 0.2 0.4				
Maximum Conta           Federal Contaminant ID           Number           2063           2105           2105           2110           2051           2050           2306           2046           2959           2031           2035           2039	Minant Levels for Synthetic Organic Contaminant (CAS NUMBER)           2,3,7,8-TCDD (Dioxin) (1746-01-6)           2,4-D (94-75-7)           2,4,5-TP (Silvex) (93-72-1)           Alachlor (15972-60-8)           Atrazine (1912-24-9)           Benzo(a)pyrene (50-32-8)           Carbofuran (1563-66-2)           Chlordane (57-74-9)           Dalapon (75-99-0)           Di(2-ethylhexyl)phthalate (103-23-1)	Aminants           MCL (mg/L)           3 X 10 <sup>-8</sup> 0.07           0.05           0.002           0.003           0.004           0.002           0.04           0.02           0.4           0.006				
Maximum Conta           Federal Contaminant ID Number           2063           2105           2105           2105           2051           2050           2306           2046           2959           2031           2035           2039           2931	Minant Levels for Synthetic Organic Cont           Contaminant (CAS NUMBER)           2,3,7,8-TCDD (Dioxin) (1746-01-6)           2,4-D (94-75-7)           2,4,5-TP (Silvex) (93-72-1)           Alachlor (15972-60-8)           Atrazine (1912-24-9)           Benzo(a)pyrene (50-32-8)           Carbofuran (1563-66-2)           Chlordane (57-74-9)           Dalapon (75-99-0)           Di(2-ethylhexyl)adipate (103-23-1)           Di/2-ethylhexyl)phthalate (117-81-7)           Dibromochloropropane (DBCP) (96-12-8)	aminants MCL (mg/L) 3 X 10 <sup>-8</sup> 0.07 0.05 0.002 0.003 0.0002 0.04 0.002 0.2 0.4 0.006 0.0002				
Maximum Conta           Federal Contaminant ID Number           2063           2105           2105           2105           2051           2050           2306           2046           2959           2031           2035           2039           2931           2041	Minant Levels for Synthetic Organic Contaminant (CAS NUMBER)           2,3,7,8-TCDD (Dioxin) (1746-01-6)           2,4-D (94-75-7)           2,4,5-TP (Silvex) (93-72-1)           Alachlor (15972-60-8)           Atrazine (1912-24-9)           Benzo(a)pyrene (50-32-8)           Carbofuran (1563-66-2)           Chlordane (57-74-9)           Dalapon (75-99-0)           Di(2-ethylhexyl)adipate (103-23-1)           Di(2-ethylhexyl)phthalate (117-81-7)           Dibromochloropropane (DBCP) (96-12-8)           Dinoseb (88-85-7)	aminants MCL (mg/L) 3 X 10 <sup>-8</sup> 0.07 0.05 0.002 0.003 0.0002 0.04 0.002 0.2 0.4 0.006 0.0002 0.007				
Maximum Conta           Federal Contaminant ID Number           2063           2105           2105           2105           2051           2050           2306           2046           2959           2031           2035           2039           2931           2041           2032	Minant Levels for Synthetic Organic Cont           Contaminant (CAS NUMBER)           2,3,7,8-TCDD (Dioxin) (1746-01-6)           2,4-D (94-75-7)           2,4,5-TP (Silvex) (93-72-1)           Alachlor (15972-60-8)           Atrazine (1912-24-9)           Benzo(a)pyrene (50-32-8)           Carbofuran (1563-66-2)           Chlordane (57-74-9)           Dalapon (75-99-0)           Di(2-ethylhexyl)adipate (103-23-1)           Di(2-ethylhexyl)phthalate (117-81-7)           Dibromochloropropane (DBCP) (96-12-8)           Dinoseb (88-85-7)           Diquat (85-00-7)	aminants MCL (mg/L) 3 X 10 <sup>-8</sup> 0.07 0.05 0.002 0.003 0.0002 0.04 0.002 0.2 0.4 0.006 0.0002 0.007 0.007 0.02				
Maximum Conta           Federal Contaminant ID Number           2063           2105           2105           2105           2051           2050           2306           2046           2959           2031           2035           2039           2931           2041           2032	Minant Levels for Synthetic Organic Contaminant (CAS NUMBER)           2,3,7,8-TCDD (Dioxin) (1746-01-6)           2,4-D (94-75-7)           2,4,5-TP (Silvex) (93-72-1)           Alachlor (15972-60-8)           Atrazine (1912-24-9)           Benzo(a)pyrene (50-32-8)           Carbofuran (1563-66-2)           Chlordane (57-74-9)           Dalapon (75-99-0)           Di(2-ethylhexyl)adipate (103-23-1)           Di/2-ethylhexyl)phthalate (117-81-7)           Dibromochloropropane (DBCP) (96-12-8)           Dinoseb (88-85-7)           Diquat (85-00-7)           Endothall (145-73-3)	aminants MCL (mg/L) 3 X 10 <sup>-8</sup> 0.07 0.05 0.002 0.003 0.0002 0.04 0.002 0.2 0.4 0.006 0.0002 0.007 0.007 0.02 0.1				
Maximum Conta           Federal Contaminant ID Number           2063           2105           2105           2105           2051           2050           2306           2046           2959           2031           2035           2039           2931           2041           2032           2033           2005	Minant Levels for Synthetic Organic Contaminant (CAS NUMBER)           2,3,7,8-TCDD (Dioxin) (1746-01-6)           2,4-D (94-75-7)           2,4,5-TP (Silvex) (93-72-1)           Alachlor (15972-60-8)           Atrazine (1912-24-9)           Benzo(a)pyrene (50-32-8)           Carbofuran (1563-66-2)           Chlordane (57-74-9)           Dalapon (75-99-0)           Di(2-ethylhexyl)adipate (103-23-1)           Di(2-ethylhexyl)phthalate (117-81-7)           Dibromochloropropane (DBCP) (96-12-8)           Dinoseb (88-85-7)           Diquat (85-00-7)           Endothall (145-73-3)           Endrin (72-20-8)	aminants MCL (mg/L) 3 X 10 <sup>-8</sup> 0.07 0.05 0.002 0.003 0.0002 0.04 0.002 0.2 0.4 0.006 0.0002 0.007 0.007 0.002 0.1 0.002				
Maximum Conta           Federal Contaminant ID Number           2063           2105           2105           2105           2051           2050           2306           2046           2959           2031           2035           2039           2931           2041           2032           2033           2005           2946	Minant Levels for Synthetic Organic Contaminant (CAS NUMBER)           2,3,7,8-TCDD (Dioxin) (1746-01-6)           2,4-D (94-75-7)           2,4,5-TP (Silvex) (93-72-1)           Alachlor (15972-60-8)           Atrazine (1912-24-9)           Benzo(a)pyrene (50-32-8)           Carbofuran (1563-66-2)           Chlordane (57-74-9)           Dalapon (75-99-0)           Di(2-ethylhexyl)adipate (103-23-1)           Di(2-ethylhexyl)phthalate (117-81-7)           Dibromochloropropane (DBCP) (96-12-8)           Dinoseb (88-85-7)           Diquat (85-00-7)           Endothall (145-73-3)           Endrin (72-20-8)	aminants MCL (mg/L) 3 X 10 <sup>-8</sup> 0.07 0.05 0.002 0.003 0.0002 0.04 0.002 0.2 0.4 0.006 0.0002 0.007 0.007 0.002 0.007 0.02 0.1 0.002 0.002				
Maximum Conta           Federal Contaminant ID Number           2063           2105           2105           2105           2051           2050           2306           2046           2959           2031           2035           2039           2931           2041           2032           2033           2005           2946           2034	Minant Levels for Synthetic Organic Contaminant (CAS NUMBER)           2,3,7,8-TCDD (Dioxin) (1746-01-6)           2,4-D (94-75-7)           2,4,5-TP (Silvex) (93-72-1)           Alachlor (15972-60-8)           Atrazine (1912-24-9)           Benzo(a)pyrene (50-32-8)           Carbofuran (1563-66-2)           Chlordane (57-74-9)           Dalapon (75-99-0)           Di(2-ethylhexyl)adipate (103-23-1)           Di(2-ethylhexyl)phthalate (117-81-7)           Dibromochloropropane (DBCP) (96-12-8)           Dinoseb (88-85-7)           Diquat (85-00-7)           Endothall (145-73-3)           Endrin (72-20-8)           Ethylene dibromide (EDB) (106-93-4)           Glyphosate (1071-83-6)	aminants MCL (mg/L) 3 X 10 <sup>-8</sup> 0.07 0.05 0.002 0.003 0.0002 0.04 0.002 0.2 0.4 0.006 0.0002 0.4 0.006 0.0002 0.007 0.002 0.007 0.02 0.1 0.002 0.1 0.002 0.002 0.7				
Maximum Conta           Federal Contaminant ID Number           2063           2105           2105           2105           2051           2050           2306           2046           2959           2031           2035           2039           2931           2032           2033           2005           2946           2034           2034	Minant Levels for Synthetic Organic Contaminant (CAS NUMBER)           2,3,7,8-TCDD (Dioxin) (1746-01-6)           2,4-D (94-75-7)           2,4,5-TP (Silvex) (93-72-1)           Alachlor (15972-60-8)           Atrazine (1912-24-9)           Benzo(a)pyrene (50-32-8)           Carbofuran (1563-66-2)           Chlordane (57-74-9)           Dalapon (75-99-0)           Di(2-ethylhexyl)adipate (103-23-1)           Di(2-ethylhexyl)phthalate (117-81-7)           Dibromochloropropane (DBCP) (96-12-8)           Dinoseb (88-85-7)           Diquat (85-00-7)           Endothall (145-73-3)           Endrin (72-20-8)           Ethylene dibromide (EDB) (106-93-4)           Glyphosate (1071-83-6)           Heptachlor (76-44-8)	aminants MCL (mg/L) 3 X 10 <sup>-8</sup> 0.07 0.05 0.002 0.003 0.0002 0.04 0.002 0.2 0.4 0.006 0.0002 0.007 0.007 0.002 0.1 0.002 0.1 0.002 0.1 0.002 0.7 0.0004				
Maximum Conta           Federal Contaminant ID Number           2063           2105           2105           2105           2051           2050           2306           2046           2959           2031           2035           2039           2931           2041           2032           2033           2005           2946           2034           2065           2067	Minant Levels for Synthetic Organic Contaminant (CAS NUMBER)           2,3,7,8-TCDD (Dioxin) (1746-01-6)           2,4-D (94-75-7)           2,4,5-TP (Silvex) (93-72-1)           Alachlor (15972-60-8)           Atrazine (1912-24-9)           Benzo(a)pyrene (50-32-8)           Carbofuran (1563-66-2)           Chlordane (57-74-9)           Dalapon (75-99-0)           Di(2-ethylhexyl)adipate (103-23-1)           Di(2-ethylhexyl)phthalate (117-81-7)           Dibromochloropropane (DBCP) (96-12-8)           Dinoseb (88-85-7)           Diquat (85-00-7)           Endothall (145-73-3)           Endrin (72-20-8)           Ethylene dibromide (EDB) (106-93-4)           Glyphosate (1071-83-6)           Heptachlor (76-44-8)           Heptachlor epoxide (1024-57-3)	aminants MCL (mg/L) 3 X 10 <sup>-8</sup> 0.07 0.05 0.002 0.003 0.0002 0.04 0.002 0.2 0.4 0.006 0.0002 0.007 0.007 0.007 0.002 0.1 0.002 0.1 0.002 0.1 0.002 0.7 0.0004 0.0002				
Maximum Conta           Federal Contaminant ID Number           2063           2105           2105           2051           2050           2306           2046           2959           2031           2035           2039           2931           2041           2032           2033           2005           2946           2034           2065           2067           2274	minant Levels for Synthetic Organic Cont           Contaminant (CAS NUMBER)           2,3,7,8-TCDD (Dioxin) (1746-01-6)           2,4-D (94-75-7)           2,4,5-TP (Silvex) (93-72-1)           Alachlor (15972-60-8)           Atrazine (1912-24-9)           Benzo(a)pyrene (50-32-8)           Carbofuran (1563-66-2)           Chlordane (57-74-9)           Dalapon (75-99-0)           Di(2-ethylhexyl)adipate (103-23-1)           Di(2-ethylhexyl)phthalate (117-81-7)           Dibromochloropropane (DBCP) (96-12-8)           Dinoseb (88-85-7)           Diquat (85-00-7)           Endrin (72-20-8)           Ethylene dibromide (EDB) (106-93-4)           Glyphosate (1071-83-6)           Heptachlor (76-44-8)           Heptachlor epoxide (1024-57-3)           Hexachlorobenzene (118-74-1)	aminants MCL (mg/L) 3 X 10 <sup>-8</sup> 0.07 0.05 0.002 0.003 0.0002 0.04 0.002 0.2 0.4 0.006 0.0002 0.007 0.007 0.002 0.1 0.002 0.1 0.002 0.002 0.1 0.002 0.002 0.002 0.0002				
Maximum Conta           Federal Contaminant ID Number           2063           2105           2105           2051           2050           2306           2046           2959           2031           2035           2039           2031           2035           2039           2031           2035           2039           2031           2035           2031           2035           2039           2031           2041           2032           2033           2005           2946           2034           2065           2067           2274           2042	minant Levels for Synthetic Organic Cont           Contaminant (CAS NUMBER)           2,3,7,8-TCDD (Dioxin) (1746-01-6)           2,4-D (94-75-7)           2,4,5-TP (Silvex) (93-72-1)           Alachlor (15972-60-8)           Atrazine (1912-24-9)           Benzo(a)pyrene (50-32-8)           Carbofuran (1563-66-2)           Chlordane (57-74-9)           Dalapon (75-99-0)           Di(2-ethylhexyl)adipate (103-23-1)           Di(2-ethylhexyl)phthalate (117-81-7)           Dibromochloropropane (DBCP) (96-12-8)           Dinoseb (88-85-7)           Diquat (85-00-7)           Endothall (145-73-3)           Endrin (72-20-8)           Ethylene dibromide (EDB) (106-93-4)           Glyphosate (1071-83-6)           Heptachlor (76-44-8)           Heptachlor epoxide (1024-57-3)           Hexachlorobenzene (118-74-1)           Hexachlorocyclopentadiene (77-47-4)	aminants MCL (mg/L) 3 X 10 <sup>-8</sup> 0.07 0.05 0.002 0.003 0.0002 0.04 0.002 0.2 0.4 0.006 0.0002 0.2 0.4 0.006 0.0002 0.007 0.007 0.002 0.007 0.002 0.007 0.002 0.1 0.002 0.002 0.1 0.002 0.002 0.001 0.001 0.005				

2015	Methoxychlor (72-43-5)		0.04			
2036	Oxamyl (vydate) (23135-22-0)		0.2			
2326	Pentachlorophenol (87-86-5)		0.001			
2040	Picloram (1918-02-1)		0.5			
2383	Polychlorinated biphenyls (PCBs)		0.0005			
2037	Simazine (122-34-9)		0.004			
2020	Toxaphene (8001-35-2)		0.003			
Se	econdary Drinking Water Standards	5				
Federal Contaminant ID	Contaminant	MCL (mg/L)				
Number						
1002	Aluminum	0.2				
1017	Chloride	250				
1022	Copper	1				
1025	Fluoride	2.0				
1028	Iron	0.3				
1032	Manganese	0.05				
1050	Silver	0.1				
1055	Sulfate	250				
1095	Zinc	5				
1905	Color	15 color units				
1920	Odor	3 (threshold odor number)				
1925	рН	6.5 - 8.5				
1930	Total Dissolved Solids	500				
2905	Foaming Agents	0.5				
Radionuclides						
	Contaminant		MCL			
Combined radium226 and radium228			5 pCi/L			
Gross alpha particle activity i uranium	15 pCi/L					
	30 ug/L					

Abbreviations Used: MCL = maximum contaminant level

mg/L = milligrams per liter. pCi/L = picoCuries per liter

MRDL = maximum residual disinfectant level

CAS Number = Chemical Abstract System Number

**3.3.13 DISINFECTION:** The CONTRACTOR will thoroughly disinfect the well to inactivate any microbiological contaminant that may have been introduced into the well during rehabilitation. The well will be disinfected to remove contamination that may cause well water supply to be unsafe for human consumption, in accordance with Sections 1 through 4. and Section 5.2 of American Water Works Association (AWWA) Standard C654 as incorporated into Rule 62-555.330, FAC. The water in the well casing will be treated with chlorine approved by the state and local regulatory agencies. The quantity of chlorine used for disinfection will be sufficient to produce a minimum of 100 ppm and not more than 200 ppm residual chlorine in the solution when mixed with the total volume of water in the well. The disinfectant will be delivered to the site of the work in original closed containers bearing the original label indicating the percentage of available chlorine. The disinfectant will be furnished or prepared in liquid form and pumped into the well in sufficient volume to assure that the entire cased and open-hole portions of the well come into contact with the disinfection solution. A minimum of two well volumes of chlorine solution will be pumped into the well. An alternative disinfection method may be used with ENGINEER's written approval; however, it is the CONTRACTOR responsibility to ensure that a uniform concentration of chlorine solution contacts the well casing and open-hole portions of the well and that the well is adequately disinfected to regulatory standards. The chlorine solution will stay in the well for a period of 24 hours after which the well will be pumped free of chlorine as indicated by a negligible chlorine residual, and in preparation for water quality sampling if requested by the ENGINEER. All equipment and material to be installed in the well will be chlorinated/disinfected prior to its installation. The CONTRACTOR will take adequate measures to collect the chlorinated water and dispose of it in a proper manner as per regulatory guidelines without impacts to natural systems. Measures will include, but are not limited to, impoundment of highly chlorinated water or dechlorination before disposal. If bacteriological evaluation shows the presence of coliform after disinfection, then the CONTRACTOR will perform corrective actions as determined by the ENGINEER.

**3.3.14 SITE RESTORATION**: The site will be restored to its original condition. All expended work materials will be removed from the site by the CONTRACTOR.

## EXHIBIT A

QUOTE SCHEDULE FOR WELL CONDITIONING OF 2 COLLIER COUNTY SUPPLY WELLS

WELL CONDITIONING OF 2 COLLIER COUNTY SUPPLY WELLS							
Bid Item	Description	Quantity	Unit	Unit Price	Total		
13-1	Perform pre-treatment downhole video camera survey		LS				
13-2	Install temporary test pump and perform pre-treatment step-drawdown test		LS				
13-3	Install required temporary wellhead, isolation packer, and tubing, and treat each well using 6000 gallons of HCl as specified		LS				
13-4	Conduct airlift surge development for 16 hours		Hours				
13-5	Install temporary test pump and perform post-treatment high-rate pump development for 16 hours. Perform sand content, turbidity, and silt density index testing during pump development.		Hours				
13-6	Conduct post-treatment step-drawdown test		LS				
13-7	Collect water samples and provide analysis results for primary and secondary drinking water standards.		LS				
13-8	Disinfect well as specified		LS				
13-9	Clean and restore site and demobilize.		LS				
Total							

FOR REFERENCE ONLY-COMPLETE BID TABULATION INCLUDED IN BID DOCUMENTS



